Electronics & Communication Engg.

Compulsory Subjects

IC 402 Engineering Management
EC 403 Communication Engineering
EC 404 Circuit Theory and Control
EC 405 Micro-processors and Micro-controllers
EC 406 Electronic Circuits
EC 407 Design of Electronic Devices and Circuits

Optional Subjects ***(Any three from any one Group)***

Group I Telecommunication Engineering

EC 411 Broadcast and Television Engineering
EC 412 Radar and Antenna Engineering
EC 413 Microwave Engineering
EC 414 Optical and Satellite Communication
EC 415 Computer Networks and Communication

Group II Integrated Circuits & Systems Engineering

EC 421 Digital Hardware Design
EC 422 Pulse and Digital Circuits
EC 423 IC Design Techniques
EC 424 Solid State Physics and Semiconductor Devices
EC 425 Software Engineering

Group III Control and Instrumentation

EC 431 Sensors and Transducers
EC 432 Industrial Instrumentation and Computer Control
EC 433 Biomedical Electronics
EC 434 Signal Processing
EC 435 Control Systems

ENGINEERING MANAGEMENT

Group A

Management and Organisations

Management process: Definition, planning organizing, directing, controlling, coordinating, types of management.

Organisation Definition, planning, design and development, types of organizations.

Management planning and control: Classical, new classical and modern principles. General Management, scientific management, engineering, management, systems management.

Planning: Procedures, resources and constraints, objectives, goals, policies and procedures.

Control: Setting of reference or standards, appraisal or evaluation, monitoring and controlling, types of control.

Human resource planning and management, selection, recruitment, training, retraining, skill development, competence development, promotion and career development, participative management, trade unions, and collective bargaining,

Management of Physical Resources

Plant: site selection procedures, factors affecting selection. Layout-types and relative merits and demerits, Maintenance-Objectives, different types of associated decisions, strategies for effective maintenance, computer applications.

Material : Functions, objectives, planning and control including inventory models with or without storage costs, price break (excluding dynamic and probabilistic considerations).

Different classes of inventory. Material Requirement Planning (MRP).

Group B

Financial management: Introduction to standard forms of financial statements, i.e., balancesheet, profit and loss, and income statement. Fixed and current asset items. Fixed and current liability items. Linkage of two successive balance-sheets through income or profit and loss statement. Funds flow statement. Financial ratios and their implications.

Managerial economics: Concepts, theory of production, marginal productivity and cost. Introduction to theory of firm.

Quality management: Quality definition, quality planning, quality control and quality management, Total quality management, ISO 9000 systems, simple quality control techniques like control charts and acceptance sampling.

Marketing management consumer behavior, market research, product design and development pricing and promotion.

Project management: Introduction. Concept of a project, project management concepts, project simulation, cost or project and means of financing, economic evaluation criteria of the project, project implementation, project planning, scheduling and monitoring, project control (PERT, CPM techniques including crashing). Project evaluation.

Information technology and management. Role of information, management information system and decision support system, Information technology-introduction to e-business, ecommerce and integration tools like enterprise resource planning (ERP).

COMMUNICATION ENGINEERING

Group A

Field theory: Fields, vector calculus, gradient, Divergence, curl, Gauss's laws. Stoke' theorem, Helmholtz Theorem. Electric field intensity and potential, conducting Boundaries, coaxial cylinders, Poisson's equations and Laplace equation. Ampere's circuital law, differential equation for vector potential. Magnetic polarization and field intensity, boundary conditions for Band H. Faraday's law. Time varying fields, displacement current. Maxwell's equations in differential and integral forms.

Communication preliminaries. Signal representation in frequency and time domain. Fourier transforms, power Spectrum, energy density spectrum. ,Direct delta function. Orthogonal representatives of signals (Gram Schmidt Procedure), autocorrelation, sampling theressare (Nyquist criterion). Random signal theory. Discrete probability theory, continuous random variables, probability density functions, ergodic processes, correlation function, spectral density, white noise.

Noise: Atmospheric, thermal, shot and partition noise, noise figure and experimental determination of noise figure, minimum noise figures in networks. Analog communication. Modulation theory and circuits. Amplitude modulation, AM-DSB, AM-DSB/SC, AM-SSB and their comparison. Modulating and detector circuits for AM, FM and phase modulation. Automatic frequency control. Pulse modulation. PAM, PDM, PPM, PCM, delta modulation and circuits. Principle multiplexing FDM and TDM.

Group B

Transmission through network: Networks with random input, auto-correlations, special density and probability density input-output relationships, envelope of sine wave plus Gaussian noise, optimum systems and nonlinear systems. Maximum signal to noise ratio' criterion. Minimum mean square error criteria, equivalent noise bandwidth. SNR in envelope detectors and PCM systems. Comparison of modulation systems.

Digital communication: Basic information theory: Definition of information, entropy, uncertainty and information, rate of communication, redundancy, relation between systems capacity and information content of messages, discrete systems, discrete noisy channel, channel coding. Introduction to digital communication, quantization, PCM, log-PCM, DM, DPCM, AD, PCM and LPC for speech signals, TOM. Baseband transmission, optimum detection, matched filter, optimum terminal filters. LSI pulse shapes for controlled ISI, line codes; digital RF modulation. Modems, performance of digital modulation systems. Synchronization. Timing recovery.

CIRCUIT THEORY AND CONTROL

Group A

Graph of a network. Concept of tree, concepts of loop current and node pair voltage, circuits cut-set and cut-set matrices, formulation of equilibrium equations of the loop and node basis. Mesh and nodal analysis.

Laplace transform. Transient response using Laplace transform. Initial and final value theorems. Unit step, impulse, ramp functions. Laplace transform for shifted and' singular functions.

The convolution integral, Fourier series, complex exponential form of the Fourier series. The frequency spectra of periodic waveforms and their relationship to Laplace transform.

The concept of complex frequency, transform impedance and admittance; series .and parallel combinations. Frequency response, coupled circuits.

Terminals and terminal pairs, driving point impedance, transfer functions, poles and zeros, restrictions on pole and zero locations in s-plane. Analysis of 1-port and 2-port networks. Time domain behavior from pole and zero plot, sinusoidal network functions in terms of poles and zeros. Resonance, Q and bandwidth of a circuit.

Introduction to synthesis of passive networks: Butterworths, Chebyshev and Bessel type low pass, high pass, band pass and band rejection filters.

Group B

Introduction: Basic concepts and symbols, open loop and closed loop systems, effects of feedback. Concepts of linear and nonlinear systems. Definition of transfer function. Block diagram representation. Signal flow graphs.

Servo components: Mathematical modelling and simulation of dynamic systems. Synchros, potentiometers, gyros. d.c. and a.c. servomotors. d.c.. and a.c. tachogenerators. Power and preamplifiers. Modulators and demodulators. Position and speed control systems.

Time response: Typical test input' signals. Time domain performance of first and second order systems to impulse, step, ramp and sinusoidal inputs. Definition of error coefficients and steady state error.

Stability: Routh-Hurwitz criteria.

Frequency response: Frequency domain specifications. Bode plots. Polar plots. Regulators and controllers. Proportional, PI and PID controllers.

MICROPROCESSOR AND MICRO CONTROLLERS

Group A

Microprocessor architecture and microcomputer systems, memory systems, input and output devices. Number systems-binary, hexadecimal and BCD numbers, 2s complement and arithmetic operations.

8085 microprocessor architecture. Memory interfacing address decoding techniques, memory read and write operations. Memory map. Interfacing I/O devices-Memory-mapped I/O and I/O mapped I/O. Polled and interrupt modes of data transfer. 8085 interrupts, direct memory access. Introduction to 16-bit microprocessor using 8086 as an example. Concept of debugger and MASM/T ASM for PC assembly language programming.

Peripheral devices. 8255 programmable peripheral interface, 8253 programmable counter timer, serial communication with SID and SOD, 8251 programmable communication interface, 8259 programmable interrupt controller, keyboard and display devices.

8085 assembly language programming: 8085 instructions-addressing modes. Stack and subroutines. 8085 programmer's model-CPU registers. Addition, subtraction and multiplication routines. Software delay and counting routines. Logical operations. Analog and digital I/O interface routines-ADC and DAC.

Software development systems: Assemblers and cross assemblers.

Microprocessor applications. Microprocessor based system design aids and troubleshooting techniques.

Group B

Introduction to microcontroller: Comparison of various microcontrollers. 8051 microcontroller architecture. Bi-directional data ports, internal ROM and RAM, counters/timers. Oscillator and clock.

8051 registers. Memory organisations-program memory and data memory, internal RAM and bit addressable memory, special functions, registers, memory map.

External memory systems and I/O interface. Accessing external program memory, accessing external data memory, available I/O ports during external memory access. Alternate ports functions. Serial interface. 8051 interrupts. Power down modes.

8051 assembly language programming. 8051instruction sets, addressing modes, bit level operations. Arithmetic routines, counting and timing under interrupt control, keyboard and display interface routines, accessing lookup tables.

Software development systems. Assemblers and simulators. Microcontroller based system design and applications.

ELECTRONIC CIRCUITS

Group A

Blasting techniques of BJT and FETs; Bias stability; Self-bias, hybrid II model of BJT and 'high frequency response.

Single stage amplifiers-bipolar amplifiers, CE, CB, CC configurations, characteristics, gain, h-parameters, analysis using h-parameters. FET amplifiers.

Multistage amplifiers-classification, distortion, frequency response, step response, RCcoupled amplifiers, transformer coupled amplifiers.

Feedback amplifiers-concept, gain with feedback, negative feedback-example of Boot strapped CE amplifier, advantages and limitations, input and output impedance; voltageseries, voltage-shunt, current -series, current-shunt feedback amplifiers.

Stability and oscillators-condition of oscillation, sinusoidal oscillator, phase shift oscillator, resonant circuit oscillator, Wein bridge oscillator, crystal oscillator, stability of frequency.

Operational amplifiers-differential amplifiers, transfer characteristics, IC op-amp functions, frequency response, step response; introduction to analog computer.

Power amplifiers-class A, B, AB, C amplifiers. Distortion, efficiency, push-pull principle,
power supply half wave, full wave, ripple factors, filters, regulation.

Group B

Introduction, binary numbers, binary codes. Boolean algebra-functions and expressions, gates- OR, AND, NOT, NOR, NAND, De Morgan's theorem, laws and theorems.

Minimization of logical functions-Karnaugh map. Arithmetic circuits-Ex-OR gate, half adder, full adder, subtraction, code conversion, etc.

Basic gate structures-RTL, DTL, Tll.., ECL, MOS, CMOS.

Flip-flops-RS, T, RST, D, JK, Schmidt trigger, astable, monostable:

Counter techniques-Ripple counter, parallel counter. BCD counter, synchronous counter, ring counter.

Shift registers, memory.

D/A and A/D converters.

DESIGN OF ELECTRONIC DEVICES AND CIRCUITS

Group A

Introduction to linear ICs. Operational amplifiers and their basic applications; audio/radio/video ICs and their specifications.

Power supplies. Rectifiers, filters and electronic stabilization circuits, considerations regarding ripple, regulation and efficiency, short circuit protection; polyphase rectifiers, electronic converters, applications in industry. Introduction to UPS.

IC voltage regulators. Positive and negative voltage regulators, adjustable voltage regulators, high current short circuit protected regulators, dual tracking regulations, programmable supply, current regulators, witching regulators, fold back current limited and shutdown Circuits.

Amplifiers: Inverting amplifiers, non-inverting amplifiers, differential amplifiers, integrator and differentiator, logarithmic amplifiers and multipliers, filters, voltage to frequency converters, sample and hold circuit, high input impedance amplifiers, instrumentation amplifiers, sensing amplifiers and comparators, zero crossing detector.

Group B

Oscillators. Expression for oscillation frequency and conditions for maintenance of oscillations, sine wave oscillators, multivibrators, function generators, voltage controlled oscillators, crystal oscillators.

Communication circuits. RF and IF amplifiers, video amplifiers, AM detectors, balanced modulators and demodulators, phase locked loop, FM demodulation, frequency shift keying, frequency multiplication.

Digital systems. Frequency counters, A/D and D/A converters, digital voltmeters, programmable digital generators, frequency synthesizer. Design of ALU.

BROADCAST AND TELEVISION ENGINEERING

Group A

Microphones, loudspeaker 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.

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 centre's facilities.

Superhetrodyne receiver, 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.

Group B

Television system and standards—FCC and CCIR-B standards and their comparison.

Theory of scanning-progressive scanning, interlaced scanning. Video bandwidth.

Composite video signal-Hoz, Sync, hoz. blanking, equalizing pulses, serrations, block diagram of sync, generator.

Television pick-up cubes and cameras-vidicon, plumbicon, saticon, etc., CCD image sensors, picture tube, output coupling circuit.

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, RA and TA system. 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.

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.

RADAR AND ANTENNA ENGINEERING

Group A

Block diagram of pulse radar. Radar equation. Signal-to-noise ratio, probability density function and range, ambiguities, radar cross-section of target, target models, PRF, system losses.

CW and frequency-modulated radar Doppler effect, CW radar, FMCW radar.

MTI and pulse Doppler radar-delay line cancellers and characteristics, blind speeds, douplet cancellation. MTI radars with power amplifier and power oscillators, transmitters. MTI from moving platform, pulse Doppler radars.

Tracking radars. Tracking techniques-sequential lobing, conical scan monopulse. Tracking in range, acquisition. Tracking performance.

Electronic scanning radar system, beam forming and steering methods, fire controlled radar. SAR.

Radar transmitters, magnetron oscillators, hard tube and line-type pulser. Radar receivers, mixer amplifier, receiver noise, duplexers, displays, clutters, weather and interferences, system engineering and design. Pulse compression radar.

Group B

Fundamentals of radiation mechanism, vector potentials, radiation from current elements, radiation pattern, superposition and reciprocity theorems.

Small antennas, images, small antenna above ground, different types of linear arrays, multiplication of patterns, binomial arrays, antenna gain, effective area, antenna impedance, beam width, self and mutual impedance, folded dipole, Yaginda antennas.

Mathematical theories of antennas, aperture antennas, slot antennas, cavity back slot antennas, horn antennas, waveguide radiator, parabolic reflectors, Cassegrain antennas.

Broad band antennas, microstrip antennas, noise consideration, antenna measurements.

MICROWAVE ENGINEERING

Group A

Wave propagation through waveguides-rectangular, circular, elliptical-cutoff frequency, modes, group and phase velocities.

Cavity resonators and filters.

Network representations of discontinuity—S-matrix. Impedance transformation and matching technique.

Microwave passive components—Tee junctions, magic tee, couplers, circulators, attenuators, phase shifters, bends, twists, corners, irises, windows.

Group B

Microwave generators and amplifiers—thyristor, magnetors, TWTs, BWOs, transistors, tunnel diodes, PIN GUNN, etc. Parametric amplifier. Ferrite and ferrite devices.

Microwave propagation and link design.

Microwave measurements, network analyser concept. Anechoic chambers.

Microwave integrated circuits—MMIC, strip and microstrip lines, slot and coplanar lines.

OPTICAL AND SATELLITE COMMUNICATIONS

Group A

Optical fibre-step index, graded index, material, preparation, measurement of propagation, properties, jointing, connectors and couplers. Fibre optic communication systems.

System model. Optical channel-space, fibre optic, sources-lasers, LEDs.

Fibre laser for optical communication through guided media.

Modulation techniques—direct modulation and indirect modulation—injection modulation, A/O, E/O modulation techniques.

Optical detection—PIN diodes and APDs.

Optical communication systems—analog and digital communication system. Low bandwidth/low bit rate to ultra wideband/ultra high bit-rate communication system.

Introduction to communication networks—LANs, MANs and WANs.

Group B

Satellite launching and control. Orbits. Launch vehicles and rockets. Space shuttles. Propagation characteristics-attenuation, noise, space environment. Frequency bands.

Types of satellite systems. Satellite sub-system, power communication, control, thermal.

Earth station equipment. Satellite link design-power budget, EIRP, G/T ratio of receivers, CNR of satellite system.

Multiple access technique, TDMA, FDMA, CDMA, SPADE. Multiple beams-spot beams.

COMPUTER NETWORKS AND COMMUNICATIONS

Group A

Introduction-Principles of data communications: Analog and digital transmission, multiplexing, transmission impairments, concepts of frequency spectrum and bandwidth, bandwidth efficient modulation techniques.

Basics of computer networks: Protocol hierarchies, design issues for the layers, interfaces and services. Concepts of circuit switching and packet switching, connection-oriented and connectionless services. Reference models—OSI model and TCP/IP reference model. Example networks.

Physical layer: Transmission media—twisted pair, coaxial cable, optical fibre. Wireless transmission—radio, microwave, infrared and millimeter waves, telephone (Systems, cell phones. RS-232C, SONET, modems.

Data link layer: Services provided to the network layer, framing, error control, flow control. Error detection and correction. Unrestricted simplex protocol, stop-and-wait protocol, sliding window protocols. HDLC.

Network layer: Design issues. Routing algorithms. Congestion control. Internetworking: concepts of subnetwork, bridges, etc. X.25 frame relay.

Group B

Transport layer: Services provided to the upper layers. Elements of transport control protocols—addressing, establishing a connection, releasing a connection, flow control and buffering, crash recovery. Example of simple protocols using services primitives. TCP and UDP.

IP: IPV4 datagram, IP addressing. ICMP.

Media access control protocols: Concept of LANs and MANs. ALOHA, slotted ALOHA, CSMA, CSMA/ €D. Ethernet, token bus, token ring, FDDL

ATM: Protocol architecture. ATM logical connections. ATM cells. Transmission of ATM cells. ATM adaptation layer. Traffic and congestion control.

Narrowband and broadband ISDN. Application layer: SNMP, SMTP, FTP, TELNET.

DIGITAL HARDWARE DESIGN

Group A

Basics of digital electronics: Number representation, Boolean algebra, logic minimization, hazard-free design.

Combinatorial and sequential design.

Synchronous and asynchronous circuits.

Memories and PLA.

Finite state machines.

Group B

Processor model: Data-path synthesis and control structures.
Fast adders, multipliers, barrel shifters, etc.
Micro-programmed control unit.
Pipelined and parallel architectures.
Fault-tolerant structures.

PULSE AND DIGITAL CIRCUITS

Group A

Combinational Logic

Boolean algebra: Introduction, postulates of Boolean algebra, fundamental theorems, uniqueness properties, laws of Boolean algebra, De Morgan's theorem, the (inclusion) implication relation, bounds of Boolean algebra, duality in Boolean algebra, Boolean constants, variables and functions, two-valued Boolean algebra switching algebra, electronic gates and mechanical contacts.

Boolean functions and logic operations: Introduction, the normal form, the canonical form, fundamental products and sums, disjunctive and conjunctive normal forms, binary, octal and hexadecimal, designations, self-dual functions, logical operations, NAND and NOR operations, EXCLUSIVE-OR operation, functionally complete sets.

Minimization of switching functions: The Karnaugh map-introduction cubes and the Karnaugh map, prime cubes, maximum sum of products, minimum product of sums, don't care forms, five- and six-variable maps, multiple output minimization.

Tabular methods of minimization: Introduction, Quine-McCluskey algorithm, the dominance relation cyclic functions, the degree of adjacency and essential prime cubes. Logic synthesis of switching functions: Introduction, AND, OR and inverter networks, NAND and NOR networks, EXCLUSIVE-OR networks, multiplexers, read only memories, programmable logic arrays (PLA), PLA minimization, essential prime cube theorems, PLA folding.

Reliable design and fault detection tests: Introduction, fault classes and models, fault diagnosis and testing, test generation, fault table method, path sensitization method, Boolean difference method, reliability through redundancy, hazards and hazard-free designs, quaded logic.

Group B

Sequential Circuits

Introduction to synchronous sequential circuits, the finite-state model-basic definitions, the memory elements and their excitation functions-S-R flip-flop, J-K flip-flop,D flip-flop, T flip-flop, synthesis of synchronous sequential circuits.

Capabilities, minimization and transformation of sequential machines, the finite-state modelfurther definitions, capabilities and limitations of finite-state machines, state equivalence and machine minimization, simplification of incompletely specified machines compatible states, the non-uniqueness of minimal machines, closed set of compatibles. The compatible graph and the merger table.

Asynchronous sequential circuits. Fundamental mode circuits, synthesis, state assignments in asynchronous sequential circuits, pulse mode circuits.

Finite state recognizers: Deterministic recognizers, transition graphs, converting nondeterministic into deterministic graphs, regular expressions, transition graphs recognizing regular sets, regular sets corresponding to transition graphs.

IC DESIGN TECHNIQUES

Group A

Introduction to IC design flow; System specification to final packaging.

MOS transistor, CMOS inverter, static and dynamic logic circuits, latch up problem in CMOS.

Factors for optimization (speed, power, area, etc.)

Timing issues: Clock skew, critical path, logic hazards, etc.

Interconnect: Capacitive, resistive and inductive parasitics.

Basic concepts of partitioning, floor planning, placement, routing and layout. Design rule and circuit extraction, mask making procedure.

Computer aided design, simulation and testing, behavioural modelling and hardware description language.

Group B

Memories and other replicable structures: ROM, PROM, EPROM, E2PROM, Static RAM and dynamic RAM, PLA and PAL.

Basic design methodologies: Full custom and semi-custom design. ASIC vs. field programmable devices.

Basic fabrication technology: Bipolar and MOS processing steps and important process parameters.

Importance of semiconductor device modeling. Computer aided design.

SOLID STATE PHYSICS AND SEMICONDUCTOR DEVICES

Group A

Solid state physics: Atomic structures and quantum mechanical concepts,-chemical bonds, solid state structure, band structure, election and hole concept, intrinsic, extrinsic and compensated semiconductors, carrier concentration, lattice vibrations,

mobilities and drift velocities, Fermi level, energy-band diagram-Carrier transport mechanism: Scattering and drift of electrons and holes, diffusion mechanism, Hall effect, magneto-resistance, quasi- Fermi levels, generation, recombination and injection, of carriers, Boltzman transport equation and scattering rates, transient response, basic governing equations in semiconductor.

P-N junction theory:. Physical description of P-N junction, depletion approximation, biasing, transition capacitance, varacter, junction breakdown, space charge effect and diffusion approximation, current-voltage characteristics and temperature dependence, tunneling current, small signal a.c. analysis.

Bipolar junction transistors: BJT action, derivation of current components and gain expressions, breakdown voltages, Ebers-Moll model, hybrid-pi equivalent circuit, frequency response of transistors, P-N diode, SCR.

Group B

Fundamentals on technology of semiconductor devices; Unit processes for semiconductor device fabrication, oxidation, diffusion, photolithography and etching, film deposition, device isolation, integrated BJT fabrication processes.

Field effect transistors-JFET and MOSFET: Physical description and theory of JFET, static characteristics, small signal analysis, equivalent circuit, MOS structure, MOS capacitance, flat-band threshold voltages, MOS static characteristics, small signal parameters and equivalent circuit, charge-sheet model, strong, moderate and weak inversion, short-channel effects, hot-carrier effects, scaling laws of MOS transistors, LDD MOSFET, NMOS and CMOS IC technology, CMOS latch-up phenomenon.

Metal semiconductor junctions: Ideal Schottky barrier, current-voltage characteristics, MIS diode, Ohmic contacts, heterojunctions, MESFET.

Photonic devices: Optical absorption in a semiconductor, photovoltaic effect, solar cell, photoconductors, PIN photodiode, avalanche photodiode, LED, semiconductor lasers.

SOFTWARE ENGINEERING

Group A

Software project planning and management: Basic concepts of life cycles models, milestone, cost models, successive versions model, project structure, team structure. Empirical and heuristic estimation techniques.

Requirement analysis. Specifications, algebraic axioms, regular expressions, decision tables, event tables, transition tables, FS mechanism, petri nets.

Software design: Architectural and detailed design, abstraction, information hiding, modularity, concurrency, etc, coupling and cohesion, data How diagrams, structure charts, pseudo code, stepwise refinement, top-down and bottom-up programming.

Test plan and implementation issues-structured coding, recursion, documentation.

Group B.

Modern programming language features: Typeless, strong type and pseudo strong type checking, user defined data types, data encapsulation, generic facilities,' concurrency mechanism, object oriented concepts.

Program verification and validation. Unit testing, integration testing, acceptance testing, formal verification.

Software maintenance: Source code metrics, Halstead's effort equation, cyclomatic metric.

Reliability and software quality assurance.

Software cost estimation.

SENSORS AND TRANSDUCERS

Group A

Functional description of instrumentation systems. Performance characteristics-static and dynamic, time and frequency responses.

Electrical passive transducers. Hot wire anemometers and associated circuit, LVDT and phase-sensitive detection, variable reluctance type transducers and associated circuits. Capacitive microphone and associated circuits.

Magnetostrictive transducers: Magnetostrictive materials and their application to measurement of force.. Hall transducers: principles and applications.

Thermocouple, semiconductor-type temperature sensors.

Piezoelectric transducers: Piezoelectric crystal and its properties, sensitive coefficients, ferroelectric materials, bimorph, charge amplifiers, measurement of force.

Group B

Signal conditioning: Push-pull arrangement and reduction of non-linearity. Linearizing circuits and their applications. Differential amplifiers, instrumentation amplifiers, logarithmic amplifiers. Sources of noise and their reduction, grounding and shielding techniques.

Special transducers: Digital shaft encoders. DC and AC tachogenerators, synchros.

Actuators and servos: DC and AC servomotors, step motors. Elastic transducers: Springs bellows, diaphragms, Bourdon tubes-their characteristics and applications, combination of elastic and electrical transducers. Pneumatic sensors.

INDUSTRIAL INSTRUMENTATION AND COMPUTER CONTROL

Group A

Ultrasonic devices and their applications for sensing and non-destructive testing. Radio isotopes and their applications. Radio isotope sources, nucleonic detectors, ionization chambers, proportional-Geiger Mueller-and scintillation-counters. Ionization gauges and nucleonic gauges for measurement of thickness, density, pressure, flow, etc.

Optical transducers: LDR, LEDs, lasers, photodiodes, photomultiplier tubes, IR and UV detectors. Applications to industrial and pollution measurement. Introduction to optical fibre based sensors.

Microwave sensors: Doppler shift technique for velocity measurement.

Sampling techniques for liquids and gases for analysis purposes. Gas analysis, gas chromatography, thermal conductivity method, heat of reaction method.
Paramagnetic oxygen meters.

Group B

Humidity and moisture measurement, measurement of viscosity, pH measurement, electrical conductivity measurement.

Spectrochemical analysis: Mass spectrometry, emission spectrometry, absorption spectrometry.

Different types of digital control. Single loop and multiloop, direct digital control, software implementation of multiloop controllers. Sequence control: Programmable logic controllers, relay ladder logic programming.

Supervisory control: Functionality, process optimization, process monitoring. Man-machine interfaces. On-line computer control of processes.

BIOMEDICAL ELECTRONICS

Group A

Introduction to human physiology: Body skeleton: Nerve physiology, membrane protenual and action potential, function of nerves and of myoneural junction.

Muscle physiology: Functions of skeleton and smooth muscle, cardiac muscle and its rhythmic contraction.

Heart physiology: Dynamics of system, blood flow, arterial pressure, ECG.

Respirations: Mechanism of respiration.

Neuro physiology: C N S function of spinal cord and cord reflexes.

Transducers and electrodes: Different types of transducers and their selection for biomedical applications. Electrode theory. Different types of electrodes-hydrogen, calomel, Ag-AgCI, pH, P02-PC02 electrodes, selection criteria of electrodes.

Group B

Measurement and recording: Cardiovascular measurement: The heart and other cardiovascular systems. Measurement of blood pressure, blood flow, cardiac output and cardiac rate. Electrocardiography, phonocardiography ballistocardiography, plethysmography, magnet cardiography, computer applications.

Measurement of electrical activities in muscles and brain. Electromyography, electroencephalograph and their interpretation.

Respiratory mechanism. Measurement of gas volume, flow rate, carbon dioxide and oxygen concentration in inhaled air, respiratory controller.

Instrumentation for clinical laboratory: Measurement of pi f value of blood, ESR measurements, haemoglobin measurement, oxygen and carbon dioxide concentration in blood, GSR measurement, polarographic measurements, computer applications.

Medical imaging: Ultrasound imaging, radiography magnetic resonance technique and applications.

Biotelemetry: Transmission and reception aspects of biological signals via long distances. Patient care monitoring.

Electronic instruments affecting the human body. Stimulator, defibrillator, pacemaker, diathermy, blood pumps, myoelectric control of paralysed muscles.

SIGNAL PROCESSING

Group A

Periodic signal analysis: Fourier series, a periodic signal analysis, Fourier transform. Discrete representation of signals, Z-transform, sampling theorem. Effect of quantization. Flow graph.

Digital filter design: IIR filter design based on analog filters, inpui variance and bilinear transformation approach.

Computer aided design. FIR filter design using windows, computer-aided design. Introduction to multirate filters.

Group B

Computation of the DFT, DCT and WHT. The FFT, mixed radix algorithm, simulation of digital filters. Hardware implementation. Effects of finite register length. Digital signal processors (Ex TMS-320 family). Discrete random signals. Discrete correlation. Estimation of power spectral density. Application of digital signal processing.

CONTROL SYSTEMS

Group A

Frequency response techniques: Nyquist criteria—the principle of argument, the Nyquist path; Nyquist criteria for stability, effect of addition of poles and zeros on the shape of Nyquist locus.

Relative stability: Determination of gain margin and phase margin from Nyquist and Bode plots. Constant M and N loci in the G-plane; Nichol's charts. Application of Nichol's charts.

State space techniques: State variable analysis o! dynamical systems, canonical forms, controllability and observability, stability. Introduction to optimal control quadratic performance index and regulator problems.

Group B

Compensation techniques: Specifications of control systems in time and frequency domains.Series compensations—lag, lead and lag-lead design using Bode plots. Linear system design by state variable feedback.

Discrete data systems: Z-transforms and inverse Z transforms, stability-unit circle, bilinear transform, Jury' stability criterion. Difference equations. Types of digital control of plants.

Nonlinear elements and systems: Phase-plane an< describing function methods. Stability analysis am Liapunov's method.