

SYLLABUS FOR THE WRITTEN EXAMINATION TO THE POST OF PROGRAMME ASSOCIATE IN MEGHALAYA WATER RESOURCES DEVELOPMENT AGENCY

Surveying:

- Classification of surveys, scales, accuracy;
- Measurement of distances- direct and indirect methods; optical and electronic devices;
- Measurement of directions, prismatic compass, local attraction;
- Theodolites- types;
- Measurement of elevations – Spirit and trigonometric leveling; Relief representation; Contours; Digital elevation modeling concept;
- Establishment of control by triangulations and traversing – measurements and adjustment of observations, computation of coordinates; Field astronomy, Concept of global positioning system; Map preparation by plane tabling and by photogrammetry; Remote sensing concepts, map sussitutes.

Design of concrete and masonry structures

- Limit state design for bending, shear, axial compression and combined forces. Codal provisions for slabs, beams, walls and footings. Working stress method of design of RC members. Principles of prestressed concrete design, materials, methods of prestressing, losses, Design of simples members and determinate structures, Introductions to prestressing of indeterminate structures.
- Design of brick masonry as per I.S. Codes.

Fluid Mechanics, Open Channels flow, Pipe flow:

- Fluid Properties, Pressure, Thrust, Buoyancy: Flow Kinematics: Integration of flow equations; flow measurement; Relative motion; Moment of momentum; Viscosity, Boundary layer and Control, Drag, Lift; dimensional Analysis, Modelling; Cavitation; Flow oscillations; Momentum and Energy principles in open channel flow, flow controls, hydraulic jump, flow sections and properties; Normal flow, gradually varies flow: Surges; Flow development and losses in pipe flows , Measurements; Siphons' Surges and water hammer' Delivery of Power Pipe networks.

Hydrology:

- Weather and hydrology, Hydrological cycle,
- precipitation- Forms, measurements and estimations and related data analyses, PMP, Unit and synthetic hydrographs;
- Evaporation and transpiration- Factor affecting, measurements and estimation;
- Floods and their management, PMF;
- Streams and their gauging, Streams flow measurement- measurement of stage and velocity, Stage discharge relationship; River morphology; Routing of floods Capacity of reservoirs.
- Runoff – Introduction hydrograph, runoff characteristics of streams, yield (annual runoff volume), flow duration curve, flow mass curve.
- Hydrograph – Factors affecting flood hydrograph, components of hydrograph, Base flow separation, effecting rainfall, unit hydrograph.

Irrigation and Drainage:

- Irrigation – definition, necessity, advantages and disadvantages, Types of irrigation: surface (Flow and lift) and sub-surface (natural and artificial):
- water requirement of crops – crop period or base period, duty and delta, relation between duty and delta, importance of duty, factors affecting duty, kor-water demand (kor-watering and kor-period); Consumptive use of water, direct measurement and empirical methods for consumptive use:
- Application of irrigation water- surface and sub surface methods, design of sprinkler and drip irrigation; Irrigation efficiencies application, conveyance, use, storage and distribution:
- Soil water and plant relationship, soil structure, Soil texture, water – holding capacity of soil, classification of soil water, soil water characteristics- field capacity and permanent wilting point: causes of waterlogging, drainage methods, types of drainage systems, design of surface and subsurface drainage system, land reclamation methods.
- Sources of water for irrigation. Planning and design of minor irrigation projects. Techniques of measuring soil moisture- laboratory and in situ, soil-water plant relationships. Water requirement of crops. Planning conjunctive use of surface and ground water. Measurement of irrigation water, measuring devices – orifices, weirs and flumes.
- Methods of irrigation – surface, sprinkler and drip, fertigation. Irrigation efficiencies and their estimation. Design and construction of canals, field channels, underground pipelines, head-gates , diversion boxes and structures for road crossing. Occurrence of ground water, hydraulics of wells (tube wells and open wells) and their construction. Well development

and testing. Pumps types, selection and installation. Rehabilitation of sick and failed wells. Drainage causes of waterlogging and salt problem.

- Methods of drainage- drainage of irrigated and unirrigated lands, design of surface, sub-surface and vertical drainage systems. Improvement and utilization of poor quality water. Reclamation of saline and alkali soils. Economics of irrigation and drainage systems.
- Use of waste water for irrigation – standards of waste water for sustained irrigation, feasibility and economics.

Water resources engineering;

- Water resources of the globe; Multipurpose use of water;
- Soil-Plant-Water relationships, irrigation systems, water demand assessment; Storages and their yield and well hydraulics;
- Water logging, drainage design; Irrigation revenue; Design of rigid boundary canals; Non-Overflow and overflow sections of gravity dams and their design, Energy dissipaters and tailwater rating; Design of headworks, distribution works, falls, cross- drainage works, outlets; River training.

River Engineering and Flood Water control;

- River Engineering; Introduction and classification of river, behavior of rivers, river region theory, mechanism of meanders development, types of alluvial river region, cut off, effects of dam on river region.
- Objectives and Principles of River Training: Methods of river training, classification of river training works, design parameters of embankments, bank protection spurs and artificial cutoff,
- Flood Control; Definition and causes of floods, Different methods of flood control, selection and estimated of design flood, CWC recommendations to select design flood for various hydraulic structures. Flood control by reservoirs, operation problems of flood control reservoirs, levees nad dlood walls, diversion of flood water, watershed management for flood control, flood plain management, emergency evacuation, flood-plain zoning and flood proofing, benefit of flood control.

Soil and Water Conservation

- Scope of soil and Water Conservation. Mechanics and types of erosion, their causes. Rainfall, runoff and sedimentation relationships and their measurement.
- Soil erosion- Factors affecting and damages caused, Processes and types of erosion.
- Soil erosion control measures – biological and engineering including stream bank protection vegetative barriers, contouring, contour bunds, contour trenches, contour stone walls,

contour ditches, terraces, outlets and grassed waterways. Agronomical practices, crop rotation, strip cropping, Vegetative control of gullies, Vegetated water ways, Mulching, Green manuring Pastures and Agro-forestry.

- Contour and Graded Bunds- Types, layout, design construction, cost estimation and maintenance.
- Gully control structures – temporary and permanent-design of permanent soil conservation structures such as chute, drop and drop inlet spillways, Planning and design of soil bed earthen bunds, Wooden post and woven wire check dam, loose rock fill dam. Design of farm ponds and percolation ponds.
- Principles of flood control – flood routing.
- Watershed Management – investigation, planning and implementation – selection of priority areas and water shed work plan, water harvesting and moisture conservation.
- Land development – leveling, estimation of earth volumes and costing.
- Land Slides and Erosion Control on Hills-Stream bank erosion, Planning, Design and construction of vegetation and Machinery spur, wind erosion and its control practices.
- Wind Erosion process –design for shelter belts and wind brakes and their management. Forest (Conservation) Act.
- Bench Terraces – Types, Design construction, Layout, Cost estimation and maintenance, Land clearing Leveling and grading.
- Rain Water Harvesting and storage Structures –Water harvesting techniques, types of water harvesting structures, Planning design and maintenances of ponds and reservoir.

Ground Water development;

- Occurrence, Distribution and movement of ground water supply; Geologic formation of ground water supply; Methods of Ground water exploration; Types of Aquifers and wells;
- Aquifer Properties- Hydrologic properties of aquifers; Steady and unsteady flow in a confined and unconfined aquifer;
- Types of wells – Open Wells and Tube Wells and their Construction Development of wells; Ground Water Recharge;
- Methods of Ground Water Recharge Development of Ground Water – Zones of Under Ground Water, Movement of Ground Water and its Velocity, Darcy's Law for determining Ground water, Empirical formulas for estimating Ground Water Velocity.