

GUJARAT TECHNOLOGICAL UNIVERSITY

BE-6 SEMESTER – OLD PAPER – S22 TO W25 – QUESTION BANK

Subject Name & Code:

WATER RESOURCES ENGINEERING AND HYDROLOGY- 3160610

Unit 1: Hydrological Parameters

Repeated Questions:

1. **Define/Explain terms: Hyetograph, Hydrograph, and their difference.** (S23 - Q1b, 04 marks); (S24 - Q1a, 03 marks); (W25 - Q2a, 03 marks).
2. **Define/Explain: Hydrology, Precipitation, Flood/Hydrographic cycle.** (W23 - Q1a, 03 marks); (S23 - Q1a, 03 marks); (S25 - Q1c, 07 marks).
3. **State Dalton's law of evaporation and discuss factors affecting evaporation.** (S23 - Q1c, 07 marks); (S25 - Q1c, 07 marks).
4. **Enlist methods to evaluate the rate of evaporation.** (S22 - Q1a, 03 marks); (S25 - Q1c, 07 marks).
5. **Explain infiltration capacity, rate, and rainfall excess / Infiltration indices.** (W22 - Q1a, 03 marks); (S23 - Q2b, 04 marks).

Other Important Questions:

1. **What are applications of hydrology?** (S23 - Q1a, 03 marks).
2. **List various methods of calculating average rainfall over an area and explain the Isohyetal method.** (W22 - Q1c, 07 marks).
3. **Explain (1) Thiessen polygon method (2) Isohyetal method, to find average depth of rainfall.** (S24 - Q1b, 04 marks).
4. **Explain the terms (i) Infiltration capacity (ii) Infiltration rate (iii) Rainfall excess.** (W22 - Q1a, 03 marks).
5. **State Darcy's law of flow of water through soil along with assumptions made in its derivation.** (S23 - Q3a, 03 marks).
6. **How infiltration capacity of soil can be measured in field?** (S23 - Q3b, 04 marks).
7. **Write a short note on Thiessen's polygon method of calculating average rainfall over area.** (S23 - Q3 OR(b), 04 marks).
8. **Describe various forms of precipitation.** (S25 - Q2a, 03 marks).
9. **Describe various methods to find out missing rainfall data.** (S25 - Q3b, 04 marks).
10. **Describe double mass curve technique to check consistency of rain gauge station data.** (S22 - Q1b, 03 marks).
11. **Discuss briefly isohyetal method to determine average depth of precipitation.** (S25 - Q3 OR(a), 03 marks).
12. **Discuss non- automatic type of rain gauge.** (W24 - Q3 OR(b), 04 marks).
13. **Explain various forms of precipitation in brief.** (W23 - Q4 OR(b), 04 marks).

Numerical Problems:

1. **For a storm of 2-hrs durations, the rainfall intensity is as follows. If the ϕ -index is 3 cm/hr. Find out the surface runoff and W-index.**
Time period (min): 20,20,20,20,20,20
Rainfall intensity (cm/hr): 2.6, 2.5, 10.2, 7.8, 5.2, 2.0. (W23 - Q2 OR(c), 07 marks).
2. **A rain gauge recorded the following accumulated rainfall during the storm. Draw the mass rainfall curve and the hyetograph.**
Time (A.M.): 10.00, 10.15, 10.30, 10.45, 11.00, 11.15, 11.30, 11.45, 12.00.
Accumulated rainfall (mm): 0.0, 8.5, 16, 27, 37, 48, 62, 80, 90. (W22 - Q2(c), 07 marks)
[Table given - refer Question paper].

3. A storm with 12 cm precipitation produces a direct surface runoff of 7.2 cm. The time duration of the storm is given in below table. Determine ϕ -index of the storm.
Time (Hour): 1, 2, 3, 4, 5, 6, 7, 8.
Hourly rainfall (cm): 0.4, 1.0, 1.8, 2.6, 2.0, 1.5, 1.2, 0.5. (S25 - Q2 OR(c), 07 marks) [Table given - refer Question paper].
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Unit 2: Runoff & Hydrographic Analysis

Repeated Questions:

1. **Define: Unit Hydrograph (UH). Write down the assumptions of UH theory.** (S22 - Q2 OR(c), 07 marks); (S24 - Q2b, 04 marks); (S25 - Q3a, 03 marks); (W25 - Q1a, 03 marks).
2. **Explain/Discuss methods adopted to separate the base flow.** (W25 - Q1a, 03 marks); (S23 - Q2b, 04 marks); (W24 - Q5 OR(b), 04 marks); (S22 - Q2b, 04 marks).
3. **What is S-hydrograph? Also give its uses.** (W23 - Q3 OR(b), 04 marks); (W24 - Q2a, 03 marks); (S25 - Q4 OR(b), 04 marks).
4. **What do you mean by flow duration curve? And also mention its uses.** (S22 - Q2(c), 07 marks); (W23 - Q5 OR(a), 03 marks).
5. **Explain how the characteristics of drainage basin affect runoff / Discuss various factors affecting runoff.** (W25 - Q2(b), 04 marks); (S25 - Q4(c), 07 marks); (W24 - Q3(c), 07 marks).

Other Important Questions:

1. **Define: Direct runoff hydrograph (DRH), Unit hydrograph (UH), S-hydrograph.** (W22 - Q2a, 03 marks).
2. **Explain mass curve? Explain how mass curve is prepared?** (W22 - Q2b, 04 marks).
3. **Discuss various methods to determine rate of runoff.** (S23 - Q2(c), 07 marks).
4. **Explain procedure of determining direct runoff from a given storm hydrograph.** (S25 - Q2(c), 07 marks).
5. **Define: Drainage basin, Drainage density, Stream density.** (S24 - Q2a, 03 marks).
6. **Discuss briefly any four drainage basin characteristics.** (S25 - Q3 OR(b), 04 marks).
7. **Discuss various physiographic factors affecting shape of hydrograph.** (W24 - Q3 OR(b), 04 marks).
8. **Enumerate limitations of unit hydrograph theory.** (W24 - Q4 OR(a), 03 marks).
9. **Differentiate Hydrograph and Hyetograph.** (S25 - Q4 OR(a), 03 marks).
10. **Explain the procedure of determine capacity of reservoir using mass curve method.** (S25 - Q4 OR(c), 07 marks).

Numerical Problems (Unit Hydrograph Derivation/Conversion):

1. **A 6 hr unit hydrograph for a basin has ordinates as per table. Determine the ordinates of 12 hr unit hydrograph. Use S-curve method.** (W25 - Q2(c), 07 marks) [Table given - refer Question paper].
2. **The ordinates of 3 hr Unit hydrograph are given. Find the ordinates of a 6 hr UH analytically. Also, sketch 6 hr Unit hydrograph.** (W25 - Q2 OR(c), 07 marks) [Table given - refer Question paper].
3. **The ordinates of storm hydrograph for a drainage basin in response to a 6-hour storm are observed. Consider total rainfall of 9.5 cm, average infiltration loss 0.75 cm/hour, constant baseflow of 15 cm/sec. Derive ordinates of 6-hour unit hydrograph and area of basin.** (S23 - Q3(c), 07 marks) [Table given - refer Question paper].
4. **The direct runoff hydrograph resulting from a 6.0 cm effective rainfall of 6 hr duration is given. Determine the area of the catchment and the ordinates of the 6 hr unit hydrograph. Also sketch 6 hr unit hydrograph.** (S24 - Q2(c), 07 marks) [Table given - refer Question paper].
5. **Find the ordinates of a storm hydrograph resulting from a 3 hours storm with rainfalls of 2.45, 7.20 and 4.25 cm during subsequent 3 hours intervals. The ordinates of unit hydrograph are given. Assume an initial loss of 5 mm, infiltration index 2.55 mm/hour and base flow of 30 cumecs.** (S24 - Q2 OR(c), 07 marks) [Table given - refer Question paper].
6. **A peak of flood hydrograph due to 6 hr storm is 470 m³/s. The average depth of rainfall is 8 cm. Assume an infiltration loss of 0.25 cm/hour and a constant base flow of 15 m³/sec. Estimate the peak discharge of 6-hour unit for this catchment.** (W22 - Q2 OR(c), 07 marks).
7. **The ordinates of 3-hr unit hydrograph are as per given table. Compute the ordinate of**

- 6-hours unit hydrograph.** (W23 - Q3(c), 07 marks) [Table given - refer Question paper].
8. **The direct runoff hydrograph (DRH) resulting from 5.0 cm effective rainfall of 6- hr duration is given. Determine catchment area and ordinates of 6- hr unit hydrograph.** (W24 - Q4(c), 07 marks) [Table given - refer Question paper].
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Unit 3: Groundwater Hydrology, Dams and Reservoirs

Repeated Questions:

1. **Define: Aquiclude, Aquifuge, Aquitard / Aquifer, Aquiclude, Aquifuge, Aquitard.** (W25 - Q4a, 03 marks); (S25 - Q1b, 04 marks); (W24 - Q3a, 03 marks).
2. **Define: Specific yield, Specific retention, Transmissibility / Coefficient of transmissibility.** (W25 - Q4 OR(a), 03 marks); (S23 - Q4 OR(b), 04 marks); (S22 - Q3a, 03 marks).
3. **Differentiate between Confined aquifer and Unconfined aquifer.** (S24 - Q3 OR(b), 04 marks); (W23 - Q3b, 04 marks); (W24 - Q1b, 04 marks).
4. **Explain Darcy's law and its limitations.** (S24 - Q3b, 04 marks); (W22 - Q3b, 04 marks); (W24 - Q3 OR(a), 03 marks); (W23 - Q5 OR(c), 07 marks).
5. **Explain/Discuss recuperation test to estimate safe yield of an open well.** (W25 - Q4 OR(c), 07 marks); (S25 - Q3c, 07 marks).
6. **Write classification of dams / Types of dams.** (W25 - Q3a, 03 marks); (S22 - Q3 OR(c), 07 marks).
7. **Explain with neat sketch storage zones of reservoir / Discuss with a neat sketch, the various storage zones of reservoir.** (W25 - Q4b, 04 marks); (W22 - Q4c, 07 marks); (W23 - Q4c, 07 marks).
8. **Explain measure to reduce evaporation losses from reservoir.** (W25 - Q4 OR(b), 04 marks); (W22 - Q4b, 04 marks); (S23 - Q4 OR(c), 07 marks).
9. **Discuss reservoir sedimentation and control / causes and reduction.** (S24 - Q3 OR(a,c), 03 & 07 marks); (W22 - Q4 OR(c), 07 marks); (W23 - Q4a, 03 marks); (S22 - Q3 OR(b), 04 marks).
10. **Explain dams based upon their function / Classify dams.** (S24 - Q4 OR(a), 03 marks); (W25 - Q3a, 03 marks).

Other Important Questions:

1. **Define: Porosity, Specific retention, Specific yield.** (W22 - Q3 OR(a), 03 marks).
2. **Distinguish between permeability and transmissibility of soil.** (W22 - Q3 OR(b), 04 marks).
3. **Explain with a neat sketch, occurrence of ground water at various location below the earth surface.** (W22 - Q3a, 03 marks).
4. **Derive an expression for discharge from a well fully penetrating a confined aquifer.** (W25 - Q4c, 07 marks).
5. **Derive an expression for discharge in form of drawdown from well fully penetrating an unconfined aquifer.** (W24 - Q4 OR(c), 07 marks).
6. **Define: (i) safe yield (ii) secondary yield (iii) design yield.** (W22 - Q4a, 03 marks).
7. **Define: (i) Trap efficiency (ii) Density currents (iii) capacity-inflow ratio.** (W22 - Q4 OR(a), 03 marks).
8. **Explain following terms: (1) Density currents (2) Trap efficiency.** (W24 - Q4 OR(b), 04 marks).
9. **Discuss in details factors affecting selection of dam type?** (W22 - Q4 OR(b), 04 marks).
10. **Write a brief note on gravity dam with its salient features.** (S25 - Q3a, 03 marks); (W24 - Q1a, 03 marks).
11. **Distinguish between Gravity dam and Earth dam.** (S24 - Q4a, 03 marks).
12. **Give difference between gravity dam and earthen dam.** (W23 - Q1b, 04 marks).
13. **Write a brief note on any one dam located in Gujarat state.** (S25 - Q1a, 03 marks).
14. **Explain the mass curve method to determine reservoir capacity.** (S24 - Q4 OR(c), 07 marks).
15. **Describe constant level pumping test to found the yield of an open well.** (S22 - Q3b, 04 marks).
16. **Explain groundwater occurrence with sketch and define various water bearing formation.** (S22 - Q3c, 07 marks).
17. **How will you carry out hydrological investigation for planning of reservoir?** (S22 - Q3

OR(a), 03 marks).

Numerical Problems (Well Hydraulics):

1. During the recuperation test of a 4.0 m open well a recuperation of the depression head from 2.5 m to 1.25 m was found to take place in 90 minutes. Determine specific capacity per unit well area. Also determine yield of well for safe drawdown of 2.5 m. (W22 - Q3(c), 07 marks).
 2. Design an open well in fine sand to give a discharge of 0.03 cumec when worked under a depression head of 2.5 m. (W22 - Q3 OR(c), 07 marks).
 3. An artesian tube well has a diameter of 30 cm. Thickness of aquifer is 40 m and its permeability is 45 m/day. Find the yield under a drawdown of 3 m. Use radius of influence as recommended by Sichardt. (S23 - Q2 OR(c), 07 marks).
 4. An unconfined aquifer has a thickness of 40 m. A fully penetrating 25 cm diameter well is pumped at 30 lit/s. Drawdowns at 10 m and 120 m are 8 m and 0.75 m. Determine average hydraulic conductivity. At what distance is drawdown insignificant? (S24 - Q3(c), 07 marks).
 5. A well 0.7 m in diameter penetrates fully a confined aquifer of thickness 30 m, conductivity 1.5 m/day. Drawdown is limited to 2.75 m. Radius of influence is 330 m. Find maximum discharge. (S24 - Q3 OR(c), 07 marks).
 6. Water was pumped out from a well in a confined aquifer 10 m thick, hydraulic conductivity 1.5 m/day. Drawdowns at 10 m and 50 m are 3.2 m and 0.08 m. Find constant rate of pumping. (W23 - Q3 OR(c), 07 marks).
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Unit 4: Floods, Flood Analysis & Hydel Power

Repeated Questions:

1. **List out causes of floods and explain any one / Explain various causes of flood.** (W25 - Q3 OR(a), 03 marks); (S23 - Q3 OR(a), 03 marks); (S25 - Q2b, 04 marks); (W22 - Q5c, 07 marks).
2. **Explain flood frequency analysis.** (S24 - Q4 OR(b), 04 marks); (W23 - Q5b, 04 marks).
3. **Define flood routing. Discuss Muskingum's method / Explain flood routing through reservoir.** (W24 - Q2 OR(e), 07 marks); (W23 - Q5 OR(a), 03 marks).
4. **Write a note on Levees / Explain levees with sketch / Discuss levees as flood control measure.** (W25 - Q5 OR(a), 03 marks); (S22 - Q4a, 03 marks); (W24 - Q5 OR(a), 03 marks).
5. **Write a note on Flood walls / Flood proofing and Flood forecasting.** (W25 - Q5a, 03 marks); (W23 - Q5a, 03 marks).
6. **Classify hydroelectric power plants based on storage characteristics and based on head.** (W25 - Q3c, 07 marks); (S22 - Q4c, 07 marks); (W24 - Q4b, 04 marks); (W23 - Q5b, 04 marks).
7. **List out components of hydropower project also draw general layout / Draw a neat sketch of 'Hydroelectric power plant'. Explain each component briefly.** (S22 - Q4a, 03 marks); (W25 - Q3 OR(c), 07 marks).
8. **Explain: Penstocks, Surge tank, Turbines / Write functions of components: Penstocks, Surge tank, Draft tube.** (S24 - Q5 OR(a), 03 marks); (W24 - Q5a, 03 marks).
9. **Write short note on Surge Tank.** (S22 - Q4b, 04 marks).
10. **Explain rational method of flood estimation.** (S22 - Q4b, 04 marks).

Other Important Questions:

1. **What are adverse effects of flood?** (S23 - Q3 OR(a), 03 marks).
2. **Discuss various structural measures to mitigate flood disaster.** (S23 - Q3 OR(c), 07 marks).
3. **Discuss channel improvement works as flood control measure.** (S25 - Q5 OR(b), 04 marks).
4. **Define 'flood routing'. Discuss Muskingum's method for channel routing.** (W24 - Q2 OR(e), 07 marks).
5. **Define spillway and describe various bucket-type energy dissipaters.** (W24 - Q3 OR(c), 07 marks).
6. **Discuss various types of energy dissipation devices used below spillway.** (S25 - Q3 OR(c), 07 marks).
7. **Give essential requirements of spillway.** (S23 - Q2a, 03 marks).
8. **Classify hydro power plants. Explain any one in detail.** (W23 - Q4 OR(b), 04 marks).
9. **Explain classification of hydropower plant based on head.** (S24 - Q5a, 03 marks).
10. **Write a note on check dam.** (S24 - Q5b, 04 marks).
11. **Define flood routing. What are the uses of flood routing?** (W22 - Q5a, 03 marks).
12. **Write a note on flood routing.** (S24 - Q4b, 04 marks).

Numerical Problems:

1. **What return period you would adopt in the design of a culvert on a drain if you are allowed to accept only 20% risk of flooding in the 50 years of expected life of the culvert?** (S22 - Q4c, 07 marks).

Unit 5: Drought Management, Water Harvesting & Water Resources Planning

Repeated Questions:

1. **Define drought. Explain causes and types of drought / Define and classify drought.** (W25 - Q3 OR(b), 04 marks); (W23 - Q2b, 04 marks); (S25 - Q5 OR(a), 03 marks); (W22 - Q5 OR(c), 07 marks).
2. **Explain various effects of drought.** (S23 - Q5 OR(b), 04 marks); (W24 - Q2b, 04 marks).
3. **Discuss various measures adopted for water conservation / Discuss water conservation measures.** (W25 - Q5 OR(b), 04 marks); (W24 - Q1c, 07 marks); (W23 - Q5c, 07 marks).
4. **Explain roof top rain water harvesting with neat sketch / Describe in detail with sketch the components of the roof top rainwater harvesting system.** (W25 - Q5b, 04 marks); (S24 - Q5 OR(c), 07 marks); (S22 - Q5b, 04 marks); (W22 - Q5b, 04 marks).
5. **Discuss the recharge to ground water method of rain water harvesting / What is artificial ground water recharge explain any two methods.** (W25 - Q5c, 07 marks); (W22 - Q5 OR(a), 03 marks).
6. **Discuss various environmental consequences / impacts of water-resource projects.** (W25 - Q5 OR(c), 07 marks); (S22 - Q5 OR(c), 07 marks); (W23 - Q4 OR(c), 07 marks); (S25 - Q5 OR(c), 07 marks).
7. **Explain/Enumerate principles, objectives, requirements, steps in water resources planning.** (S25 - Q4b, 04 marks); (S22 - Q5 OR(a,b), 03 & 04 marks); (W24 - Q5 OR(c), 07 marks); (S23 - Q4a,b, 03 & 04 marks); (S23 - Q5 OR(c), 07 marks).
8. **Discuss drought contingency planning.** (W25 - Q3b, 04 marks).
9. **Explain "runoff enhancement".** (S22 - Q5c, 07 marks); (S25 - Q5a, 03 marks).
10. **Write a note on water harvesting system / Water harvesting: rainwater collection, small dams, etc.** (W23 - Q5 OR(b), 04 marks).

Other Important Questions:

1. **Explain need for conservation of water.** (S23 - Q4a, 03 marks).
2. **Discuss briefly various purposes to plan water resources development projects in India.** (S23 - Q4b, 04 marks).
3. **Define reservoir routing. Describe Modified Pul's & Goodrich method for reservoir routing.** (S23 - Q4c, 07 marks).
4. **Give requirements of water resources planning.** (S23 - Q4 OR(a), 03 marks).
5. **Describe briefly reservoir losses.** (S23 - Q4 OR(c), 07 marks).
6. **Discuss various methods of direct measurement of consumptive use of water.** (W24 - Q2c, 07 marks).
7. **Describe double ring infiltrometer to determine rate of infiltration.** (W24 - Q5b, 04 marks).
8. **What is transpiration? Discuss factors affecting it and phytometer method to measure rate of transpiration.** (W24 - Q5c, 07 marks).
9. **Give the functional requirements of a multi-purpose projects.** (W22 - Q5 OR(b), 04 marks).
10. **Explain various non-structural mitigation measures are adopted to control flood.** (S25 - Q5c, 07 marks).

Numerical Problems (Rain Gauge Network Design):

1. **A catchment has four rain gauge stations, with normal precipitation as 850, 500, 450 and 360 mm. Determine optimum number of rain gauges if error in mean rainfall is to be limited to 12%.** (W25 - Q1c, 07 marks).
2. **In a certain river basin, five rain gauge stations have normal precipitations: 810, 420, 540, 380, 1000 mm. Determine optimum number of rain gauges required. Error in mean rainfall is 12%.** (W23 - Q2 OR(c), 07 marks).
3. **There are four rain-gauge stations in a basin with normal annual precipitations: 850, 520, 430, 370 mm. Determine optimum number of rain-gauges if error in mean rainfall is to be limited to 15%.** (S22 - Q1c, 07 marks).