

JUNIOR ENGINEER

SYLLABUS: CIVIL ENGINEERING

PART- I and II



1. Measurements:

Area and Volume, Force and Energy, Pressure, Velocity, density, length and square measure, metric measure of (liquid, volume, weight)

2. Surveying:

Chain survey, plane table survey, compass survey, leveling and contour survey, and theodolite survey.

3. Strength of Materials:

Definition of determinate and indeterminate structure, calculation of reaction, bending moment and shear force of simple determinate structure, stress, strains, elasticity, impact, moment of inertia, Newton's Laws of Motion, forces of motion, friction, velocity, acceleration due to gravitational forces.

4. Soil Mechanics and Foundation:

Engineering Properties of soil, calculation of bearing capacity of soil, various types of foundation, causes of failure of foundation and remedial measures, design of foundation, design of isolated footing.

5. General Masonry (Design G Construction):

Safe permissible loads on masonry, design of retaining and breast walls, abutments, wing wall, and toe walls, causes of failure of retaining wall, and remedies.

6. R.C.C. Structure:

Theory of reinforced concrete, properties and strength of concrete, requirements of structural concrete and reinforcing steel, shearing and anchorage, cutting and bending of bars, concrete covering to reinforcement, physical properties of the concrete and material for the concrete mix, curing of concrete, limit state design principles for RCC slabs, beams, and columns.

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7. Hydraulics:

Hydraulics data, general principle of measurement of discharge through notches, orifices, weirs, flow formulas for open channels, drains and pipes, Chezy, Bazin, Manning, Kotter, Hazen-William's formulae for calculation of maximum discharge, Bernoulli's Theorem of Hydraulic gradients, and different kinds of head loss.

8. Water Supply:

- i. Drinking water qualities: common impurity effects and remedial measures, hard and soft waters. Different types of sources of water and its extraction.
- ii. Water Purification Treatment: Storage settling basins, sedimentation tanks, coagulation, flocculation, sterilization, chlorination, colour and taste removal, filtration, slow sand filters, negative head, rapid sand aeration, monitoring, and analysis of water quality.
- iii. Storage of Water: pure water storage and service reservoirs, domestic storage tanks, elevated and underground tanks, pressure equalizing reservoirs, cisterns, simple design of water storage tanks.
- iv. Distribution of Water: consumption and demand of water for domestic and public purposes; leakage and wastage of water and its prevention methods; different methods of distribution; boosting water gravity and pressure. Distribution of storage tanks, design of mains, taps, economical velocities of mains and distribution pipes, service connections from mains, house services design, fittings, fire hydrants, and stand posts, design of distribution system—losses of pressure in a distribution system. Intermittent and constant systems of supply, laying and testing of new pipelines, corrosion of water mains, various fittings, water taps, and valves.
- v. Pipes of Different Metals: Choice of materials for piping like cast-iron, steel, wrought iron, galvanized, lead, copper, cement concrete, and asbestos pipes.
- vi. Pumping water, suction and delivery pipes, water pumps: types of pumps, pumps used in various classes of water works and engineering services, power for working pumps, diesel, gasoline, electric, efficiency tests of pumps, fuel required

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for plants, centrifugal, turbine, reciprocating pumps.

- vii. Design of Pumping Stations, Groundwater, and Wells: Water-bearing strata, measurements of velocity of flow of groundwater, yields of the wells, tests for yield of a well, construction of tube-wells, ring wells, methods of boring, strainers, household tube wells, open wells, well linings, and cavity wells.

9. Drainage:

- i. Surface Drainage and Runoff: Calculation of catchment areas, surface runoff for design of drainage.
- ii. Design of Town Drains C Sewers: systems of drainage, combined and separate systems, open drains in small towns, shape of street drains, size of sewers. Storm water flow, rainfall data, self-cleansing velocity, domestic drains, flushing of drains C sewers, design of drains.
- iii. House Drainage: Different systems of plumbing for building drainage, one and two pipe systems, sanitary fixtures, traps, inspection chambers, house drains, anti-siphonage vent pipe, toilet, sizes of pipes and traps for house drains, testing drainage pipes for leakage, smoke test, water test, different types of pipes, soil rainwater pipes. Flushing pipes, sanitary latrines, water-sealed latrines, septic tanks and soak pits.
- iv. Plumbing and internal fixtures, joints for various kinds of pipes.
- v. Household Disposal Work: Septic tanks, disposal of effluent from septic tanks.
- vi. Cesspools and seepage pits, simple designs.

10. Timber Structures:

Structural properties of timber, seasoning of timber, decay and its preservation, types and classification of timber trusses, beams.

11. Steel Structure:

Structural properties of steel and limit state design of simple beams, columns, tension and compression members, loading for design of roof truss, different types of roof truss, and design of truss members.



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12. Roads and Bridges:

Cross drainage, culverts, guidelines for location and alignment of bridges, type of bridge foundations, abutments, and wing walls.

13. Estimate & Costing:

Rate analysis of items of work, analysis of cost of transportation of materials, calculation of detailed quantities of items of work, estimation of cost of projects.

14. Highway and Transportation Engineering:

Classification of roads, alignment of roads, geometric designs of roads and factors governing geometric design, ruling gradients, exceptional gradient on curves, hairpin bend, camber, design of curves, superelevation, types of pavements, components of pavement and factors governing design of pavement, method of construction of embankment, water-bound macadam, wet-mixed macadam, and bituminous macadam. Introduction to Hill Road and Hill Road drainage system.

15. Introduction to Earthquake Engineering:

Earthquake, cause of earthquake, terminology of earthquake engineering such as focus, epicentre, magnitude, intensity, seismic zoning map of India, detailing of beam and column.

16. Flood Control Structures and River Training Works:

Structural and non-structural measures to mitigate flood, flood control structures like guide bund, marginal bund, spur, revetment, etc. Design flood, flood forecasting, and flood warning.

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SYLLABUS: MECHANICAL ENGINEERING

PART-I



1. Principles of Mechanical Engineering:

Study of hand tools for workshop practice, machine components. Transmission system belt, chain, rope and gear drives, process equipment like compressors, blowers and fans. Automobiles and their components and auxiliary system. Practice on welding, automobile maintenance and dismantling and assembling of machine components.

2. Applied Mechanics:

Free body diagrams and equilibrium, friction and its application, centre of gravity, moment of inertia, trusses and frames, combined motion of rotation and translation, balancing of rotation masses, central force motion and satellite motion, transmission of power by belt and gear drives.

3. Basics of Hydraulics:

Properties of liquid, Hydraulic pressure and its measurement, flow of liquids. Steady, unsteady, laminar and turbulent flows Orifice, mouthpiece and nozzles, flow through pipes, fundamentals of channel flow.

4. Hydraulics Machinery:

Flow measurements: different types of pumps; reciprocating and rotary pumps; operation and maintenance of pumps; characteristics curves of pumps efficiency of pumps; different types of (turbines) Francis, Kaplan and Pelton turbines operation and maintenance of turbines; flow through turbines, characteristic curves, work done and efficiency of turbines.

5. Machine Drawing-II:

Drawing of gear, gear boxes, lathe and milling machine components, Drawing of miscellaneous machine parts of pumps, engines, compressors, etc.

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6. Fundamentals of Mechanical Engineering:

Introduction to engineering thermodynamics, power generating equipment's like boiler, turbines and IC engines, Power transmission device: belt and gear drives, study of power plants, materials handling equipment's, fabrication methods like riveting and welding.

7. Materials and Material Science:

Engineering materials, mechanical, thermal, chemical and manufacturing properties, structure of materials, alloys, phase diagram.

PART-II

1. Basics of Mechanical Engineering:

Introduction to engineering thermodynamics, power generating equipment's like boiler, turbines and I.C engines. Power transmission devices. Introduction to fluid and fluids machineries.

2. Machining Processes:

Fundamentals of metal cutting, calculations of cutting and tool life, general purpose machine tools and their operations. Newer and advanced machining processes like USM, LBM, EDM, ECM and CNC machines.

3. Thermal Engineering:

Ideal gas compression and compressors, steam generators. Fuel and combustion, IC engines, cycles calculation of efficiencies, open and closed gas turbine cycles. Introduction to heat and mass transfer. Refrigeration cycles. Testing of IC Engines, turbines and compressor. Determination of fuel properties.

4. Refrigeration and Air Conditioning:

Principles of refrigeration, air refrigeration systems, vapour compressed and absorption refrigeration system, refrigerating equipment's, psychometry, refrigerants, principles of air conditioning, humidification and dehumidification, summer and winter air conditioning, industrial and comfort air conditioning, effective temperature, ventilation

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requirements. Experiments related to vapour compression, vapour absorption systems, vortex tube, cooling tower.

5. Power plant Engineering:

Types of Power plants, components of steam power plants, details of diesel generating set, gas turbine power plants, nuclear power plants, hydel power plants, non-conventional sources of power generation, load distribution and calculation of power tariffs. Design and drawing of plant layout, power plant equipment's, and other related factors.

6. Mechanics of Materials:

Stress, strain, elastic constant, Poisson's ratio, Thermal stresses, Mohr's circle for plane stress and plane strain, shear force and bending moment diagrams, bending and shear stresses, deflection of beams, torsion of circular shafts, Column theory and theories of failure.

JUNIOR ENGINEER

SYLLABUS: ELECTRICAL ENGINEERING



PART-I

1. Electrical Material:

Conducting Material: Atomic structure, properties, composition and application of conductors, semiconductors and insulators.

Magnetic Material: Type and uses of magnetic materials, permeability, B-H curve of magnetic materials, magnetic field intensity, magneto-motive force, reluctance, Hysteresis loop, Ferrite cores.

Insulation Material: Electrical, Thermal and mechanical properties of various insulators. transformer oil, SF₆ PVC, Bitumen's, quartz etc. Electrical components: Different types of resistors capacitor, inductor and reactors. Electromagnetic and Electrostatic shielding.

2. Electrical Circuits:

Single Phase A.C Series and parallel Circuits: Generation of alternating voltage, Phasor representation of sinusoidal quantities, L, C circuit elements its voltage and current response R-L, R-C, R-L-C combination of A.C series circuit, impedance, reactance, impedance triangle, Power factor, active power, reactive power, apparent power, power triangle and vector diagram Resonance, Bandwidth, Quality factor and voltage magnification in series R-L, R-C, RL-C circuit

Three Phase Circuits: Phasor and complex representation of three phase supply, Phase sequence and polarity, Types of three-phase connections, Phase and line quantities in three phase star and delta system, Balanced and unbalanced load, neutral shift in unbalanced load, three phase power, active, reactive and apparent power in star and delta system.

Source transformation, Star/delta and delta/star transformation, Mesh Analysis, Node Analysis, Superposition theorem, Thevenin's theorem. Norton's theorem, Maximum power transfer theorem, Reciprocity theorem, Duality in electric circuit

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3. Electrical Measuring Instruments.

Principles of measurement classification accuracy and sensitivity, damping, deflecting force and control forces. Shunt and multiplier, DC potentiometer, AC potentiometer, Moving coil, Moving iron, megger, Electrodynamometer type, induction type ammeter, voltmeter, wattmeter, energy meter; megger, frequency meter, power factor meter.

4. Electrical Machine-I

Electromechanical Energy Conversions: Elementary concepts of electrical machines, classifications, its common features, basic principles of generator & motor, torque due to non-alignment of two magnetic fields, EMF induced in a coil rotating in a magnetic field.

DC Machines: Constructional features and working principle of DC machine as a generator and a motor; Types DC machines; EMF equation of generator, building up of emf, relation between EMF induced and terminal voltage enumerating the brush drop. The concept of armature reaction, inter poles; Back EMF and its significance, analogy of back EMF with armature reaction, torque equation, Types of DC motors, characteristics and applications.

Speed Control of DC Motor: DC Motor Starters. Conventional methods for speed control of DC motor.

Transformers: Introduction, constructional details and working principle, emf equations, phasor diagrams, equivalent circuits, losses, efficiency and condition for maximum efficiency, rating of the transformers, autotransformers & its applications, parallel operation of transformers, 3-phase transformers, instrument transformers.

5. Electrical Estimating and costing.

Estimating: Estimates; abstract, detailed (main & sub) supplementary and revised estimate. Work contract (Lumpsum, schedule & piece work contract).

Tender: single, limited, open, global, security deposit, general condition and technical specification, measurement books. Preparation of estimate for small low and medium voltage installation. Inventory control.

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Estimating and its procedure of estimating plan: specification, electrical schedule, types of load, wiring plan, size of cable, sub-circuits, material estimation labour calculation, estimating form, overhead charges, profit, method of estimating. Purchase system, catalogue, market survey, tenders, comparative statement, order for supply, payment of bills

Estimating and costing of domestic installation: relevant IE Rules and symbols for domestic installation. CTS wiring of a room, cleat/casing capping wiring in a house, conduit wiring of building; dining hall, institute hall, hospital etc. with appropriate drawing; estimating of industrial installation: IE Rules and symbols and chart notes on house wiring, determination of rating of cable, fuse, switches, starter,

PART-II

1. Generation Transmission and Distribution:

Generation: Hydro Electric Station, Thermal power station, Nuclear power station, Diesel power station, Solar and wind power generation systems, Hybrid generation systems, Cogeneration systems, Basics of different types of electric generators, ratings of prime movers and alternators.

Transmission: Performance of the short, medium and long transmission lines, voltage, regulation, corona effect, Ferranti effect, Voltage levels, mechanical design consideration of Overhead lines, electrical line parameters of short lines, voltage regulation corona.

Distribution: DC and AC system, voltage levels types of distribution feeders and distributor's voltage drop and effects, power factor improvement plant, distribution substation, planning of residential and industrial systems. Underground cables. Common types of cable faults.

The IE Rules 1956 for generation, transmission and distribution systems.

2. Electrical Machines II:

Three phase Induction Machines: Workings, Rotating field, torque-speed characteristics, maximum torque, starting torque, circle diagram, no-load test and

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blocked rotor test, equivalent circuit, crawling and cogging of induction motor, starting and speed control of induction motor, Induction generator.

Three phase synchronous machines: constructional details of three phase-synchronous generator, workings, phasor diagram and synchronous impedance, voltage regulation, parallel operation of alternator, synchronous generator working as synchronous motor and its starting, effects of change of excitation of synchronous motor driving a constant load and V-curves.

Single phase motors: single phase induction motors, single phase synchronous motor, single phase commutator type motors, workings, Relevant field theories associated and starting characteristics.

3. Electrical Measurements and Instrumentation:

Introduction to measurement system: Introduction, types of measurement, instruments, error in measurement, Types of error corrections. Measurement of resistance: Types of resistance: low, medium and high, Measurement of medium resistance by V-I method.

Wheat stone Bridge, Sensitivity of stone Bridges: Difficulty in measurement of high resistance, Methods for measurement of High Resistance, Measurement of insulation resistance.

Measurement of inductance/self-inductance by: Maxwell's Inductance capacitance bridge, Hay's bridge, Owen's Bridge, Measurement of self and mutual inductance. Measurement of capacitance by: Schering Bridge, Measurement of relative permittivity, Measurement of frequency: Wein's Bridge method, Types of frequency meters, Electrical resonance type, and Weston frequency meter.

Measurement of power factor: Single-phase Electro dynamometer type power factor meter 3-phase Electrodynamometer type PF meter. Potentiometer: Basic Potentiometer circuit, Types of Potentiometer, Crompton type, Standardization of Calibration and application.

4. Power Electronics:

Power Diodes: Basic structures and V-I characteristics, breakdown voltage, ON state losses, switching state characteristics, principle of operation, diode snubbers, Schottky diodes.

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Thyristor: Thyristor family, operating principle of thyristor, dynamic characteristics, ratings and protection, temperature rise and cooling of thyristor; thyristor firing circuits: R and RC triggering circuit, UJT triggering; thyristor commutation-line, load and forced; series and parallel operation of thyristor.

Power MOSFETS: Structure, V-I characteristics, switching characteristics, operating limitations and safe operating area, gate and snubber circuit, GTO: basic structures and characteristics; IGBT: structure and characteristics, drive and snubber circuit, FCT, MCT, RCT, Power BJT and its applications.

Rectifiers: Uncontrolled rectifiers, basic concepts, single phase bridge rectifier, three phase full bridge rectifiers, single phase-controlled rectifiers: half-wave, full-wave and semi-converters.

Application of Power Electronics: AC voltage regulator, different types of choppers; speed control of dc motor; zero crossing detectors; timing circuits: mono-stable and a-stable type, 555 IC timer; introduction to PLCs.

5. Rural Electrification:

LT transmission and distribution lines: Rural electrification in India regulation transmission and distribution of electricity in farms installation motors, safety rules etc. Single-Phase and three phase AC supply, 33/11KV, 11/0.415KV, Substation, distribution transformers, pole mounted transformer, pole and towers, HT and LT Insulators, circuit breakers, lightning arrestors, air break switches.

Service Connection and metering: Service Mains, Service Feeder pillar, distribution box, LT metering, single phase and three phase energy, energy meter, electric tariffs.

Earthing: system Earthing and equipment earthing, purpose, types of earthing, electrodes, earth leakage circuit, breaker. Measurement of earth resistance.

Campus Lighting: Terminology of illumination, laws of illuminations, street lighting, various types of light sources and design considerations of good lighting scheme and service feeder pillar.

Types of lamps: Incandescent lamp, Arc lamps – AC and DC arc lamps, Fluorescent lamp, Mercury vapour lamp, Sodium vapour lamp, Halogen Lamps, Neon Lamps, Metal halides, LED lamps, CFL etc. and selection Criteria for lamps.

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SYLLABUS: ELECTRONICS & COMMUNICATION ENGINEERING

PART-I



1. Electrical Material:

Conducting Material: Atomic structure and its properties, composition and application of conductor, semiconductor and insulator.

Magnetic Material: Type and uses, B N Curves, hysteresis loop, Ferrite Cores.

Insulating Material: Electrical, thermal and mechanical properties of various insulators, air, transformer oil, SF₆, PBC, Bitumen's Quartz etc.

Electrical components: Different types of resistors, capacitor choke and reactors, electromagnetic and electrostatic shielding.

2. Fundamental of electronics and measurements:

Electronics components: Types, colour codes, ratings of resistors, inductor and capacitors. Introduction to semiconductor diodes and transistors.

Electronic devices: Introduction to rectifiers, voltage regulators, amplifiers, oscillators.

Binary number system: Logic Gate truth table.

Instruments: systems of units of measurements, standards, working principle of Ammeter and voltmeters, ohm meters, use of multimeters and CRO.

3. Digital Electronics:

Binary number codes logic gates, simplification of logic gates concepts of error correction, working of display devices, fundamentals of TTL logic counters, registers, shift registers.

Study of logic families, A to D and D to A converters Arithmetic circuits, ICL7106/7107, ALU and its operations, Binary multiplications, introduction of computer, organisation computers, Microprocessors Architecture, peripherals.

4. Fundamentals of Network, Filters and Transmission Lines:

Network Theorems: Superposition, Thevenin's Norton maximum power transfer.

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Network: One part and two parts, balanced and unbalanced active and passive T-pipe, lattice, ladder.

Concepts and significance of characteristic impedance, loss, propagation constant, phase shift constant. Star delta transformation, equivalent T and pi networks, characteristics impedance of T and pi networks.

Attenuator: Symmetrical and other types.

Filter: Brief idea of their use and types and characteristics simple design problem.

Transmission lines: Types, induction to characteristics and application.

PART-II

1. Industrial Electronics:

Power Diodes Transistors, Thyristor Principle and various characteristics, power conversion, electronic relay and timer circuits, electronic motor control. Servomechanism.

Transducer signal processing, electronic instrumentation, Data recorders, microprocessor application in industry.

2. Trouble Shooting of Electronic Systems:

Electronic components and systems symbols, identification of terminal, ratings and limitations. Types of troubles cause and effects of troubles.

Measuring and test equipment: Multimeters, other meters for current, voltage, frequency, radio and microwave frequency measurements.

Testing and Alignment: of rectifiers audio, video, DC and radio amplifiers.

Trouble shooting procedure for receivers: Radio and Video. Reliability and safety:

Condition affecting reliability and serviceability of electronic components and equipment, electrical safety.

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3. Audio System:

Review black and white TV, colour TV: Relative sensitivity of eye to different colours. NTSC SECAM and PAL, their advantages and disadvantages. Delta gun and PIL type of colour picture tubes. Sub carrier frequency. Synchronous quadratic modulation and representation of colour by a vector, Block diagram of PAL TV.

AUDIO SYSTEM

4. Communication Engineering:

Analog signals – types and representation, Amplitude modulation, Frequency modulation and phase modulation.

Typical digital communication system design, sampling theorem, time multiplexing of signals, A/D conversion and quantization noise. Delta modulation time division multiplexing of digital signals. Error detection correction for partial response coding.

Basic on binary communication by on-off keying frequency shift keying.

Introduction to modulation techniques for digital communication.

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SYLLABUS: COMPUTER ENGINEERING

PART-I



1. Electronics:

Solid state devices: Physics, characteristics and model logic design, Binary arithmetic, Boolean algebra, circuit minimization, combinational and sequential circuits, flip flops, counter, and shift registers.

2. Computer Programming:

Computer Programming in C syntax and semantics, variable, control flow, Arithmetic and Boolean expression, structured programming, sub programming.

Object oriented programming, Functions - Pass by value, pass by reference and program structure, string manipulation, pointer, and array, Passing pointers as arguments in function. inheritance, Polymorphism, and encapsulation.

3. Web Technology:

HTML: Introduction to HTML, Elements of HTML syntax, Head and Body sections, Building HTML documents, inserting text, images, hyperlinks, Backgrounds and Color Control, ordered and unordered lists, content layout & presentation. Tables: Creating Tables, use of table tags and various other HTML tags, Introduction to CSS: Creating Style Sheets, Common Tasks with CSS.

HTML Editors & web Authoring Tools: Use of different HTML editors and tools like Microsoft Front Page, Macromedia etc. Graphical and Animation Tools: Use of Different graphical and animation tools like Adobe Photoshop: Image Editing, Working with sound and Video in photoshop, Gif Animator, Flash.

Java Script: Frames: Developing Web pages using frames. Security: Considering various security issues like firewalls etc.

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PART-II

1. Microcomputer:

Organisation and programming 8-bit microprocessor, memory and CPU of microcomputer, interfacing memory and I/O devices microprocessor support chips. Microprocessor Development tools, microprocessor-based and application.

2. Design and Maintenance of computer Installation:

Introduction to firmware, BIOS definition, BIOS booting process, CPU configuration, SATA configuration, POST test process, common error messages.

3. Peripheral devices and Fault Diagnosis:

Input devices e.g., Keyboard, mouse, joystick, light pen, digitiser, scanner, output devices e.g., VDU, laser printer, inkjet printer, thermal printer, plotter, Hard Disk Drive, Troubleshooting process, various diagnostic tools. Maintenance checklist, reliability.

4. Programming language and Algorithms:

Introduction to Data Structures, Various ways of representation of array elements: Row Major and Column Major order, Performance analysis of sorting algorithms, e.g., bubble sort, selection sort, insertion sort, quicksort, heapsort, and merge sort. Searching algorithms.

5. Computer Networking Concepts & Devices:

Computer communication fundamentals: network topology – mesh, tree, bus, star, ring; network types - LAN, MAN, WAN; transmission media types- guided and unguided.

LAN connecting devices – hub, repeater, bridge, switch; internetworking devices – router, gateway; firewall.

Wireless networks: satellite systems, cellular systems – GSM, Wi-Fi, WiMAX, Mobile Ad hoc networks, Bluetooth, wearable computers.



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SYLLABUS: AGRICULTURAL ENGINEERING

PART-I

1 MEASUREMENTS:

Area and volume, Force and Energy, Pressure, Velocity, Density, Length and Square measure, Metric measure of (Liquid, Volume, weight)

2 SURVEYING:

Measurement of distance, concept of scale, principles and methods of chain surveying, Measurement of regular and irregular area and volume, estimation of earthwork, Introduction to basic modern surveying tools like handheld GPS and Total station (conceptual awareness level only), Introductory GIS applications for Land and Water Management

3 TECHNICAL MECHANICS:

Free Body Diagram; Internal and External forces; Force systems; equilibrium principles; Equilibrium of concurrent and coplanar force systems; equilibrium of bodies in space, Friction and impending motion, rolling resistance, Wedge friction, Centroid, centre of mass, centre of gravity, centroid of a length and area, Moment of Inertia: parallel axes theorem and perpendicular axis theorem, Types of motion, fixed axis rotation, plane motion of a rigid body, instantaneous centre of rotation, relative velocity and acceleration for points on a rigid body.

4 FARM POWER:

Sources of farm power (mechanical, electrical, renewable), mechanization level (Farm power availability per hectare), tractor types, and differences from automobiles. IC engine classification, SI vs CI engines, components, valve/ignition timing, firing order, and efficiency. Combustion, fuel types and ratings, fuel systems, ignition systems, air intake and exhaust, emission controls (DPF, DOC), cooling systems, and lubrication systems with their maintenance. Tractor and power tiller transmission (clutch, gearbox, PTO, differential), steering, brakes, and electrical systems (battery, alternator, starter). Cost analysis. Mechanization needs in agriculture.

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5 FARM MACHINERY:

Implement types (mounted, trailed), field capacity/efficiency, tillage tools (ploughs, harrows, levellers), sowing/planting equipment (seed drills, planters), intercultural tools, sprayers and dusters, and harvesting and threshing equipment with performance evaluation. Brief inclusion of newer technologies such as Battery-operated small equipment, Solar-powered devices and UAV-based spraying systems.

6 PROCESSING OF FARM PRODUCES

Importance of engineering properties; Cleaning, sorting, and grading operations and machinery; Drying utilities of agricultural produce; Milling of cereals, pulses, and oilseeds; Storage of agricultural produce; Material handling: Application, conveyor, elevator. Dairy processing and machinery; Introduction to Heat transfer; Principle of Food Preservation & methods; Refrigeration; Freezing; Evaporation.

PART-II

1 FLUID MECHANICS:

Basic Concepts and Definitions – Density, Specific weight, Specific gravity, viscosity, Newton's law of viscosity; surface tension, capillarity, Bulk modulus of elasticity, compressibility. Pascal's law, Manometer, Hydrostatic pressure and force: horizontal, vertical, and inclined surfaces. Buoyancy and stability of floating bodies. Dimensional Analysis and Dynamic Similitude - Definitions of Reynolds Number, Froude Number, Mach Number, Weber Number, and Euler Number.

2 SOIL MECHANICS:

Preliminary definitions and relationships, three-phase system of soil, determination of index properties. Soil water, Analysis of effective and neutral pressures under different hydraulic pressures at different points below the soil. Darcy's law, determination of permeability by laboratory and field methods. Analysis of active and passive earth pressures on retaining wall, Rankine's theorem of earth pressure.

3 FARM IRRIGATION:

Major and medium irrigation schemes of India, purpose of irrigation, merits and demerits of irrigation, Sources of irrigation water. Soil-plant-water relationships, crop water requirement, irrigation efficiencies and irrigation scheduling. Land grading and



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field layout for efficient irrigation systems. Measurement of irrigation water: weirs, orifice, Parshall flume, float method, current meter. Surface irrigation methods: border, check basin, furrow – adaptability, specification. Sprinkler and drip methods of irrigation – adaptability and layout.

FARM DRAINAGE:

Water logging - causes and impacts; objectives of drainage, drainage coefficient, types of surface drainage; sub-surface drainage: purpose and benefits. Hydraulic conductivity, drainable porosity. Drainage structures, vertical, bio, ditch, tube, and mole drains. Classification of salt-affected soils; Reclamation of saline and alkaline soils. Leaching requirement for saline soils, gypsum requirement for alkali soils.

5 WATER WELLS & PUMPS:

Occurrence and movement of groundwater, groundwater resources development and utilization, and artificial recharge techniques. Well hydraulics: steady and unsteady flow towards a well in confined, unconfined; pumping tests. Design, construction, and development of tube wells. Water lifting devices, reciprocating pump, centrifugal pump, characteristic curves, and selection of pump. Economics of water pumping.

6 HYDROLOGY & SOIL WATER CONSERVATION:

Hydrologic cycle, precipitation, infiltration, evaporation, runoff. Land use capability classification, types, and estimation of water and wind erosions. Conservation measures for hill slopes, agricultural lands, gullies (Check dams), vegetative waterways and their design, stream bank erosion and its control. Water harvesting and farm ponds, rate of sedimentation and loss of storage, concept of watershed management.

7 CLIMATE RESILIENCE:

Basic introduction to soil health management, Sustainable agricultural practices, Hydroponics, Protected cultivation and Precision farming.

