

UPPSC Junior Engineer Syllabus

PAPER I & II of ALL Disciplines:-

Civil Engineering

PAPER I: Section A

(a) Strength of Materials & Theory of Structures: Effect of a force, tension and compression, free body diagram, virtual work, force distribution system. Principle of energy, conservation of energy and momentum, rotation of rigid bodies about fixed axis, mass moment of inertia. Types of stresses and strains, Definition of tension, compression, shear, bending, torsion, volumetric and lateral strain. Poisson's ratio, Hooke's law. Bending moment and shear force: Types of beam, simply supported, cantilever, fixed, overhanging and continuous beams. Analysis of trusses, slope and deflection of beams. Long columns, short columns & struts, slenderness ratio. Circular shaft, combined bending, torsion and axial thrust, strength of hollow and solid shaft.

(b) Design of Reinforced concrete structures: Design based on working stress method Flexural strength shear strength and bond strength of a singly reinforced RCC beam. Design of lintels, Design of a Cantilever beam and slab, Design of doubly reinforced concrete beam. Design of RCC slab, design of one way and two way slab. Design of Reinforced brick beams, slab & lintels, design of T-beams. Design of columns and column footings, cantilever retaining walls. Components of (1) overhead water tank and (ii) Multistoried framed structures. Introduction to design based on limit state method. Prestressed concrete.

(c) Steel & Machinery structures: Tension and Compression members in steel, Design of Steel of steel beams. Design of simple column bases. Design of simple trusses and purlins. Design of masonry retaining walls. Design of masonry wall foundation. Building estimates & coating, construction management, account & entrepreneurship development.

Section B

(a) Soil Mechanics and Foundation Engineering: Fundamental terms and their relationships. Classification and identification of soil. Phase relationship index property, laboratory determination. Capillary phenomenon permeability, factors affecting permeability. Compaction, methods of compaction. Consolidation, difference compaction and consolidation. Stresses in soil, shear strength, column's equation unconfined compression test. Earth pressure retaining structures. Shallow and deep foundations, classifications of piles. Stabilization of soils by lime and cement. Sub-surface exploration.

(b) Surveying: General principles. Chain surveying. Compass traversing, bearings, local attractions, types of traversing, traverse computations, corrections and missing readings. Levelling – Theory, Temporary & permanent adjustment of levels types of levelling. Reciprocal levelling. L. section and cross section, Retraction and curvature corrections. Contouring –

Characteristics, uses and plotting of contours. Plane table surveying – orientation, plotting methods, two & three point problems, Lehmann's ruler errors and precautions. Theodolite: Adjustment (Temporary & permanent) Measurement of angles, curves, horizontal and vertical curves, their

design and layout transition curves. Minor Instruments Abbeys Level, Tangent Clinometer, Ceylon Ghats tracer, pantograph and plan meter.

(c) Building Materials and construction: Building Materials: Bricks, their classification and characteristics, building stones source, quarrying, classification and properties, lime, properties, Cement Types, properties and tests, timber and wood products, types, properties and uses, paints, varnishes and distempers, glass and plaster etc. Lime concrete, user in foundation and terracing, Cement Concretes, ingredients, grading of aggregates, workability water cement ration, mixing, laying compaction curing. Building constructions- Detailing of walls, floors, roofs, stair cases doors and windows finishing of building, plastering pointing damp proofing etc. Ventilation and air conditioning fire fighting.

(d) Water supply and sanitation for public building: - Sources of Water, Quality of water supply, water treatment, water distribution, lying of pipes, building water supply & maintenance. Quantity of sewage, sewerage systems sanitation and drainage, Disposal of Rainfall and domestic wastes, including night soil, waste water and garbage, plumbing for public and residential buildings, septic tanks and soak pit, sewage treatment.

#### PAPER II:

Water Resources Engineering: Introduction Definition of Irrigation, Necessity of Irrigation History of development of Irrigation in India, Types of Irrigation in India, Sources of Irrigation Water.

Rain Fall & Run-off: Definition of rainfall & fun-off, catchment area, Dicken's & Ryve's formula, Types of rain gauges-Automatic & Non-automatic, Stream guaging.

Water Requirement of Crops: Definition of crop season, Duty Delta and base period, their relationship, Irrigation methods & efficiencies, Gross Command area, Culturable command area intensity of Irrigation, Irrigable area, Water requirement of crops-kharif and Rabi Preparation of water supply schedules for Kharif and Rabi.

Lift Irrigation: Types of wells, shallow & deep well, aquifer, and type's ground water flow. construction of open wells and tube wells Yield of an open/tube well and problems, methods of lifting water, manual and mechanical devices, use of wind mills lift canals-their design, construction and water scheduling.

Flow Irrigation : Irrigation canals, parricidal Irrigation, different parts of Irrigation canals and their functions, sketches of different canal cross sections classification of canals according to their alignment, Design of Irrigation canals Chevy's formula Mannings formula, Kennedy's and Lacey's silt theory and equations, comparison of above two sill theory, equations, critical velocity ratio, Use of Garrets and Lacey's charts, various types of canal lining, Advantages.

Canal Head Works : Definition, object, General layout functions of different part. Difference between weir and Barrage.

Regulatory Works: Functions and explanation of terms used cross head regulators, Falls Energy dissipates, Outlets-Different types, Escapes, Cross Drainage Works: Functions and necessity of the

following types: Aqueduct, Syphon, Super passage, Level Crossing, Inlet outlet, Constructional details of the above.

Dams : Earthen dams-types, Causes of failure, Classification into masonry & Concrete dams, labelled cross section of gravity dam, Spillways.

Water Logging and Drainage : Definition, causes and effects, detection prevention and remedies, surface and sub-surface drains and their layout, field drainage, salinity controlling measures, groundwater recharging measures.

Flood Protection: Estimation of flood discharges, systems of flood warning, Fiver behaviours, training works and control, Marginal embankments, their design, causes of failure, spurs & dykes, Attracting & repelling types, Non-structural flood management, Relief & Rehabilitation measures.

Irrigation Management: Checking of Irrigated, areas, raising water charges bills compensation for crop damages, penalties for unauthorized use of Irrigation water, procedure for imposition of panel rates. Canal law and its application, Formation of water users, Associations and their participation in irrigation management, Command area development. Major Irrigation Projection in India.

Fluid Mechanics : Properties of Fluids Hydrostatic Pressure of various types of surface, Measurement of pressure, Kinematics of fluid flow. Dynamics of fluid flow, Bernoulli's theorem Measurement of flow, Pilot tube, piezometer, orifices venturi meter, Current meter. Flow through pipes-losses and pipe network, water hammer, Reynold's number. Flow through open channels-Hydraulic gredience, Equation for Uniform flow, Chevy's and manning formula. Most Economical section. Measurement of discharges by (i) weirs and (ii) notch. Hydraulic-Pumps (Reciprocating and Centrifugal) Turbines (Impulse & Reaction).

Mechanical Engineering

PAPER I : Section A

### 1. Applied Mechanics

Forces : Transferability, moments and couples, funicular polygon, Lam's theorem, Varigon theorem, Friction: limiting and dynamical friction, coefficient of friction: bodies on inclined planes, simple screw jack.

Machines : basic terms-mechanical advantage, velocity ration, mechanical efficiency. Lifting machines system of pulley's Weston differential pulleys.

Stress & Strains : volumetric and lateral strains Hook's law, Poisson ratio, modules of rigidity, bulk modules. Application to bars and composite sections.

Beams & Trusses : determination cases, Bow's nation. Types of supports. analytical methods of joints and sections. hoop stress, longitudinal stress. charges in dimensions and volumes of thin shells subjected to internal pressure.

### 2. Theory of Machines and Automobile Technology :

Slider crank mechanism: turning moment in single cylinder engine: Fluctuation of speed and energy: crank effort diagrams, flywheel size Gear drive: gear trains, simple, compound epicycle and reverted. Automobile gear box. Automobile differential.

Clutches : Function of clutch in automobiles: single plate and multiplate clutches friction torque for uniform wear and uniform pressure.

Cams : Concept, classification of different cams and followers. Application to automobile Engine, simple Cam Profiles for uniform velocity, SHM and uniform Acceleration.

Balancing : Static and Dynamic balancing of masses rotating in same planes, Basic concept of several masses rotating in different Planes, Application of automobile engines.

Belt Drive : Derivation of limiting ratios of Driving tensions, centrifugal tensions. V-belts ropes and chains.

Dynamo-meters : Classification Functions, Construction and Working Concepts.

Governor : Functions, classification, Watt, Porter Hartnell, Hartung, Elementary Numerical About Height, maximum and minimum Controlling Forces etc.

### 3. Mechanics of Solids :

Mechanical Properties of Materials :- concept of stress and strain, stress-strain curves of mild steel, aluminum, cast iron, rubber etc. various moduli, determination of stresses and strains in bolts, stepped bars, compound bars and columns. Oblique plane. Principal stresses, Mohr circle shear force/Bending moments/ deflection: analysis of cases of concentrated and uniformly load.

Shear force and bending moment diagrams: cantilever, simply supported, overhanging beams.

Strain Energy : resilience, derivation of formulae of strain energy for uniform bars in tension, shock load, shear stress. Modulus of resilience. Torsion: solid and hollow circle shafts-polar modulus, weights, power transmitted.

Springs : close coiled helical springs, Laminated springs. Maximum stress and central deflection, (Simple numerical, no proof of formulae).

Columns & Struts : long and short columns, slenderness ratio. End conditions and equivalent lengths. Euler and Rankine formulae (no derivation).

### PART B

#### Material Science :

Materials: Ferrous-iron, steel alloy steels. Nonferrous materials-aluminium, zinc copper, tin, lead Nonmetallic materials-timber, polymers. Basic knowledge of their production.

Structure of materials: Crystalline, amorphous, arrangement of atoms, Crystal structural, imperfection. Mechanical properties of common metals and alloys, deformation.

Heat treatment: Iron- carbon equilibrium, TTT curves: recovery, recrystallisation and grain growth. Elementary concepts of hardening, tempering annealing normalizing and case hardening.

Alloy elements: effects of alloying Cr, Co, Si, Mn etc. Tool steels stainless steels, heat resisting alloys, spring steel, Nonferrous materials: duralumin, solders brass, bronze, gunmetal, inconel, Non-metallic materials: timber-ply wood, hard board, seasoning.

Polymers: thermoplasts and thermosets, Heat insulating materials. Glass wool thermocol, rubber, Electric insulating materials: bakelite, mica refractory materials: composites.

Design and Estimating :-

General design considerations for machine parts: Steps in machine design, factor of safety. Mechanical properties of materials, selection of materials. Machine parts subjected to the following loadings: (I) Direct and shear loads: threaded connections, cotter and knuckle joints. (II) Bending moment: design for railway wagon axle and road vehicle axles. Proof load and proof stress.

Semi elliptic laminated springs: maximum stress and deflection. (III) Twisting moment: solid and hollow shafts. Design of keys and coupling bolts in rigid flanged coupling.

Reveted and welded joints: types of revetted joints, strength, efficiency, safe load and pitch of revets, lap and butt joints. Common types of welded joints: Theories of failure: maximum principal stress theory, maximum shear stress theory, concept of equivalent bending moment and torque.

Rolling elements bearing: equivalent load dynamic capacity, life of bearings. Estimation of material requirements: estimation of weight of simple machine parts. Review of the area/volume of triangle, hexagon octagon, cylinder, frustum of cone and pyramid etc.

Estimation of time for common operations: turning, facing threading, drilling, shaping, chamfering, Simple problems pertaining to above.

Estimate of cost: concept of costing-direct materials, indirect materials, direct labour, indirect labour, overhead expenses. Break-even analysis. Cost estimation of welding: cost of materials, fabrication, welding. Finishing and overhead expenses.

Industrial Engineering :-

Plant Layout: general plant locations, selection of plant site. Product layout process layout.

Standardization: nation and international standards, value of standardization. Standardization techniques and problems.

Quality control: elements of quality control and objectives. Frequency distribution. X-R charts. P-charts and acceptance sampling concept of production. Inspection and its objectives. Types of inspections.

Work study: flow process chart, flow diagrams, work measurement, time study. Time and motion study. Products, planning and control: sales forecasting and its uses: Planning-products, process. parts, material Optimum batch quantity for production and inventory. Routing dispatching and follow-up activities.

Inventory control: elements of control procedures. types of controls inventory controls. Inventory control system of bin and records cycle system. Safety stock concepts.

Material Handling: factors in material handling problems. Reduction of cost and time through improved material handling. Material handling equipment: lifting, lowering, transporting and combination devices.

Industrial safety: need for safety-legal humanitarian, economic and social considerations, Safety at, work place-unsafe conditions and hazards-electrical hazards, lighting, ventilation heat control, noise and vibration, fire and explosion, chemical hazards; hygiene. Brief knowledge of relevant acts like factory act, Workman compensation act, Indian Boiler act, Indian-electricity act, explosive act.

## PAPER – II

### PART – A

#### Thermal Engineering :-

Boilers: fire tube, water tube, mountings and accessories. Equivalent evaporation: efficiencies: Steam and Gas turbines: impulse and reaction. Turbine components. Classification.

Steam condensers: components and construction features. Internal combustion engines: classification. Two stroke and four stroke engines. Main components and their functions. Air standard cycles: Otto, Diesel, dual, efficiencies. Engine lubrication, cooling systems.

Air compressors: Types reciprocating and rotary: single stage and two stage compressors. Simple numerical problems.

#### Refrigeration and Air Conditioning :-

Refrigeration: various cycles. COP Representation of cycles in p-V-Ts and P-H diagrams. Vapour compression system: wet and dry compression. Domestic refrigerator, Vapour absorption system: cycles of operation. Simple numeric problems.

Refrigerants: classification, properties- SO<sub>2</sub>, CO<sub>2</sub>, NH<sub>2</sub>, Freon-12 etc. Air conditioning: psychrometry: Basic ideas of salient terms-dry and wet bulb temperature dew point, enthalpy, sensible heating, humidification and dehumidification, sensible heat factor, Basic knowledge of room air conditioning, Central air conditions systems.

#### Hydraulics & Hydraulic Machines :-

Fluid properties: pressure-depth relationship. Total pressure on lamina: condition of equilibrium of floating bodies, meta center and meta centric height (simple numerical problems).

Fluid dynamics: types of flow, equation of continuity, Bernoulli equation, orifices, coefficients of contraction, velocity and discharge, Minor losses in fluid flow, Venturimeter, orifice meter, Pilot tube.

Notches and weirs: rectangular notch, V-notch: Francis and Bazin formulae for rectangular weirs. Broad crested weirs. Flow through pipes: friction loss Darcy Weisbach equation. Simple numericals.

Channels: uniform flow in rectangular and trapezoidal channels: Chezy and Manning equations. Most economical selections. Hydraulic Machines: Impulse and reaction turbines: Pelton: Francis, and Kaplan turbines-constructural and operational features. Velocity diagrams.

Pumps: centrifugal and reciprocating pumps. Basic knowledge of constructural and operational features.

## PART – B

### Manufacturing Processes :-

Metal forming processes: classification on the basis of properties of deformability fusibility such as rolling, forging, drawing, extruding, pressing, punching, blanking, spinning.

Welding: concept of various welding processes-electric arc, resistance thermit, metal-inert-gas, laser beam, electron beam, electron beam, explosion and ultrasonic, Welding of different materials in Industries: plastics, aluminium, copper, brass, bronze, alloy steels, cast iron stainless steel: oxyacetylene method, welding arcs: initiation, structure, types metal transfer characteristics. Different types of electrodes. Basic knowledge of testing of welds are relevant welding code. Foundry practice: patterns and moulding-pattern types, materials allowance, layout, colour scheme, defect. Cores.

Moulding processes: mould materials, types of sands, parting powders, sand mixing and preparation. Moulding defects. Melting and pouring Basic knowledge of refractory materials and fluxes. Furnaces-cupola. pit, tilting and electric types. Special casting: shell mould casting, die casting, investment mould casting, centrifugal and continuous casting, full mould casting.

Powder metallurgy: basic knowledge of the process: production of metal powders, blending, compaction sintering etc. self lubricated bearing Advantages and limitations of the process.

### Machine Tool Technology & Maintenance :-

Machine tools: Basic common features, drive systems, sources of power, work tool holding devices, speed varying systems, mechanical methods of providing automatically in machine tools.

Lathe: various parts, their functions and kinematics: lathe accessories and attachments. Capstan and turret lathes. Common lathe tools. Operations carried out on lathes such as turning, taper turning, drilling, screw cutting, reaming, knurling. common lathe tools and their uses, simple knowledge of computer numerical control (CNC) lathes and automation.

Milling machines: types components general maintenance. Operations such as plane milling, angular milling straddle milling, spur gear milling, Indexing, Shaping, planing and slotting machines: components, working principle, quick return mechanism, types of tools used, their geometry.

Drilling and Boring machines: constructural details and principle of working. Classification such as simple and Radial types. Tools used, Maintenance: general and periodic.

Grinding Machines: types common abrasive materials grains gifts, speeds and feeds. Use of coolants.  
Jigs and Fixtures: difference between jigs and fixtures, types of jigs cooling processes: coolants and cutting fluids-their functions: selection for difference material and operations.

Workshop practice & production Technology :-

Workshop technology: scope in engineering, Brief survey of different shops general contained in a standard engineering workshop viz. carpentry, foundry smithy, sheet metal, fitting painting and machine shops carpentry: common carpentry tools-their classification such as marking and measuring holding and supporting, cutting and sawing, drilling and boring, striking and turning (name of parts functions and specifications only).

Joining of timber components:- types of joint common defects likely to occur in joints: their causes  
Foundry: basic knowledge of tools used in foundries. Pattern-types, uses and allowance: green sand moulding: sand preparation, and additives, parting powders, problems in moulding uses of cores rises gates chills etc.

Smithy: basic concepts of operations in smithy shop such as fullering, upsetting, swaging, forge welding, drawing down, Tools used in smithy (names, functions and size specifications only) smithy forge, blower, shovel, anvil swage block, striking tools punch, draft and hammers.

Sheet Metal shop: basic knowledge of operations such as laying out, shearing, blanking, seaming, burning stamping etc. tools in sheet metal shop used for marking, measuring, punching fitting shop: fastener like rivets, bolts, nuts screws, keys, pins etc. (basic understanding only). Tools used in fitting shop such as threading tools, dies taps, vices, wrench and spanners, hack saw, drills, (names function and specifications only).

Painting shop: surface preparation, sand and emery papers, varnishing and polishing common materials used such as red oxide, putty yellow clay, defects likely to occur in painting and their remedies.

Machine shop: elementary theory of metal cutting chips-geometry of formation. Brief idea of newer machining processes such as abrasive jet machining, ultrasonic machining, Chemical machining, electric discharge machining, laser beam machining, electron beam machining plasma arc machining. Metal finishing processes such as diamond machining, honing lapping buffing etc.

Electrical Engineering

#### SECTION – A

1. Basic Electrical Engg.: Basic Terminology and their concept D.C. Circuits, Batteries, Capacitors, Electromagnetism, Electromagnetic induction, A.C. Circuits, polyphase circuits
2. Electrical and Electronic Engg. Materials: Classification conducting materials, Insulating materials magnetic materials, semiconductor materials, special purpose materials.
3. Electronics-I: Semiconductor diode, Bipolar Junction Transistor, Basic transistor amplifier, single stage amplifier, Transistor power amplifier, Feedback in amplifier Regulated power supply.



4. Electrical Machine-I: Generalized treatment D.C. machines, transformer, A.C. generator (Alternator). Voltage regulators.

SECTION – B

5. Electrical Instruments and Measurements: Introduction to Electrical measuring Instruments, Measurement and Errors. Ammeters and Voltmeters (Moving coil and moving iron), Wattmeters (Dynamometer type) and max. demand indicator, Energy meter (induction type) Miscellaneous measuring instruments. Measurement of resistance, inductance and capacitance. Elements of Process Instruments.

6. Power plant Engg.: Thermal stations, Hydro-Electric Plants, Nuclear Power Plants Diesel Power Plants Gasturbine Plants Combined working of Power Plants Major Electrical Equipment in Power Stations Recent Development.

7. Transmission and Distribution of Electrical Powers: Electrical Design of Lines, Constructional features of transmission lines, Economic principles of transmission, mechanical design of distribution System Lines/Power Factor Improvement, Underground Cables, Carrier Communication.

8. Electronics: Digital Electronics, Microprocessors, Oscillators, Integrated Electronics. Operational Amplifiers, Communication Engg.

PAPER – II

SECTION – A

1. Installation Maintenance & Repair of Electrical Machines: Brief study of: scope & organization Electrical Maintenance Depth, Installation and Installation and commissioning preventive Maintenance of Electrical Equipment and other Installations, trouble shooting, Earthing Arrangements. Insulation testing, Electrical Accidence and safety.

2. Switch Gear and Protection: Faults, Switch Gear Schemes, Protection against over voltages, Different types of submissions.

3. Industrial Electronics and Control: Introduction, High power Switching Devices, Thyristor and their operation, Thyristor Applications. Thyristor control of Electrical Machines., Industrial control, servo Mechanism.

SECTION – B

4. Electrical design, Drawing & Estimating: Study of only theoretical aspects. Principles of Estimating and costing Earthing, Estimation of power wiring estimation of OPH and U. Ground Distribution Lines Estimation of Service Connections.

5. Utilization of Electrical Energy: Illumination, Electric heating, Electric Cooling Electric Welding, Electrochemical Processes, Electric Traction, Economic Consideration.

6. Electrical Machine-II: Introduction Motor, Synchronous motor, F.H.P. motors, Converting Apparatus, Electrical Drives.

7. Elective anyone of the following (only four selected):

(i) Control of Electrical Machines: Control components AC. control circuits, control of synchronous motors. Control of single phase Motors, Industrial control circuits Trouble shooting in control circuits, "OR"

(ii) Process control & Instrumentation: Introduction, control system components. Instrument Transformer, Transducers, Process Instrumentation. "OR"

(iii) Electric Traction: Introduction, Electric traction drives, Power Supply for traction, Mechanics of traction, Rectification Equipment, Overhead Equipment, Tract Circuit, Supervisory remote control. Rail and return path. "OR"

(iv) Non conventional Sources of Energy & Appropriate Technology : Introduction, Wind Energy, solar Energy, Tidal Power, Appropriate Technology.

OR

SECTION – A :-

1. Installation, Maintenance & Repair of Electrical Machines: Syllabus is common (same) with Electrical Engg. Diploma Stream.

2. Switch Gear And Protection : Syllabus is common (same) with Electrical Engg. Diploma Steam.

3. Industrial Control-1: Speed control of D.C. motors, Speed control three phase Induction motors. Solid State control of single phase A.C. motors, Control components, Electromagnetic controllers. Solid state control of synchronous motors.

SECTION – B :-

4. Industrial Control – II: Electric Drives, Electric Braking. Refrigeration & Air Conditioning. Process Instrumentation.

5. Control System & Process Application: Introduction, Components and devices used in Control System, I/O relationship of simple control system components. Stability criterion, Performance of Control System, Automatic control actions. Controllers in Process control, Discrete Data System.

6. Principles of Digital Electronics : Introduction, Number System, Codes, code conversion and parity. Logic Gates, Logic Families and Digital ICs, Logic simplification. Arithmetic Operations, Ex-coder, Decoders & Display devices' associated circuits. Flip Flops, Counters, Shift Registers, Memories A/D and D/A converters Arithmetic circuits.

7. Electrical & Electronics Instrumentation: Instruments transformers, transducers. Data Acquisition System, Recorders, Display devices, Electronics Equipments.

Agriculture Engineering

PAPER I : Section A

1. Farm Power Engineering & Non-Conventional Sources of Energy : Introductions- Sources of power on farms, comparative study and uses. Limitation and brief description of animal, fossil fuel (Diesel/petrol) wind, solar, Biogas and electric power.

I.C. Engines – Principles Heat engine, principle of operation, classification of I.C. Engines, principles of operation two stroke and four stroke engine. Diesel and petrol engine, stationary, reciprocating and rotary parts, their material of construction and functions. Concept of terms related with I.C. engine, Numerical problems related with different terms. Performance of engine.

Tractor - Introduction : Classification of tractor and adoptability. Factors affecting selection of tractor. General idea about different makes, models, in different H.P. ranges of tractors.

Hourly cost of operation of small petrol engine, diesel engine and tractor.

2. Non-Conventional Energy: Bio Gas Technology – Introduction to Biogas, production of Biogas, Bio-digestion of plants and animals waste, reaction taking place during bio digestion, gases produced during the process, elimination of unwanted gases such as CO<sub>2</sub> and H<sub>2</sub>S. Factors affecting production of gas, efficiency of Bio-gas plants in winter, uses of biogas.

Wind Energy Technology : Types of wind mills- Vertical axis and Horizontal axis. Various uses of wind mills. Site selection for a wind mill construction, working and maintenance of wind mills.

Solar Energy Technology : Solar radiation and potentially of solar radiation in India. Application of solar energy. Solar collector.

#### Section B

3. Post Harvest Technology & Agro Based Industries : Introduction : Importance of grain and seed processing principles of agricultural processing, sequence of operation, Flow digestion services offered by processor of farmers: Wheat, Maize, paddy and Soyabean.

AGRO-BASED INDUSTRIES: Sugarcane crushing, Khandsari and Gur making process and equipment, vegetable and animal waste utilization, bye products of Soyabean and potato, dehydration of vegetables.

4. Farm & Land Development Machinery : Farm Mechanization : Definition, Status of Farm mechanization in India, Scope, limitation, advantages. Primary and Secondary tillage equipment, Sowing and Planting equipment, Harvesting and threshing equipment, Land Development equipment: construction, operating and output of the following Dozen Scraper, Draghoe and Dragline.

#### PAPER II : Section A

1. Irrigation & Drainage Engineering : Introduction: Definition of Irrigation, History of Irrigation, Necessary and scope of Irrigation.

Water Requirement of Plants : Types of soil, soil properties in relation of Irrigation and drainage, classes and availability of soil water, Evaporation, transpiration, evapotranspiration, consumptive use, estimating crop water requirements, duty of water, delta. Assessment Irrigation water

requirements of different crops, estimation of depth and time of Irrigation, different criteria for irrigation scheduling depending upon soil- plant-atmospheric factor.

Irrigation Methods : Surface and subsurface methods, sprinkler and drip system of irrigation and conjunctive use. Measurement of irrigation efficiencies, water conveyance, storage, application, distribution and water use efficiency.

Drainage Engineering : Definition, necessity, water logging salinity, its control interrelationship of irrigation, drainage, drainage coefficient. Different types of surface and subsurface drainage system.

2. Minor Irrigation : Importance, necessity and advantages of minor irrigation, Land survey, method of levelling, determination of cuts and fill. Importance and necessity of levelling. Sources of minor irrigation. Definition of tubewell, need, advantage & disadvantage, characteristics of tubewell site, factor affecting site selection.

#### Section B

3. Soil & Water Conservation and Land Reclamation Engineering: Mechanics, types and causes of soil erosion, factors affecting erosion, damages caused by soil erosion. Agronomical measures for soil & water conservation: Contour farming, mulching, step cropping, cover cropping, mixed cropping, role of grasses in soil conservation. Mechanical method of erosion control: Field bunding, contour bunding, graded bunding, ridge and channel terraces. Gully erosion control: Classification of gullies, control of gullies by temporary and permanent structures: earthen check dams, brush dams, loose rock dams, straight drop spillway.

Land Reclamation: Classification of user soils, salty resistant crops, reclamation of user soils. Reclamation of waste lands forest lands and sandy soils, sand dunes stabilization.

Ravine Reclamation: Classification of ravines and various measures for ravine reclamation