

**INSTRUCTIONS TO PAPER SETTERS:****MAXIMUM MARKS: 75**

1. Question No. 1 should be compulsory and cover the entire syllabus. This question should have objective or short answer type questions. It should be of 25 marks.
2. Apart from question no. 1, rest of the paper shall consist of four units as per the syllabus. Every unit should have two questions. However, student may be asked to attempt only one question from each unit.

**UNIT – I**

Water Requirements: Need to protect water supplies, Various types of water demands, Factors affecting consumption of water, variations in demand, Per capita demand, Total requirements of water for a town or a city, Coincident draft, Effect of variations in demand on the design capacities of different components of a water supply scheme, Design periods, Population forecasting methods, Water Quality standards for municipal or domestic supplies, Water quality standards for industrial supplies.

Classification of sources of water, Surface sources: Reservoir planning, Storage capacity and yield, Zones of underground water, Movement of ground water and its velocity, Groundwater yield, Specific yield & specific retention, Aquifers & their types, Locating a well, Construction of well, Tube wells & Ranney wells.

**[No. of Hours: 10]****UNIT – II**

Water lifting arrangement, Source selection in hilly and rural areas, Appropriate treatment technology for rural water supplies.

Intakes: Factors governing the location of intakes, Types of intakes including simple submerged intakes, Wet & dry intake towers.

Conduits: Gravity conduits such as canals, Flumes, Aqueducts and pressure conduits. Cast iron pipes & their joints, steel pipes & their joints, Cement concrete pipes, asbestos cement pipes, Plastic pipes, Vitrified clay pipes & miscellaneous types of pressure pipes, Corrosion of metal pipes, Laying of pipes & pipe appurtenances such as gate valves, Air valves, Blow off valves, Pressure relief valves, Check valves, Manholes, Insulation joints, Anchorages etc. Testing of pipe lines, Head loss through pipes and pipe fittings, Disinfection of pipelines before use.

**[No. of Hours: 11]****UNIT – III**

Distribution system planning. Types of distribution reservoirs including surface reservoirs & elevated reservoirs, Analysis of complex pipe networks by using Hardy – Cross method, Types of fire hydrants & their requirements, Types of water meters & their requirements Wastage of water in distribution system. Materials for service pipes, Service connection.

Types of sewage and types of sewerage systems, Components of sewerage system, Future forecasts and estimating design sewage discharge. Estimating the peak runoff.

**[No. of Hours: 10]****UNIT – IV**

Provision of free board in sewers and Storm water drains Hydraulic formulas for determining flow velocities in sewers and drains, Maximum and minimum velocities to be generated in sewers.

Shapes of sewer pipes, Forces acting on sewer pipes, Sewer materials, Laying and testing of sewer pipes.

Sewer Appurtenances: Man holes, Drop man holes, Lamp holes, Clean outs, Street inlets, Called gullies, Catch basins, Flushing tanks, Grease and oil traps, Inverted siphons, Storm water regulators.

Maintenance, Cleaning and Ventilation of sewers.

Types of pumps and pumping stations for water supply & Sewerage system: Rotodynamic pumps including centrifugal pumps & their types, Displacement pumps including reciprocating & rotary pumps. Factors affecting the selection of particular type of a pump, Head power and efficiency of pumps, Economic diameter of pumping mains.

Plumbing systems, Sewerage plans for building and design of sewer, Sanitary fittings and other accessories.

Wastewater disposal into rivers,lake and estuaries, Characteristics of sewage, BOD and COD Tests.

**[No. of Hours: 11]**

**Text and Reference Books:**

1. Santosh Kumar Garg, “Environmental Engineering (Vol. 1), Water Supply Engineering”, Khanna Publishers.
2. S.K. Garg “Sewage Disposal and Air Pollution Engineering (Vol. II)”. Khanna Publishers.
3. B.C. Punamia, Ashok Jain, Arun Jain, “Water Supply Engineering”, Laxmi Publications.
4. Karia Christian, “Wastewater Treatment”, Prentice Hall of India.
5. A.C. Twort, D.D. Ratnayaka, M.J. Brandt, “Water Supply”, IWA publishing.
6. Jerry A. Nathanson, “Basic Environmental Technology, Water Supply, Waste Management and Pollution Control”, Prentice Hall of India.