

..... के विद्यार्थी ने दिनांक से दिनांक तक (स्थान का नाम) में आयोजित स्कूलों के नेशनल गेम्स की (क्रीडा/खेल-कूद का नाम) प्रतियोगिता/टूर्नामेंट में स्कूल की ओर से भाग लिया। उनके टीम के द्वारा उक्त प्रतियोगिता/टूर्नामेंट में स्थान प्राप्त किया गया।

यह प्रमाण-पत्र डाइरेक्ट्रेट ऑफ पब्लिक इन्सट्रक्शन्स/शिक्षा में उपलब्ध रिकार्ड के आधार पर दिया गया है।

स्थान हस्ताक्षर
दिनांक नाम
पद
संस्था का नाम
मुहर

नोट : यह प्रमाण-पत्र निदेशक/या अतिरिक्त/संयुक्त या उपनिदेशक डाइरेक्ट्रेट ऑफ पब्लिक इन्सट्रक्शन्स/शिक्षा द्वारा व्यक्तिगत रूप से हस्ताक्षर होने पर मान्य होगा।

परिशिष्ट-4

परीक्षा योजना एवं पाठ्यक्रम

सम्मिलित राज्य अभियन्त्रण सेवा परीक्षा हेतु वस्तुनिष्ठ प्रकार के निम्नवत दो प्रश्न-पत्र होंगे:-

प्रथम प्रश्न पत्र

विषय	प्रश्नों की संख्या	अंक	कुल अंक	समय
1- सामान्य हिन्दी	25 (प्रत्येक प्रश्न 3 अंक)	75	375	2.30 (ढाई) घण्टा
2- मुख्य विषय (सिविल इंजी0-1, मैके0 इंजी0-1, विद्युत इंजी0-1, कृषि इंजी0-1, केमिकल इंजी0-1, इण्डस्ट्रियल इंजी0-1, फायर इंजी0-1, हाइड्रॉलिकस इंजी0-1, इलेक्ट्रानिकस इंजी0-1)	100 (प्रत्येक प्रश्न 3 अंक)	300		

द्वितीय प्रश्न पत्र

विषय	प्रश्नों की संख्या	अंक	कुल अंक	समय
1- सामान्य अध्ययन	25 (प्रत्येक प्रश्न 3 अंक)	75	375	2.30 (ढाई) घण्टा
2- मुख्य विषय (सिविल इंजी0-11, मैके0 इंजी0-11, विद्युत इंजी0-11, कृषि इंजी0-11, केमिकल इंजी0-11, इण्डस्ट्रियल इंजी0-11, फायर इंजी0-11, हाइड्रॉलिकस इंजी0-11, इलेक्ट्रानिकस इंजी0-11)	100 (प्रत्येक प्रश्न 3 अंक)	300		

व्यक्तित्व परीक्षा (साक्षात्कार) - 100 अंक

कुल योग - 375 + 375 + 100 = 850 अंक

पाठ्यक्रम

सामान्य हिन्दी- हिन्दी का पाठ्यक्रम इस प्रकार बनाया जायेगा ताकि उम्मीदवार की हिन्दी भाषा की समझ और शब्दों के कुशल प्रयोग की जाँच हो सके। इसका स्तर हाई स्कूल का होगा।

सामान्य अध्ययन: सामान्य अध्ययन के प्रश्न-पत्र समसामयिक घटनाओं और ऐसी बातों की उनके वैज्ञानिक पहलुओं पर ध्यान देते हुए जानकारी सम्मिलित होगी जो प्रतिदिन के अनुभव में आती है तथा जिनकी किसी शिक्षित व्यक्ति से अपेक्षा की जा सकती है। प्रश्न-पत्र में भारत का इतिहास, राजनीति और भूगोल के ऐसे प्रश्न भी सम्मिलित होंगे जिनका उत्तर उम्मीदवार विशेष अध्ययन किये बिना ही दे सकेंगे।

CIVIL ENGINEERING

PAPER - 1

PART - A

ENGINEERING MECHANICS, STRENGTH OF MATERIALS AND STRUCTURAL ANALYSIS.

Units and Dimensions, SI units, vectors, concept of force, Concept of particle and rigid body Concurrent, Non- Concurrent and parallel forces in a plane, moment of force and varignon's theorem free body diagram, conditions of equilibrium Principle of virtual work, equivalent force system.

First and second Moment of area, Mass moment of inertia, Static Friction, inclined plane and bearings, kinematics and kinetics, kinematics in Cartesian and Polar Coordinates, motion under uniform and non-uniform acceleration, motion under gravity, Kinetics of particle: Momentum and Energy principles, D' Alembert's principle, Collision of elastic bodies, rotation of rigid, bodies, simple harmonic motion.

STRENGTH OF MATERIALS:

Simple Stress and Strain, Elastic constants, axially loaded compression members, Shear force and bending moment, theory of simple bending, bending stress, Shear Stress, Beams of uniform strength, Leaf Spring, close coiled helical springs, Strain Energy in direct stress, bending & shear. Deflection of beams; Macaulay's method, Mohr's Moment area method, Conjugate beam method, unit load method, Torsion of shafts, Transmission of power, Elastic stability of columns, Euler's Rankin's and Secant formulae. Principal stresses and strains in two dimensions, Mohr's Circle, Theories of Elastic Failure, Thin and Thick cylinder, Stresses due to internal and external pressure-Lame's equations.

STRUCTURAL ANALYSIS:

Castiglianos theorems I and II, Unit load method of consistent deformation applied to beams and pin jointed trusses. Slope-deflection, moment distribution, Kani's method of analysis and column Analogy method applied to indeterminate beams and rigid frames. Rolling loads and influence lines: Influence lines for reactions of beam, shear force and bending moment at a section of beam. Criteria for maximum shear force and bending moment in beams traversed by a system of moving loads, influence lines for simply supported plane pin jointed trusses, Arches: Three hinged, two hinged and fixed arches, rib shortening and temperature effects, influence lines in arches, Matrix methods of analysis: Force method and displacement method of analysis of indeterminate beams and rigid frames. Plastic Analysis of beams and frames: Theory of plastic bending, plastic analysis, statical method, Mechanism method. Unsymmetrical bending: Moment of inertia, product of inertia, position of neutral axis and principal axis, calculation of bending stresses.

PART - B

DESIGN OF STRUCTURES: STEEL, CONCRETE AND MASONRY STRUCTURES.

STRUCTURAL STEEL DESIGN:

Structural steel: Factors of safety and load factors, rivetted, bolted and welded joints and its connections, Design by working, stress/limit state method of tension and compression member, beams of built up section, rivetted and welded plate girders, gantry girders,

stanchions with battens and lacings, slab and gusseted column bases, Design of highway and railway bridges: Through and deck type plate girder, Warren girder, Pratt truss.

DESIGN OF CONCRETE AND MASONRY STRUCTURES:

Reinforced Concrete: Working Stress and Limit State Method of design-Recommendations of B.I.S. codes, design of one way and two way slabs, stairs-case slabs, simple and continuous beams of rectangular, T and L sections, compression members under direct load with or without eccentricity, isolated and combined footings, Cantilever and counter-fort type retaining walls, Water tanks: Design requirements as per B.I.S. code for rectangular and circular tanks resting on ground, Prestressed concrete: Methods and systems of prestressing, anchorages, analysis and design of sections for flexure based on working stress, losses of prestress, Earth quake resistant design of building as per BIS code. Design of brick masonry as per I. S. Codes, Design of masonry retaining walls.

PART - C

Building Materials, Construction Technology, Planning and Management

Building Materials: Physical properties of construction materials with respect to their use: stones bricks, tiles, lime, glass, cement, mortars, Concrete, concept of mix design, pozzolans, plasticizers, super plasticizers, Special concrete: roller compacted concrete, mass concrete, self compacting concrete, ferro cement, fibre reinforced concrete, high strength concrete, high performance concrete, Timber: properties, defects and common preservation treatments, Use and selection of materials for various uses e.g. Low cost housing, mass housing, high rise buildings.

Constructions Technology, Planning and Management:

Masonry constructions using brick, stone, construction detailing and strength characteristics paints, varnishes, plastics, water proofing and damp proofing materials. Detailing of walls, floors, roofs, staircases, doors and windows. Plastering, pointing, flooring, roofing and construction features. Retrofitting of buildings, Principle of planning of building for residents and specific uses, National Building code provisions and uses. Basic principles of detailed and approximate estimating, specifications, rate analysis, principles of valuation of real property. Machinery for earthwork, concreting and their specific uses, factors affecting selection of construction equipments, operating cost of equipments. Construction activity, schedules, organizations, quality assurance principles. Basic principle of network CPM and PERT uses in construction monitoring, cost optimization and resource allocation. Basic principles of economic analysis and methods. Project profitability: Basis principles of financial planning, simple toll fixation criterions.

PART - D

GEO TECHNICAL ENGINEERING AND FOUNDATION ENGINEERING

Types of soils, phase relationships, consistency limits particles size distribution, classifications of soils, structure and clay mineralogy. Capillary water, effective stress and pore water pressure, Darcy's Law, factors affecting permeability, determination of permeability, permeability of stratified soil deposits. Seepage pressure, quick sand condition, compressibility and consolidation, Terzaghi's theory of one dimensional consolidation, consolidation test.

Compaction of soil, field control of compaction total stress and effective stress parameters, pore pressure parameters, shear strength of soils, Mohr Coulomb failure theory, shear tests.

Earth pressure at rest, active and passive pressures, Rankin's theory Coulomb's wedge theory, Graphical method of earth pressure on retaining wall, sheetpile walls, braced excavation, bearing capacity, Terzaghi and other important theories, net and gross bearing pressure.

Immediate and consolidation settlement, stability of slope, total stress and effective stress methods, conventional methods of slices, stability number.

Subsurface exploration, methods of boring, sampling, penetration tests, pressure meter tests, essential features of foundation, types of foundation, design criteria, choice of type of foundation, stress distribution in soils, Boussinessq's theory, Westergaard method, Newmarks chart, pressure bulb, contact, pressure, applicability of different bearing capacity theories, evaluation of bearing capacity from filed tests, allowable bearing capacity, settlement analysis, allowable settlement, proportioning of footing, isolated and combined footings, rafts, pile foundation, types of piles, plies capacity, static and dynamic analysis, design of pile groups, pile load test, settlement of piles lateral loads, foundation for bridges, Ground improvement techniques: sand drains, stone columns, grouting, soil stabilization geotextiles and geomembrane, Machine foundation: Natural frequency, design of machine foundations based on the recommendation of B.I.S. codes.

CIVIL ENGINEERING PAPER- II

Part - A

FLUID MECHANICS, OPEN CHANNEL FLOW, HYDRAULIC MACHINES AND HYDROPOWER ENGINEERING.

Fluid Mechanics: Fluid properties and their roles in fluid motion, fluid statics including forces acting on plane and curved surfaces, Kinematics and Dynamics of Fluid flow: Velocity and acceleration, stream lines, equation of continuity, irrotational and rotational flow, velocity potential and stream functions, flownet, methods of drawing flownet, source and sink, flow separation, free and forced vorties.

Flow control volume equation, continuity, momentum and energy equations, Navier-Stokes equation, Euler's equation of motion and application to fluid flow problems, pipe flow, plane, curved, stationary and moving vanes sluice gates, weirs, orifice meters and Venturi meters.

Dimensional Analysis and Similitude: Buckingham's Pi-theorem, dimensionless parameters, similitude theory, model laws, undistorted and distorted models.

Laminar Flow: Laminar flow between parallel, stationary and moving plates, flow through pipes.

Boundary Layer: Laminar and turbulent boundary layer on a flat plate, laminar sub-layer, smooth and rough boundaries, submerged flow, drag and lift and its applications.

Turbulent flow through pipes: Characteristics of turbulent flow, velocity distribution, pipe friction factor, hydraulic grade line and total energy line, siphons, expansion and contractions in pipes pipe networks, water hammer in pipes and surge tanks.

Open Channel Flow: Flow types, uniform and nonuniform flows, momentum and energy correction factors, Specific energy and specific force, critical depth, resistance equations and roughness coefficient, rapidly varied flow, flow in transitions, Brink flow, Hydraulic jump and its applications, waves and surges, gradually varied flow, classification of surface profiles, control section, Integration of varied flow equation and their solution.

HYDRAULIC MACHINES AND HYDROPOWER:

Centrifugal pumps-Types, characteristics, Net Positive Suction-head (NPSH), specific

speed, Pumps in series and parallel.

Reciprocating pumps, Air vessels, Hydraulic ram, efficiency parameters, Rotary and positive displacement pumps, diaphragm and jet pumps.

Hydraulic turbines: types, classification, Choice of turbines, performance parameters, controls, characteristics, specific speed.

Principles of hydropower development: Types, layouts and component works, surge tanks, types and choice, Flow duration curves and dependable flow, Storage and pondage, Pumped storage plants, Special types of hydel plants.

Part – B

Hydrology and Water Resources Engineering

Hydrology: Hydrologic cycle, precipitation, evaporation, transpiration, infiltration, overland flow, hydrographs, flood frequency analysis, flood routing through a reservoir, channel flow routing- Muskingam method.

Ground Water flow: Specific yield, storage coefficient, coefficient of permeability, confined and unconfined aquifers, radial flow into a well under confined and unconfined conditions, Open wells and tube wells.

Ground and surface water recourses single and multipurpose projects, storage capacity of reservoirs, reservoir losses, reservoir sedimentation.

Water requirements of crops consumptive use, duty and delta, irrigation methods, Irrigation efficiencies.

Canals: Distribution systems for cannal irrigation, canal capacity, canal losses, alignment of main and distributory canals, Design of cannal by Kennedy's and Lacey's theorie, Water logging and its prevention.

Diversion head works: Components, Principles and design of weirs on permeable and impermeable foundations, Khosla's theory, Bligh's creep theory Storage works.

Cross drainage works.

Types of dams, design principles of gravity and earth dams, stability analysis. Spillways: Spillway types energy dissipation.

River training: Objectives of river training, methods of river training and bank protection.

Part – C

Transportation Engineering

Highway Engineering: Principles of Highway alignments, classification and geometric design, elements and standards for roads.

Pavement: flexible and rigid pavements Design principles and methodology. Construction methods and materials for stabilized soil. WBM, Bituminous works and Cement Concrete roads.

Surface and sub-surface drainage arrangements for roads, culvert structures. Pavement distresses and strengthening by overlays.

Traffic surveys and their application in traffic planning, Typical design features for channelized, intersection, rotary etc., signal designs, standard traffic signs and markings.

Railway Engineering: Permanent way, ballast, sleeper, chair and fastenings, points, crossings, different types of turn outs, cross-over, setting out of points, Maintenance of track, super elevation, creep of rails ruling gradients, track resistance tractive effort, curve resistance, Station yards and station buildings, platform sidings, turn outs, Signals and interlocking, level crossings.

Air port Engineering: Layouts, Planning and design.

Part – D

Environmental Engineering

Water supply: Estimation of water demand, impurities in water and their significance, physical, chemical and bacteriological parameters and their analysis, waterborne diseases, standards for potable water.

Water collection & treatment: Intake structures, principles and design of sedimentation tank, coagulation cum flocculation units slow sand filter, rapid sand filter and pressure filter, theory & practices of chlorination, water softening, removal of taste and salinity, Sewerage Systems, Domestic and industrial wastes, storm, sewage, separate and combined systems, flow through sewers, design of sewers.

Waste water characterization: Solids, Dissolved oxygen (DO), BOD COD, TOC, and Nitrogen, Standards for disposal of effluent in normal water course and on to land.

Waste water treatment: Principles and design of wastewater Treatment units-- Screening, grit chamber, sedimentation tank activated sludge process, trickling filters, oxidation ditches, oxidation ponds, septic tank; Treatment and disposal of sludge; recycling of waste water.

Solid waste management: Classification, Collection and disposal of solid waste in rural and urban areas, Principles of solid waste management.

Environmental pollution: Air and water pollution and their control acts. Radioactive waste and their disposal Environmental impact assessment of Thermal power Plants, mines and river valley projects, Sustainable development.

Part – E

Survey and Engineering Geology

(a) **Surveying:** Common methods and instruments for distance and angle measurements in Civil Engineering works, their use in plane table traverse survey, levelling, triangulation, contouring and topographical maps. Survey layouts for culverts canal, bridge, roads, railway alignment and buildings.

Basic principles of photogrammetry and remote sensing.

Introduction to Geographical information system.

Engineering Geology

Basic concepts of Engineering geology and its applications in projects such as dams, bridges and tunnels.

MECHANICAL ENGINEERING

PAPER-I

1. Engineering Mechanics:

Analysis of force systems, friction, centroid and centre of gravity, trusses and beams, principle of virtual work, kinematics and kinetics of particle, kinematics and kinetics of rigid bodies.

2. Mechanism and Machines:

Velocity and acceleration of links, cams and followers gears and gear trains clutches, belt drives, brakes and dynamometers, Flywheel and governors, balancing of rotating and reciprocating masses, balancing of multi cylinder engines, Free and forced vibration, damped vibration, whirling of shafts.

3. Mechanics of Solids:

Stresses and strains, compound stresses strains, Torsion of circular shafts, stresses and

deflections in beams unsymmetrical bending, curved beams, Thin and thick cylinders and spheres, Buckling of columns, Energy methods, helical and leaf springs.

4. Design of Machine Elements:

Design for Static and dynamic loading, Theories of failure, fatigue principles of design of rivetted, welded and bolted joints, shafts, springs, bearings, brakes, clutches and flywheels.

5. Engineering Materials:

Crystal systems and crystallography, crystal imperfections, Alloys and phase diagrams, Heat treatment, ferrous and non ferrous metals and alloys, Mechanical properties and testing.

6. Manufacturing:

Metal casting, metal forming, metal joining, Mechanics of metal cutting, machining and machine tool operations, unconventional machining methods limits, fits and tolerances, inspection: Surface roughness, comparators, computer integrated manufacturing, Flexible manufacturing systems, jigs and fixtures

7. Industrial Engineering:

Production, planning and control, inventory control and operation, research, CPM and PERT.

8. Mechatronics and Robotics:

Microprocessors and microcontrollers, Architecture, Programming, Computer interfacing Programmable logic controller, sensors and actuators, Piezoelectric accelerometers, Hall effect sensors, optical encoder, resolver, Inductosyn, Pneumatic and Hydraulic Actuators, stepper motor, control system, mathematical modeling, control signals, controllability and observability, Robotics: Robot classification, robot specification. Notation: Direct and inverse kinematics homogeneous co-ordinates and arm equation of four axis SCARA Robot.

MECHANICAL ENGINEERING

PAPER-II

1. Thermodynamics:

Thermodynamic systems and processes, properties of pure substances, concepts and applications of zeroth, first and second law of thermodynamics, entropy, availability and irreversibility, detailed analysis of thermodynamic cycles, ideal and real gases, fuels and combustion.

2. Fluid Mechanics:

Basic concepts and properties of fluids, manometry, fluid statics, buoyancy, equations of motion, Bernoulli's equation and applications, viscous flow of incompressible fluids, laminar and turbulent flows, flow through pipes and head losses in pipes, dimensional analysis, Forces on immersed bodies and boundary layer over a flat plate, isentropic and adiabatic flows, normal shock waves.

3. Heat Transfer:

Modes of heat transfer, steady and unsteady heat conduction, thermocouple time constant, critical thickness of insulation, heat transfer from fins, momentum and energy equations for boundary layer flow on a flat plate. Free and forced convection, radiation heat transfer, Stefan-Boltzmann law, shape factor, black and grey body radiation heat exchange, boiling and condensation, heat exchanger analysis, LMTD and NTU – effectiveness methods.

4. Energy conversion:

SI and CI engines, performance characteristics and testing of IC engines, combustion phenomena in SI and CI engines, carburetion and fuel injection systems, emissions and emission control. Reciprocating and rotary pumps, pelton wheel, Francis and Kaplan turbines, velocity diagrams impulse and reaction principles steam and gas turbines; Rankine and Brayton cycles with regeneration and reheat, high pressure boilers, draft, condensers. Unconventional power systems, including nuclear, MHD, biomass, wind and tidal systems, utilization of solar energy; Reciprocating and rotary compressors; theory and applications, Theory of propulsions, pulsejet and ramjet engines.

5. Environmental control:

Vapour compression, vapour absorption, steam jet and air refrigeration systems, properties of refrigerant and their nomenclature, psychometrics properties and processes, psychrometric relations, use of psychrometric chart, load estimation, supply air conditions, sensible heat factors, air conditioning system layout, comfort chart, comfort and industrial air conditioning.

ELECTRICAL ENGINEERING

PAPER – I

Networks and Systems: Steady-state and Transient-state Analysis of systems, Thevenin's-, Norton's-, Superposition- and Maximum Power Transfer-theorems, Driving point Transfer functions, Two-port networks, Laplace and Fourier transforms and their applications in Network analysis, Z-transforms for discrete systems, R-L, R-C & L-C network synthesis.

E.M. Theory: Analysis of electrostatic and magnetostatic fields, Laplace, Poisson and Maxwell equations, solution of boundary value problems, electromagnetic wave propagation, ground and space waves, Propagation between Earth Station and Satellites.

Control systems: Mathematical modelling of dynamic linear continuous systems, Block diagrams and Signal flow graphs, time-response specifications, steady-state error, Routh-Hurwitz criterion, Nyquist techniques, Root Loci, Bode Plots, Polar Plot, and stability analysis, Lag-, Lead-, Lag-Lead-compensation, state-space modelling, state transition matrix, controllability and observability.

Elements of Electronics: Basics of semiconductor diodes, BJT, FET and their characteristics, different types of transistors and FET amplifiers equivalent circuits and frequency response, feedback oscillators, colpitts oscillator and Hartley Oscillator, Operational amplifiers-characteristics and applications.

Power System Analysis and Design: Line parameters and calculations, Performance of Transmission lines, Mechanical design of overhead lines and Insulators, Corona and radio interference Parameters of single- and three-core Cables, Bus admittance matrix, Load flow equations and methods of solutions, Fast-decoupled load flow, Balance- and Unbalanced-faults analysis, Power system stability, Power system transients and travelling Waves, EHV Transmission, HVDC transmission, Concepts of FACTS, Voltage Control and Economic operation, Concepts of distributed generation, solar and wind power, smart grid concepts.

Elements of Electrical Machines:- General concepts of E.m.f., m.m.f., and torque in rotating machines, DC Machines: motor and generator characteristics, equivalent circuits, commutation and amature reaction, starting and speed controls of motors; Synchronous Machines: performance, regulation, Parallel operation of generators, motor starting, characteristics and applications, Transformers: phasor-diagram and equivalent circuit,

efficiency, and voltage regulation, auto-transformers, 3-phase transformers.

Measurement: Basic methods of measurement, Precision and standards, error analysis, Bridges and Potentiometers; moving coil, Moving iron, dynamometer and induction type instruments, measurement of voltage, current, power, energy, and power factor, Instrument transformers, digital voltmeters and multimeters, phase-, time- and frequency-measurement, Q-meters Oscilloscopes, Basics of sensors, and data acquisition system, Instrumentation systems for pressure and temperature measurements.

ELECTRICAL ENGINEERING

PAPER – II

Power Electronics and Drives: Semiconductor, power, diodes, transistors, thyristors, triacs, GTOs, MOSFETs and IGBTs static characteristics and principles of operation, triggering circuits single phase and three-phase controlled rectifiers-fully controlled and half controlled, smoothing and filters regulated power supplies, DC-DC choppers and inverters, speed control circuits for DC and A.C. drives, Basics of electric drives: types, quadrant operation, reversing and braking of electric motors, estimation of power ratings, traction motors.

Digital Electronics: Boolean algebra, logic gates, combinational and sequential logic circuits, multiplexers, multivibrators, sample and hold circuits, A/D and D/A converters, basics of filter circuits and applications, active filters, semiconductor memories.

Microwaves and Communication systems: Electromagnetic wave in guided media, wave guide components, resonators, microwave tubes, microwave generators and amplifiers.

Analog Communication basics: modulation and demodulation, noise and bandwidth, transmitters and receivers, signal to noise ratio, digital communication basics, sampling, quantizing, coding frequency- and time-domain multiplexing, sound and vision broadcast, antennas, transmission lines at audio and ultra-high frequencies.

Induction and special Machines: Three-phase Induction motors Rotating magnetic field, Torque-slip characteristics, Equivalent Circuit and determination of its parameters, starters, speed control, Induction generators. Single phase Induction motors: Theory and phasor diagrams, characteristics, starting and applications, repulsion motor, series motor: E.m.f. equation and phasor diagram and performance, servomotors, stepper motors, reluctance motors, brushless DC motors (BLDC).

Power system protection and Switch gear: Methods of Arc Extinction, Restriking voltages and recovery voltage, testing of circuit breakers, Protective relays, protective schemes for power system equipment, surges in transmission lines and protection.

Numerical Methods: Solution of non liner algebraic equations, single and multisteps methods for solution of differential equations.

Electrical Engineering Materials: Crystal structure and defects, conducting, insulating and magnetizing Materials, super-conductors.

Elements of Microprocessors : Data representation and representation of integer and floating point-numbers. Organization and programming of a microprocessor, ROM and RAM memories CPU of a microcomputer, interfacing memory and I/O devices, Programmable peripheral and communication interface. Application of microprocessors.

AGRICULTURAL ENGINEERING

PAPER-I

(a) Thermodynamics and Heat Engines: Concept of energy, temperature and heat equations; laws of thermodynamics, pure substances and their properties; entropy, Rankine, air standard Otto, Diesel and Joule cycles; indicator diagrams.

(b) Farm Power: Sources and status of power in India; farm power and agricultural productivity relationship; construction and operational features of IC engines, various system of IC engine namely carburetion, ignition, cooling, lubrication; valves and valve timing, special features of diesel engines, tractors and their classification, power transmission, repair and maintenance; tractor testing, and tractor economics; power tillers – their economics and suitability, Energy in Agriculture.

(c) Farm Machinery: Design, construction, operation, repair and maintenance of tillage tools, implements and equipment viz. mould board and disk plough; harrows, cultivators, rotary tiller, seeding and planting machines, hoe, weeders, sprayers and dusters; harvester, threshers and combines; soil and crop factors influencing machine performance and energy requirements; selection of farm machines, economics of agricultural mechanization. Earth moving machineries.

(d) Heat and Mass Transfer: Thermal properties of materials; steady state and transient heat conduction, natural and forced convection; boiling, condensation, thermal radiation exchange, Heat exchangers, heat and mass transfer analogy; Fick's laws of diffusion, psychrometrics; analysis of heat and mass transfer processes, instrument and measurement systems.

(e) Process and Food Engineering : Unit operations in post harvest processing (cleaning, grading, drying, size reduction, evaporation, pasteurization, distillation etc.); processing of cereals, pulses, oilseeds, fruits & vegetables, animal feed, spices, dairy products, meat etc.; design of processing equipment and systems, milking machines.

(f) Storage and handling: Changes in stored products during storage; storage of food grains and their products, perishables (vegetable, fruits, dairy product, meat and eggs) storage system- air tight ventilated, refrigerated, modified atmospheric and controlled atmospheric storages; packaging; conveyors; design and management of storage and handling systems. Reducing losses in storages and handling.

AGRICULTURAL ENGINEERING

PAPER-II

(a) Hydraulics and Fluid Mechanics: Fluid properties, units and dimensions: surface tension and capillarity, equation of continuity, Bernoulli equation, Laminar and turbulent flow, steady and unsteady flow, Flow of fluids in pipes and open channels, design of open channels for non erosive and non silting velocities, most economical cross section, measurement of irrigation water and other water measuring devices viz. weirs, notches, orifices and flumes.

(b) Surveying and Leveling: Linear measurements; survey methods and devices used; principle of leveling, simple, differential and profile leveling; Contouring and characteristics of contour lines; Land leveling and grading, earth work estimation.

(c) Soil and Water Conservation Engineering: Forms of precipitation; hydrologic cycle; Point rainfall analysis, frequency analysis, agricultural watershed and its management; water management in agri-horti-aquaculture system, mechanics of water and wind erosion; Rational method of prediction of peak runoff and its limitations; concept of unit hydrograph and instantaneous hydrograph; factors affecting erosion and runoff; water erosion control measures – contour cultivation, strip cropping, terracing, afforestation, pastures; Design of gully control structures – temporary and permanent; stream bank erosion; flood routing; flood amelioration by upstream soil water management; wind

erosion control measures and sand dunes stabilization.

(d) Irrigation Pumps: Design, construction, performance characteristics, selection, installation, servicing and maintenance of different pumps (reciprocating, centrifugal, gear, turbine, submersible, propeller, jet); Hydraulic ram; Renewable and non-renewable power sources for pumping solar pumps.

(e) Irrigation and Drainage Engineering: Water wealth and irrigation in India; Soil water plant relationship; Forms and occurrence of soil water; methods and devices for soil moisture measurement; water requirement of crops; irrigation scheduling; irrigation methods – their hydraulics and design flood, border, furrow, sprinkler and drip irrigation, concept of irrigation efficiencies; water conveyance and control; Design of canals. Lacey and Kennedy's theories.

Drainage needs and its benefits; Darcy's Law, hydraulic conductivity; drainage coefficient; drainage methods, surface drainage (drainage of flat and sloping lands); design of open ditches their alignment and construction; designs and layout of subsurface drains; depth and spacing of drains and drainage outlets; installation of drains and drainage wells; drainage of salt affected areas.

(f) Ground Water Hydrology and Tube well Engineering: Occurrence and movement of ground water, steady and transient flow into wells, well interference, well drilling, design of well assembly and gravel pack, installation of well screen, completion and development of wells.

(g) Rural Engineering: Building materials and their properties; Farmstead planning, and design of dairy barns; poultry, goat-sheep, and piggery housing; selection of site, planning and design of rural houses, farm roads, village drainage; waste disposal and sanitary structures; cost estimates, green house construction.

INDUSTRIAL ENGINEERING

Paper-I

PART 'A'

(A) Statics and Dynamics: Suspension cables, Friction, Trusses, Principle of virtual work; Kinematics of rigid bodies - plane motion, absolute motion; Kinetics of rigid bodies - plane motion, force, mass and acceleration, work and energy, impulse and momentum.

(B) Theory of Machines: Velocity and acceleration of links; Cams; Gears and gear trains; Clutches; Belt drives; Brakes and dynamometers; Flywheel and governors; Balancing of rotating and reciprocating masses and multi-cylinder engines; Free, forced and damped vibrations; Critical speed.

(C) Mechanics of Solids: Stress and strain in two dimensions; Mohr's circle; Strain rosettes; Torsion of circular shafts' stresses and deflection due to bending of beams; Castigliano's theorem; Shrink fit; Stability of columns.

(D) Materials Science: Atomic structure; Crystal systems; Imperfections; Polymers; Elastomers and ceramics; Mechanical behaviour of materials; True and conventional stress-strain curves for common engineering materials; Strain hardening; Fracture, creep and fatigue.

PART 'B'

(A) Manufacturing Science & Production Processes: Merchant's theory; Taylor's equation; Machinability; Conventional manufacturing processes - Casting and welding, the related defects; Unconventional manufacturing processes - EDM, ECM and ultrasonic machining; Forming processes - High velocity forming, explosive forming; Surface roughness and its measurement; Gauges, Comparators, Jigs and fixtures.

(B) Basic Production Management: Scientific Management; Work analysis - time and motion study, work sampling; Value engineering; Line balancing and work station design.

(C) Basic Operations Research: Graphical and simplex method for linear programming; Transportation and assignment models; Elementary queueing theory.

(D) Basic of Project Management: Need for management of projects, CPM and PERT methods, Project costing ; Project crashing; Slack and float determination; Resource allocation problem - resource leveling and resource balancing.

Paper - II

PART 'A'

(A) Thermodynamics: Applications of first and second law of thermodynamics; Detailed analysis of thermodynamic cycles.

(B) Fluid Mechanics: Reynold's transport theorem and its applications; Ideal fluid flow; Velocity distribution for laminar and turbulent flow in pipes; Dimensionless analysis and similitude; Forces on immersed bodies and boundary layer over a flat plate.

(C) Heat Transfer: Conduction in the presence of heat sources and sinks; One-dimensional unsteady conduction; Time constant for thermocouples; Momentum and energy equations for boundary layers on a flat plate; Dimensionless numbers; Free and forced convection; Nature of radiant heat; Basic radiation heat transfer.

(D) Energy Conversion: Combustion phenomenon in S.I. and C.I. engines; Carburation and fuel injection; Classification of hydraulic turbines and specific speed; Centrifugal and reciprocating pumps; High pressure boilers.

PART 'B'

(E) Refrigeration and Air-Conditioning: Vapour compression, vapour absorption and air refrigeration systems; Properties of important refrigerants; Psychrometric properties and relations; Use of psychrometric chart; Estimation of cooling load.

(F) Quality and Reliability: Quality needs and parameters; Statistical quality control charts - \bar{x} , R , p , σ , c and u charts, operating characteristics curve; Quality assurance - single and double sampling plans, sampling with rectification, operating characteristic curve, average sample size; Reliability - measurement for parallel and series systems; Life expectancy; Type of maintenance.

(G) Production Planning and Control: Types of production systems; Plant and machinery layout considerations and techniques; Aggregate planning; Inventory planning and control models for discrete demand and single-period stochastic demand; service level and safety stock; Materials classification schemes; MRP, MRP-II, CRP; Scheduling and sequencing methods; JIT production system; KANBAN systems; Productivity.

(H) Engineering and Managerial Economics: Economic evaluation techniques - present worth, future worth, annuity, IRR, ERR methods; Depreciation techniques; Financial statements - balance sheet, profit and loss account, financial ratios; Financial instruments - shares, debentures, bonds; Financial instruments' evaluation.

Chemical Engineering

Paper - I

PART - A

1. Material and Energy Balances: Engineering Dimensions and Units; Gas Laws and Vapor Pressure; Conservation of Mass and Energy; Material Balance with and without

Reactions and Recycle.

Operations Involving Particulate Solids: Properties and Handling of Particulate Solids; Size Reduction- Crushing and Grinding and Related Equipment; Particle Classification; Mixing of Solids and Pastes; Sedimentation and Setting; Centrifugal Separators.

2. Thermodynamics: Perfect Gas Laws; Real Gases; General Energy Equations; Change of States; Laws of Thermodynamics; Concept of Chemical Equilibrium; Free Energy and its Applications; Fugacity and Activity Coefficients.

3. Fluid Flow Operations: Pressure Measuring Devices; Viscosity of Fluids; Equations of Fluid Flow for Compressible and Incompressible Fluids; Laminar and Turbulent Flow in Pipes; Reynolds Number; Pressure Loss; Economic Pipe Selection; Metering of Fluid Flow; Similarity Between Energy, Mass and Momentum Transfer, Non-Newtonian Fluids; **Compressors, Pumps, Fans and Blowers:** Classification; Properties; Characteristic Curves; Parallel and Series Operations; Noise; Agitation and Mixing of Liquids.

4. Heat Transfer Operations: Conduction: Basic Concepts; Film Coefficients; Composite Wall; Log Mean Values; Lagging Materials and Critical Insulation Thickness; **Convection:** Forced and Natural Convection; Film Coefficients, Heat Exchangers; Heat Transfer to Fluids with Phase Change; **Radiation:** Laws and Factors Governing Radiative Heat Transfer; Combination of Heat Transfer Modes; Unsteady-state Heat Transfer.

PART - B

1. Mass Transfer Operations: Diffusion; Convective Mass Transfer; Phase Equilibrium; Mass Transfer with Phase Change; Evaporation and **Drying:** Evaporation Equipment and Operation Methods; Heat Transfer Coefficient in Evaporators; Single, Double and Multiple Effect Evaporators; **Drying:** Water Vapor Pressure and Humidity; Psychrometric Charts; Equilibrium Moisture Content of Materials; Method of Drying; Constant and Falling Rate Drying Curves; Equipment for Drying; **Crystallization:** Solubility Curves; Crystallization; Crystallizers.

2. Gas-Liquid and Vapor- Liquid Separation Processes: Types of Separation Processes and Methods; Equilibrium between Phases; Single and Multiple Equilibrium Stages; Mass Transfer between Phases; Humidification; Absorption, Driving Force, Packed Absorption Tower, Bubble Plate Absorption Tower, Absorption Tray Efficiencies; **Vapor-Liquid Separation Processes:** Vapor-Liquid Equilibrium; Constant Boiling Mixture; Distillation Methods; Volatility; Simple Distillation Methods; Distillation with Reflux and McCabe-Thiele Method; Distillation Tray Efficiencies; Azeotropic Mixtures.

3. Liquid-Liquid and Solid -Liquid Separation Processes: Single and Multi-stage Stage Liquid-Liquid Extraction Processes; Equipment for Liquid-Liquid Extraction; Filtration; General Relationships Constant pressure and Constant Rate filtration, **Liquid-Solid Leaching:** Basic Concepts and Equipment; Equilibrium Concepts; Single and Multi-stage (Counter-current) Leaching.

4. Chemical Reactions and Reactors and Process Control: Zero, First, Second and Non-linear Order Reactions; Half-Life and Doubling Time; Consecutive Reactions; Mixed Batch Reactors; Plug-Flow Reactors; Completely Mixed-Flow Reactors; Mixing Models; Comparison of Reactor Performance; **Process Control and Instrumentation:** First and Second Order Systems; Physical and Block Diagrams; Input, Controlling, and Actuating Means; Final Control Elements; Input Functions and Their Type; Oscillatory Element; Control and Measurement of Concentration, Flow, Level, Pressure, Temperature Control Systems; Mechanical Dampers; Distillation Column Control; Computer Aided Process Control.

Chemical Engineering

Paper - II

PART - A

1. Process Equipment and Plant Design: Cylindrical and Spherical Vessels; Theories of Failures; Types of Formed Heads; Crown and Knuckle Radius; Static and Dynamic Stresses; Longitudinal and Circumferential Stresses; Joint Efficiency.

2. Materials of Construction: Corrosion and Application of Corrosion Resistant Materials; Polyethylene, Poly propylene, Poly Vinyl Chloride; Rubber; Teflon; Glass; Cast Iron; Lead; Stainless Steel; Monel; Hestelloy; Nickle Alloys; Titanium Alloys; Insulating Materials.

3. Energy Resources and Conservation: Renewable and Non-renewable Energy Resources; Solar Energy; Fossil Fuels- Classification and Composition; Physico-chemical Characteristics and Energy Content of Coal, Petroleum, and Natural Gas; Wind Energy; Biomass and Biogas; Energy Use Pattern and Future Energy Needs; Energy Conservation Policies; **Combustion:** Ultimate Analysis of Coal; Proximate Analysis of Coal; Analysis of Fuel Gas; Heating Value of Fuels; Combustion Chemistry and Equations; Combustion of Solid, Liquid and Gaseous Fuels; Air for Combustion.

4. Inorganic Industries: Steam and Water: Water Treatment; Distribution of Water; Saturated and Superheated Steam; **Inorganic Industries:** Acids; Hydrochloric, Hydrofluoric, Hydrobromic, Sulfuric, Nitric Acids; Cement and Lime; Chloralkali; Nuclear; Explosives and Propellants; Fertilizers.

Part-B

1. Organic Industries: Petroleum Refining; Petrochemicals- Methane, Ethylene, Acetylene, Propylene, Butene; Polymerization Techniques; Chemicals from Aromatics; Herbicides Pesticides and Insecticides; Paint and Varnish; Oils, Soap and Detergents; **Fermentation Industries and Herbal Products:** Production of Alcohols; Mint and Essential Oils; Flavour and Fragrance.

2. Industrial Pollution Control- Wastewater Treatment: Sources, Type and Effects of Pollutants; Collection and Transport, Preliminary and Primary Treatment, Secondary Treatment, Tertiary Treatment, Sludge Treatment and Disposal, Selection of Treatment Strategies; Design of ETP for Industrial Wastewater Effluent from Paper, Tannery, Sugar, Distillery, Dyeing, Fertilizer, Pharmaceutical and Pesticide Industries.

3. Industrial Pollution Control-Air Pollution, Solid Wastes and Noise Pollution: Major Air Pollutants, Sources and Effects of Air Pollutants, Air Quality Standards; Air Quality Control- Treatment of Gaseous and Particulate Emissions, Dispersion of Pollutants; **Solid Waste:** Generation, Collection and Characterization of Solid Wastes; Reuse, Recycling and Combustion of Solid Wastes, Hazardous Wastes and their Management; **Noise Pollution:** Measurement of Noise; Effect on Human Health and Work Efficiency; Noise Abatement and Control.

4. Hazard and Risk Analysis and Safe Working Practices and Personnel Protection: Hazard Analysis; Risk Assessment and Management; Hazard and Operability Studies; **Fire and Fire Hazard:** Fire Prevention and Fire Fighting in Chemical Plants; **Safe Working Practices and Personnel Protection:** Handling, Storage and Transportation of Materials; Intrinsic and Extrinsic Safety; Safe Working Practices; Importance of Good House-keeping; Work-Place Safety; Personnel Protection Equipment; **Engineering Decisions:** Decisions Based on Technical, Cost/Effectiveness, Cost/Benefit, Risk, Environmental and Ethical Decisions.

Fire Engineering

Paper - I

1- BASICS OF CIVIL ENGINEERING- Introduction to Civil Engineering, General concepts related to building, Components of Buildings, Building Materials, Surveying, Instrumentation in Civil

Engineering Structures, Water Resources Engineering-Introduction to Hydraulic structures of storage; water conveyance systems; Watershed management: Definition, Necessity and methods; Transportation Engineering-Role of transportation in national development; Various modes of Transportation. Classification of Highways: Expressways, NH, SH, MDR, ODR, VR; Types of Pavements, Traffic Signs, signals, Parking system, and Causes of Accidents.

2- BUILDING PLANNING AND CONSTRUCTION-I- Behaviour of building materials and elements of structure under fire and fire fighting conditions, fire hazard, personnel hazard, damage hazard, fire precautions, fire precautions in relation to fire hazard, Grading of Occupancies to damage hazard with reference to fire load and fire resistance of elements of structure. Problems of High rise buildings and their safety measures. Behaviour of retardant structures under fire, Stairs, Sizes, layout and various kinds of stairs in different kinds of buildings.

3- BUILDING PLANNING AND CONSTRUCTION-II- Grouping of buildings on the basis of- Population, characteristics and occupancy, Precautions relating to personal safety in various occupancies; their constructional features, exists, staircase, their location and travel distance, maintenance and calculation of discharge value etc.

(i) Roof Exists:

(ii) Portable Means of Escape and their Maintenance.

2) Layout Plans, Scale Plan, Elevations and Sections, Sketch of a Fire. Activity. Sketch of Zone, Surrounding, Fire Incident at a Place.

3) Maps and Layouts, Survey, map, Schematic diagram, Contour map and Isometric projection.

4) Fundamentals of Fire Safe Building design; Systems concepts of Fire Safe Building design: Building and site planning for fire safety;

3- FLUID MECHANICS - Flow Through Pipes & Fire Fighting Hoses: Equations for pipe flow. Friction charts and their uses, Losses in pipes and fittings, Hydraulic gradient lines and total energy lines, Pipes in series and parallel. Siphon, Water hammer phenomenon. Economic of pipe systems. Power Transmission Through Pipeline: Condition for maximum power transmission through a given pipeline (single pipe), Relationship of nozzle diameter to pipe diameter for maximum power transmission.

4- AUTOMOBILE ENGINEERING- Classification, construction details of Engine Component Combustion in S.I. Engines. Combustion in C.I. Engines. Type of Study of diesel petrol gas fuel feed systems Transmission assembly. Types of Gear box, Transfer of gear box operation and maintenance of gear box. Propeller shaft. Axles, Types and Application Brakes type construction and Operation of Hydraulic Pneumatic Brake systems. Maintenance of brakes. Types classification of system Lubricants Cooling System- Air Cooling Water Cooling components and working of cooling system Ignition System Magnet Ignition Battery Ignition Electronic Ignition Merits and Demerits, Working. Self Starter, Dynamo voltage regulator, Battery construction, operation and maintenance. Construction, operation and Maintenance of fire fighting. vehicles and appliances.

Construction and operation of fire boats and other rescue and extinguishing appliances, Study of different types of chassis and superstructure, Rules and Regulations of R.T.O.

5- APPLIED ELECTRICAL ENGINEERING- Introduction to Power Generation (Thermal, Hydro, Nuclear, Wind, and Solar). Generation, Transmission & Distribution through different voltage levels; Low voltage distribution system (Over head & Underground, single phase & three phase), Definitions of luminous flux, luminous intensity, candle power, illumination, luminance, luminous efficiency (lumens/watt) of different types of lamps, AC motor, Three-phase Induction Motor Single Phase Induction Motors, Necessity of equipment earthings, Fuses (Rewirable & HRC), MCB, ELCB (Elementary concepts only), Basic operation of UPS & Invertors.

6- ELEMENTS OF ELECTRONICS & COMMUNICATION: Modulation: AM, FM and Phase, modulation principles and basic circuits, HFV & VHF transmitters, Demodulation of AM and FM. AM Receivers, Crystal, Tuned Radio Frequency (TRF) and super heterodyne receivers, Block diagrams and Principles. Ground Wave, Ionosphere, Duet Propagation, Antenna: Principles of Dipole antenna, Yago array, Directive and broad band Antennas, TV: Basic Principles of T.V. transmitters and receivers, Radio links, Principles of microwave links and satellite communication.

7- APPLIED PSYCHOLOGY- Psychology of learning: Fire-fighting skills as learned behavior, Principles of learning useful in the training of fire-fighting personnel, learning values and attitudes required in a successful fire-fighter; Fire-fighting as risk-taking behavior, Calculated-as-irratic risk-taking' Need for assessing risk-taking tendency in fire-personnel. Fire-site as a social situation victims, Spectators and fire personnel as its constituents, Human factors in occurrence of fire e.g. age, sex, education, social status and in mode of escape; General characteristics of, behaviour under panic; Characteristics of crowd behavior, General considerations in handling the spectators and the victims, without lowering efficiency. Fire-fighting as interactional situation; Importance of effective communication among the interacting elements; Fire-fighting as a team-work, significance of communication in the team members.

8- PARAMEDICS - Paramedics: definition; qualities of duties, tasks of a paramedics. Study of the human body and its various systems such as the system armascular systems, digestive system, respiratory system, circulatory system central nervous system, excretory system

9- FIRE CODES & STANDARDS- Specification of Rescue of fire fighting equipment. Technical parameter / specification specific reference to appliances. Code & Standards concerning construction & Design of building. Code and Practice for construction of temporary structures, pandal, Samiyana and scaffolding. International code & standard for Hydraulic platform. Turntable ladder and other Rescue and fire fighting devices and components. Code and Standard for passive fire protection system and materials. Code, Standard and specification concerning to safety of fire fighting personnel i.e., Breathing Apparatus P.P.E., safety gears and other devices. Code, Standard and byelaws concerning Industrial, Municipal and State life safety & fire protection measures.

10- FIRE SERVICE HYDRAULICS- Basic Principles of Hydraulics — Properties of water. water Pressure at a point, Measurements of pressure, hydrostatic forces - Total pressure and centre of pressure, - Bernoulli's Theorem and Applications, Hazen-Williams Formula, Pressure Loss in pipes and Fittings, Flow through nozzles, power transmitted through nozzle, condition for maximum transmission, nozzle reaction, water hammer, Introduction, main parts of centrifugal pumps, work done by centrifugal pumps on water, cavitation, Introduction, main parts of a reciprocating pump, working of a reciprocating pump, multistage centrifugal pumps, effect of velocity on friction in suction and delivery pipe, Automatic Sprinkler system- types of sprinkler system, sprinkler system in tall building, wall wetting sprinkler, design of sprinkler system, Reliability of sprinkler system, water spray and deluge system.

11- ARTIFICIAL INTELLIGENCE- What is AI?. The Foundations of Artificial Intelligence, Robotics — Tasks', application, Parts, Architectures, Configuration Spaces, Navigation and Motion Planning, **Fundamentals of Robotics/Fundamentals of Robot Technology, Programming and Applications Robot Technology: The Robot and its Peripherals: Control Systems and Components, Robotics Technology of the Future and Future Applications:** Robot Intelligence, Advanced Sensor Capabilities, Tele-presence and Related Technologies, Mechanical Design Features, Mobility, Locomotion and Navigation. The Universal Hand. Systems Integration and Networking, Characteristics of Future Robot Tasks. Future Manufacturing Applications of Robots. Hazardous and Inaccessible Non- Manufacturing Environments, Service Industry and Similar Applications, Summary, Foundation of Reasoning & Perception, on the Possibility of Achieving Intelligent Behaviour intentionality and Consciousness

12- URBAN PLANNING- Urban Growth and System of Cities. City — Region Linkages: City; fringe and the periphery, Metro and Mega Cities: Problems and Issues, Growth trends and processes, characteristics; problems, concepts and concerns of urban sustainability, Human Settlement Planning and Urban Development Concepts, Planning for under-ground development like metro rail, tunnels, market complexes and any other modern development. Water Supply and Sanitation: Quantity & quality, source of supply, transmission and distribution, treatment methods., design guidelines. Sanitation --- concept disposal systems, low cost sanitation options, engineering aspects of sewage disposal. Fire and Electrification: Planning for fire protection, services and space standards, location criteria Traffic and Transportation: Planning for infrastructure and facilities for transport.

Fire Engineering

Paper - II

1- FIRE RETARDANTS - Basic concepts of fire retardants, definition and terminologies, classification of fire retardants, flame spread, flame retardant. Difference between flame and fire retardant, Mechanism and principles of operation of fire retardant, Physical action, Mechanism and principles of operation of flame retardant, Fire retarding materials, Textile, composites, natural polymers, lignocellulosic materials & intumescent material. Application of halogen flame retardants, Graft Copolymerization as a tool for flame retardancy, performance based test methods for material flammability.

2- SPECIAL HAZARDS & FIRE PROTECTION-I- Constructional features of an Air Crafts and Helicopters, Basic Fire-Hazards, Nature of Air Crashes, Emergency landings including belly leading etc, Problems of rescue and fire-fighting in Aircraft & helicopter carrying ammunition, bombs, nuclear weapons etc, Crash Tender: Provision of Crash — Fire — tenders including Rapid Intervening appliances; Categorization of Air-Port, their extinguishing media. Constructional features of

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Passenger and cargo ship, shipyard and port. Hazards, preventive measures and tactical management. Constructional features of Passenger and goods train, yard, tunnels and railway station. Hazards, preventive measures and tactical management, Study of Layout and plan of Nuclear establishment, Hazards, preventive measures and tactical management.

3- FIRE MODELING- Modeling: Models and reality, properties of model, building a model, need of model. Linear programming and model formulation: structure of linear programming model, application of LP model, general mathematical model for linear programming problem, solution of LP model (Graphical and Simplex method), sensitivity analysis, Network Model — Project Management, Formation of Network, CPM & PERT analysis, Probability of Completion of Project, Cost Analysis of Project, and Concept of Crashing.

Fire modeling: Elements of fire, fire propagation, fire compartment, the fire flame and plumes, the hot and cold gas layers, burning regime estimate

4- FIRE CODES & STANDARDS: Specification of Rescue of fire fighting equipment. Technical parameter / specification specific reference to appliances. Code & Standards concerning construction & Design of building. Code and Practice for construction of temporary structures, pandal, Samiyana and scaffolding. International code & standard for Hydraulic platform, Turntable ladder and other Rescue and fire fighting devices and components. Code and Standard for passive fire protection system and materials. Code, Standard and specification concerning to safety of fire fighting personnel i.e., Breathing Apparatus P.P.E., safety gears and other devices. Code, Standard and byelaws concerning Industrial, Municipal and State life safety & fire protection measures, BIS codes as mentioned in national building code of India-2016 part 4, OISD guidelines for oil and gas installations.

5- FIRE SERVICE HYDRAULICS- Basic Principles of Hydraulics — Properties of water, water Pressure at a point, Measurements of pressure, hydrostatic forces - Total pressure and centre of pressure. - Bernoulli's Theorem and Applications. Hazen-Williams Formula, Pressure Loss in pipes and Fittings, Flow through nozzles. power transmitted through nozzle, condition for maximum transmission), nozzle reaction water hammer Introduction. main parts of centrifugal pumps work done by centrifugal pumps on water, cavitation, Introduction, main parts of a reciprocating pump, working of a reciprocating pump, multistage centrifugal pumps, effect of velocity, on friction in suction and delivery pipe, Automatic Sprinkler system- types of sprinkler system, sprinkler system in tall building, wall wetting sprinkler, design of sprinkler system, Reliability of sprinkler system, water spray and deluge system.

6- FIRE PROTECTION: Fire Resistant Construction, Construction materials — Steel, Steel Insulation, Concrete, Fire resistance calculations. Fire resistance tests — **Furnace exposure tests, Empirical correlations, High intensity fire resistance tests.** Fire Walls — General criteria for fire walls, Fire wall design, Fire wall loss experience. **Fire doors** — Types of fire doors, Fusible links and detectors, Reliability issues. **Insulated metal deck roofing** — Description, Tests and classifications, Water spray protection of exposed structures, Smoke Production & Properties, Particle size of **smoke** from burning wood and plastics, Smoke Aerosol Properties, Visibility, Smoke isolation and venting, Isolation and suppression within ventilated equipment. **Building smoke control** — Buoyancy pressure differences, Volumetric expansion pressures, Isolation via ventilation exhaust, Upstream smoke propagation, Door and damper smoke leakage, Heat and smoke roof venting.

7- SPECIAL HAZARDS & FIRE PROTECTION-II- Flammable liquid ignitability and extinguish ability, Flash points and fire points, Auto ignition temperatures, High flash point, liquids, Water miscible liquids, Low flashpoint liquids Low Expansion Foam, Medium, and high expansion foam Dry Chemical and twin agent. extinguishment Carbon dioxide suppression,; Halon replacement suppression agents, **Flammable liquid storage: Storage Tanks** — Generic tank designs, Storage tank loss history and fire scenarios, Fire protection of oil Tank Farm area, Electrical cables and equipment, Electrical cables: Generic description, Cable fire incidents' Cable flammability testing and classifications, **Cable fire suppression tests** — Sprinkler and water spray suppression tests, Gaseous suppression system tests, Electronic component flammability, Detection and suppression of electronic equipment fires-, Transformer generic description, Transformer fire scenarios, Transformer fire incidents, Installation and fire protection guidelines **Blast Waves:** ideal blast waves, Pressure vessel ruptures, Vapour cloud explosions, Vented gas and dust explosions.

8- FIRE & SMOKE DYNAMICS: Fuels and the combustion process, The physical chemistry of combustion in fire, Burning of liquids and burning of solids.

Ignition of flammable vapour/air mixtures, Ignition of liquids, The phenomenology of flame spread, Theoretical models of flame spread, Spread of flame through open fuel beds, Applications, Spontaneous ignition in bulk solids, Smouldering combustion, Glowing combustion, The, growth period and the definition of flashover, Growth to flashover, Fire resistance and -fire severity, Methods of calculating fire resistance, Projection of flames from burning compartments, Spread of fire from a compartment, Production and measurement of smoke, Smoke movement, Smoke control systems.

9- PASSIVE FIRE SAFETY MEASURES: Terminology used in Buildings and different occupancies. Occupancies, General requirement in the building. Types of construction, Fire resistance ratings of materials. Affecting factors of Means Of Escape and Structural Fire Safety, Compartmentation, Fire separation wall, Smoke Extraction systems Analytical method of fire resistance of steel members concrete members, Timber member and other affecting component/parts of buildings.

10- FIRE LAWS: The Law and the Fire Service, The Law suit process, Judicial System, Legislatures and Statue, Doctrine of Sovereign immunity; Governmental liability in India with reference to the Indian Constitution, Code and code enforcement, Standards and the Law, Model Fire Service Legislation, its scope and object, The Petroleum Act of 1934, Calcium Carbide Rules, Cinematograph Act, 1938, Factories Act of 1938, Explosives Rules of 1940, Fire Safety Act, Factories Act and Civil Right Act. General Principles of Compensation Laws and Fire Insurance Assessment and Case studies, Occupational Safety and Health Act (OSHA), Disaster Management Act -2005, Uttar Pradesh Fire prevention and Fire Safety act-2005 and rules, National building Code -2016.

11- DESIGN & INSTALLATION OF DETECTION AND FIRE FIGHTING SYSTEM: Provisions & applicable standards of detection and alarm system, Introduction of detection devices, alarm and detection system, Type of detectors, Method of selection, design, installation, testing and commissioning of alarm and detection system, Hydraulic Calculation, Design of hydrants, wet riser and dry riser system, Design of Sprinkler system: types of Sprinkler Systems, Calculation of Spray systems based on hazards, Design, Calculation and installation of fire pumping system based on standard norms and procedure, Installation, Testing and Commissioning of water based fixed fire fighting system. Classification and property of foam, gases and dry chemical powder. Provisions & applicable standards of foam, gases and dry chemical powder based systems, Identification, Hydraulic Calculation and Design of foam system, foam application method, Description, number and placement of foam application devices, Selection of foam agent, Rate of application of foam solution, Rate of foam concentrate, Identification and Design of clean agent based system. Design of Fire Alarm System, purpose, general requirements, operation, types of fire alarm system and their maintenance.

12- FIRE & ARSON INVESTIGATION: The nature and behaviour of fire: Elements of Combustion, Flaming and Glowing Fire, Explosive Combustion, Heat Transfer, Sequence of Room Fire, Effects of Environmental Conditions, Combustion Properties of Liquid & Gaseous Fuels. Combustion Properties of Solid Fuels, Source of Ignition: Primary Igniter, the role of services and appliances in starting fire, Structure fire & their investigation: Elements of building construction, General principals of fire behaviour, Investigative information during suppression, Examination of structure fire scene, Documenting the fire scene, Grass and Wild Fires, Automobile Motor Vehicle and Ship Fires, Electrical causes of Fire, Clothing & Fabric Fire, Explosion & Explosive Combustion, General Fire Evidence, Identification of Charred or Burned Materials & Documents, Failure Analysis-Forensic Engineers, Evaluation of Appliances & Wiring, Miscellaneous Laboratory Test, Chemical Incendiaries Non-Fire-Related Criminal Evidence: Fingerprints, Blood, Impression Evidence, Trace Evidence.

Hydraulics Engineering Paper-I

Fluid Mechanics

Flow characteristics, Classification, Fluid properties, Fluid pressure and its measurement, Continuity equation, rotational and irrotational flow, vorticity, velocity potential and stream function, flow net, Euler's equation, Bernoulli's equation and its applications, Darcy-Weisbach equation, energy losses in pipelines, equivalent pipes, multiple pipe systems, siphon. Laminar and Turbulent flows, Laminar flow in parallel plates, pipes, characteristics of turbulent flow, Concepts of boundary layer, Dimensional homogeneity, Buckingham's π theorem, geometric, Kinematic and dynamic similarity, model studies, Types of open channels, classification of flows, concept of specific energy, critical depth, Chezy's and Mannings equation, roughness coefficients, equivalent roughness, Hydraulically efficient channel cross sections.

Equation of fluid flow - Conservation of mass, conservation of momentum, stress and strain in fluid flow and their relations, conservation of energy, work done due to viscous stress, Navier stokes equations, Three dimensional Continuity equation in Cartesian, Laminar flow of viscous incompressible fluids, Flow between parallel flat plates, Couette flow, plane Poiseuille flow, flow in cylinders, in rotating cylinders, flat plates; Boundary layer equation, Blasius solution, shear stress and boundary layer thickness, boundary layer on a surface with pressure gradient, momentum integral

theorem for boundary layer, separation and its prevention by boundary layer suction; Concept of linearized stability of parallel viscous flow, transition to turbulent flow, Reynolds equation for turbulent flow, Reynolds stresses, Prandtl's mixing length theory, velocity profile, turbulent flow in pipes, turbulent boundary layer on flat plate; Inviscid flow, Elementary plane flow solutions, uniform stream, source or sink, vortex. Superposition of plane flow solutions, flow over wedge and circular cylinder.

Hydrology

Introduction to Hydrology, study and analysis of the basic processes of hydrology of watershed including the theory, measurement and application of mathematical, statistical and graphical techniques associated with each of phenomena; Run off hydrographs and unit Hydrographs for complex storms; synthetic and instantaneous hydrographs; Flood estimation and routing -Modern techniques; prediction of peak flow and snowmelt; yields from basins; Introduction to Hydrometeorology: Agro-climate; Climatic parameters; Instrumentation; Data recording and Trend analysis.

Hydraulics

Introduction to flow in open channels, Uniform flow and critical flow, Gradually varied flow — Theory and flow computations with special reference to compound sections, Flow profiles; Rapidly varied flow — Energy-depth relationships, Hydraulic Jump — prismatic and non-prismatic channel, Hydraulic jump as energy dissipators, Crested weirs, ogee spillway; Culvert hydraulics; Sluice gate flow; Spatially varied flow with increasing and decreasing discharge, Side weirs, Bottom racks; Channel design, Silt theories — Kennedy's and Lacey's, Erodeable and non-erodeable channels; Introduction to River Hydraulics, Sediment transport, River mechanics, river erosion, river training works, Dams — purpose, classification and site identification; Hydraulic models — Concept, Classification, Applications, & Modelling.

Fluid properties, Forces on submerged objects, Similitude and dimensional analysis, the energy equation for an ideal fluid. Introduction to flow in open channels- Velocity profiles, the energy equation applied to real fluids, Flow resistance, Computations for steady, uniform flow. Flow in channel sections with variable roughness, the momentum principle, Specific energy. Gradually varied flow in open channels, Determination of flow resistance in open channels, Classification of water-surface profiles, Local energy losses in natural channels, Water-surface profile computations. Discharge computations for rapidly varied flow, Rapidly varied flow at constrictions, Flow through culverts, Flow over weirs.

Groundwater Hydrology

Introduction to groundwater resources, occurrence and movement, Aquifers and their characteristics/classification, - Surface investigation - Geophysical -electrical resistivity - Seismic refraction - Gravity and magnetic - Geologic - Air photo interpretation - Dowsing. Subsurface investigation - test drilling -resistivity logging- potential logging - temperature and caliper logging, Darcy's law, Dupit's assumptions; Flow nets, Groundwater tracers, Well hydraulics —steady/unsteady, uniform/radial flow to a well in a confined/unconfined/leaky aquifer, Well flow near aquifer boundaries/for special conditions; Groundwater levels, Quality of groundwater, Contaminant transport processes, Advection-dispersion equation, Treatment of contaminated groundwater, Climate change and groundwater; Introduction to Groundwater flow modelling, Governing equations, Finite difference solutions, Surface and sub-surface investigations, Artificial recharge, Saline water intrusion in aquifers

Hydro Power Engineering

Planning of Hydropower development; Hydropower potential; Operation of power plants for peak and base load; Characteristics of power market; Integration of various types of plants; Augmentation of power plants; Different types of hydro power plants; Small hydro power plants; Flow duration curve and its characteristics; Classification of modern turbines, efficiency, speed regulation, governors, coupling of turbines and generators. Types of power houses; Silting of reservoir, dead storage and useful life, rate of sedimentation, distribution of reservoir deposits, silt control. Surge tanks and hydraulic transients; Penstocks and pressure shafts; Intakes; Reservoir operation for hydropower generation in multipurpose projects; Basin scale hydropower development; Mathematical models for reservoir sizing and operation.

Hydraulic Machinery

Principles of impingement of jets - Impact of jet on a stationary vertical plate, stationary inclined plate, stationary curved plate, hinged plate, moving vertical and inclined plates, moving curved plate and on series of moving flat and curved vanes fixed on the periphery of circular rim. Turbines - classification-impulse turbines - Pelton wheel - Reaction turbines - Francis and Kaplan Turbines - draft tubes - Governing of a Francis turbine - Performance of turbines - specific speed and their significance. Centrifugal pump - description and working - Head, discharge and efficiency of a centrifugal pump - pressure rise in the pump - minimum starting speed of a pump - cavitation - priming -multistage pumps - characteristic curves. Reciprocating pump - Description and working - types - discharge and slip - power required to drive the pump -Indicator diagram - Air vessel - work done against friction with and without air vessels. Working principle and use of the following hydraulic pumps and machines - Deep well pumps - submersible and jet pumps, special pumps - Gear pump - screw pump, sewage pump, miscellaneous machines - Hydraulic press - hydraulic accumulator - Hydraulic ram.

Hydraulics Engineering Paper-II

Water Resources Engineering

Hydrologic cycle - rainfall, and its measurement - computation of mean rainfall over a catchment area using arithmetic mean, Thiessen polygon and Isohyetal methods - Runoff -infiltration indices - Storm Hydrograph and unit hydrograph River regions and their characteristics - classification of rivers on alluvial plains - meandering of rivers - river training Reservoir planning - Investigations -zones of storage in a reservoir - single purpose and multipurpose reservoir -determination of storage capacity and yield - reservoir sedimentation -Reservoir life - Sediment prevention - Flood estimation- Flood forecasting -Flood routing.

Ground water - types of aquifers - storage coefficient - coefficient of transmissibility - steady radial flow into a well located in an unconfined and confined aquifers - Tube wells and Open wells - yield from an open well. Water logging - causes and effects of water logging - remedial measures - land reclamation - land drainage - benefits - classification of drains - surface drains -subsurface drains - design principles and maintenance of drainage systems.

Water Resources Planning & Management

Historical profile on world water resources development; Global water resources, Hydrologic cycle, Watershed zoning, Interrelation of water resources with other natural resources and the environment, Water quantity and water budget, Water allocation and water scheduling; Watershed management, Rainfall-Runoff analysis, Floods measurement, frequency analysis, design of peak flood and routing, Reservoir operation and design; Water resources availability and demand, Water use sectors — Domestic, Industries and Agriculture, Sustainable water resources development, Integrated Water Resources Management (IWRM), Socio-economic aspects of water resources management, Rainwater Harvesting; Water resource planning — concept, preliminary study, feasibility study, detailed planning, Design of water distribution system, Irrigation scheduling and techniques; Hydrologic Processes precipitation, evaporation and transpiration. Water quality parameters. Water pollution — causes, effects and measures., Global Efforts on Water conservation. Think Globally Act Locally on water resources, Local water organizations. National Water Policy, World water, organizations. Environmental Considerations on dam Construction.

Irrigation And Hydraulic Structures Irrigation - necessity –

Types of irrigation - Methods of supplying water -Assessment of irrigation water - Consumptive use and its determination - water requirement of various crops - Duty - Delta - Base period and crop period. Functions and components of a diversion head work - Function - selection of site - type of weirs on pervious foundations - cause of failure - Bligh's creep theory and. Khosla's theory -complete design of a vertical drop weir. Gravity dams - Non overflow section - forces acting - stability rules - elementary profile - Low and High dams - drainage gallery - Construction joints - Earthen dams -stability of slopes by slip circle method - seepage analysis and its control Types of canals - canal alignment - Kennedy's silt theory - Lacey's silt theory - Design of canals using the above theories - economical depth of cutting - canal losses - canal maintenance - lined canals, and their design - silt control measures. Canal falls - Necessity and location - Design of sand type fall - design of a cross regulator - cross drainage works - selection of suitable type of cross drainage work - canal outlets

River Mechanics and Sediment Transport

Introduction to river mechanics, Width-to-depth ratio of a river, Two-phase motion and its dimensionless variables, Mechanical properties of flow, Aggrading rivers, Degradating rivers, Meandering rivers, Bed Forms; Regime Channels, Channel roughness and resistance to flow, Tractive force method of stable channel design, Erosion, deposition, scour; Local scour problems; Introduction to sediment transport, Threshold of particle transport - critical velocity and critical shear stress concepts, Sediment movement in water, Principles of transport of solids in pipes, Principles of movement of sediment by waves tides and currents; Sediment Load, Bed load estimation - du Boys, Shields, Meyer Peter, Einstein bed load function, Yalin's formula, Paintal stochastic approach, Suspended load - diffusion theory, Total sediment load by Kalinake, Latest models in sediment load assessment.

Watershed Management

Concept of watershed development, objectives of watershed development, need for watershed development in India, Integrated and multidisciplinary approach for watershed management. Characteristics of Watershed - size, shape, physiography, slope, climate, drainage, land use, vegetation, geology and soils, hydrology and hydrogeology, socio-economic characteristics, basic data on watersheds. Principles of erosion, Types of erosion, factors affecting erosion, effects of erosion on land fertility and land capability, estimation of soil loss due to erosion, Universal soil loss equation. Measures to Control Erosion, Contour techniques, ploughing, furrowing, trenching, building, terracing, gully control. rockfill dams, brushwood dam. Gabion. Rainwater Harvesting, catchment Harvesting, Harvesting structures, soil moisture conservation. Check dams artificial recharge, farm ponds, percolation tanks. Land use and Land capability classification, management of forest, agricultural, grassland and wild land. Reclamation of saline and alkaline soils. Role of Ecosystem, crop husbandry, soil enrichment, inter, mixed and strip cropping, cropping pattern, sustainable agriculture, bio-mass management, dry land agriculture, Silvi pasture, horticulture, social forestry and afforestation. Planning of watershed management activities, peoples participation, preparation of action plan, administrative requirements.

Water Harvesting Techniques:

Design of small water harvesting structures- Types of storage structures- Yield from a catchment- Losses of stored water. Water conservation practices-manuals and guidelines.

Environmental Hydrology

Basic concepts of environmental hydrology; water cycle, water balance and hydrological processes; environment and water; hydrology and climate, physical and biological interactions; water-related environmental problems; hydrological characteristics of India; drinking water, drinking water regulation and standards, water testing; forest hydrology, hydrological processes in forested area; urban hydrology, urbanization and hydrological processes, runoff process and flood; storm water storage and infiltration, reconstruction of urban water cycle; domestic, industrial, commercial, agriculture, and public water uses; water rights and development; water pollution and water quality policy, point and non-point source pollution and control, self-purification; groundwater pollution, background and measurements of groundwater contamination, sources and fate of contaminants, organic solvents, phosphate and nitrate, remediation.

Fluvial Hydraulics;

River morphology- and its characteristics.- Channel configurations such as straight channel, meandering channel, braided channel- Transitions- Cutoffs-Deltas. River behaviour Channel geometry- equilibrium, aggradations and degradation- Effects of long contraction- Effects of over bank flow- Super critical flow in rivers.

Stream profiles and bed material- erosions- Importance of bank erodability. Stabilization and rectification of rivers: Alignment- Radius of curvature-Revetments- Hydraulic models for river engineering.

Stable channels carrying sediment laden water in Alluvial Materials- Blench's Design Methods Tractive Force Method of Design- Application of optimization principles to channel design.

Sediment Engineering: Origin and formation of sediments- Fundamental properties of individual sediment particle- Bulk properties of sediments. Regimes of flow: Description of regimes of flow, origin and characteristics, importance.

River classifications and its hydraulic geometry, geomorphic analysis; Fundamentals of alluvial channel flows, uniform and unsteady cases, shear stress distribution, flow resistance in rivers; properties of sediments, sediment movement in rivers, shear stress, Shields diagram, scouring around bridge piers and embankments, river bed forms; Analysis of river meanders, design of stable alluvial channels-regime concept, dimensional model studies for rivers, braided rivers, scaling and hierarchy in braided rivers, alternate bars, bed load transport in braided gravel-bed rivers; Stream bank erosion, bank protection, flow control structures, bank protection and river training along braided rivers.

Electronics Engineering

Paper-I

Basics of Semiconductors: Energy bands in intrinsic and extrinsic semiconductors, band-gap semiconductors, P-N junction, Zener diode, Diode circuits for different uses; clipping, clamping and rectifiers. Small signal equivalent circuits of diodes,

Junction & Field Effect Transistors (BJTs, JFETs, MOSFETs): Transistor characteristics and biasing, Transistor amplifiers of different types; BJTs and FETs; Biasing & stability of BJT & JFET amplifier circuits; Analysis/design of amplifier- single/multi-stage.

Basics of Integrated Circuits (ICs): Bipolar, MOS and CMOS ICs; Basics of linear ICs, operational amplifiers and their applications-linear/non-linear; Optical sources/detectors; Basics of Opto electronics and its applications.

Operational amplifiers: Op-amp circuits: Amplifiers, summers, differentiators, integrators, active filters, Schmitt triggers and oscillators. Function generators, wave-shaping circuits and 555 timers; Voltage reference circuits; Power supplies: ripple removal and regulation.

Network Theory and Basic Machines:

DC circuits-Ohm's & Kirchoffs laws, mesh and nodal analysis, circuit theorems; Single-phase AC circuits; Network graphs & matrices; Wye-Delta transformation; Linear constant coefficient differential equations-time domain analysis of RLC circuits; Solution of network equations using Laplace transforms- frequency domain analysis of RLC circuits; 2-port network parameters-driving point & transfer functions: State equations for networks; Steady state sinusoidal analysis.

Basics-DC machines, induction machines, and synchronous machines. Transformers and its efficiency.

Digital Electronics:

Number representations: binary, integer and floating-point- numbers.

Combinatorial circuits: Boolean algebra, minimization of functions using Boolean identities and Karnaugh map, logic gates, arithmetic circuits, code converters, multiplexers, decoders. Sequential circuits: latches and flip-flops, counters. shift-registers. Data converters; sample and hold circuits, ADCs and DACs.. Basics of multiplexers. counters/registers/ memories /microprocessors, design& applications.

Control Systems: Basic control system components; Feedback principle; Transfer function; Block diagram representation, Transforms& their applications; Signal flow graph; Frequency response; Routh-Hurwitz criteria, root loci, Nyquist/Bode plots; Feedback systems-open &close loop types, stability analysis, steady state. transient and frequency response analysis; compensation; Lag, lead and lag-lead . State variable model and solution of state equations of LTI systems. Transient and steady-state analysis of LTI systems.

Analog communication Systems: AM, FM, transmitters/receivers, amplitude modulation and demodulation, angle modulation and demodulation. Spectra of AM- and FM, superheterodyne receivers.

Digital communication basics; Sampling. quantizing. Cooling PCM. DPCM, multiplexing-audio/video; Digital modulation: ASK, FSK, PSK: Multiple access: TDMA, FDMA, CDMA:

Instrumentation: Principles of measurement. Accuracy, precision and standards; Analog and Digital systems for measurement. Measuring instruments for different applications. Static/dynamic characteristics of measurement system, errors, Statisticals analysis and curve fitting.

Electronics Engineering

Paper-II

Electromagnetics:

Elements of vector calculus, Maxwell's equations-basic concepts- differential and integral forms and their interpretation; Gauss', Stokes' theorems; Poynting vector: Wave propagation through different media; Transmission lines: equations, characteristic impedance, impedance matching, impedance transformation, S-parameters, Smith chart. Waveguides-basics, rectangular types, modes, cut-off frequency, dispersion, dielectric types; Antennas-antenna types, radiation pattern, gain and directivity, return loss, monopoles/dipoles, gain, antenna arrays.

Computer Organization and Architecture:

Basic architecture, CPU, I/O organization, memory organisation. peripheral devices, trends; Hardware/software issues; Data representation& Programming: Operating systems-basics, processes, characteristics, applications. Microprocessors & microcontrollers basics, interrupts, DMA, instruction sets, interfacing: Controllers & uses: Embedded systems.

Advanced Electronics:

VLSI technology: Processing, lithography, interconnects, packaging, testing; VLSI design: Principles, MUX/ROM/PLA-based design, Moore & Mealy circuit design; Pipeline concepts & functions; Design for testability, examples.

Digital Signal Processing: Discrete time signals/systems. uses; Digital filters: FIR/IIR types, design, speech/audio/radar signal processing uses;

Communication networks: Principles/practices/technologies/uses/OSI model/security; Basic packet multiplexed streams/ scheduling; Cellular networks, types, analysis. protocols (TCP/TCP/IP).

Random signals and processes: autocorrelation and power spectral density, properties of white noise, filtering of random signals. **Information theory:** entropy, mutual information and channel capacity theorem, Huffman coding, algebraic and convolutional coding.

Microwave & satellite communication: Terrestrial/space type LOS systems. block schematics link calculations, system design; Communication satellites. orbits, characteristics, systems, uses; Fibre-optics-Light propagation in optical fibre, fibre optic communication: fibre optics, theory, practice/ standards, systems, block schematics, link calculations, system design.