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# B.M.S. College of Engineering, Bengaluru - 560 019

**Autonomous Institute Affiliated to VTU**

## June 2025 Semester End Main Examinations

**Programme: B.E** **Semester: IV**

**Branch: Civil Engineering** **Duration: 3 hrs.**

**Course Code: 19CV4PCHYM** **Max Marks: 100**

**Course: Hydraulics and Hydraulic Machines**

**Instructions**: 1. Answer any FIVE full questions, choosing one full question from each unit.
2. Missing data, if any, may be suitably assumed.

**Important Note:** Completing your answers, compulsorily draw diagonal cross lines on the remaining blank pages. Revealing of identification, appeal to evaluator will be treated as malpractice.

| | | UNIT - I | CO | PO | Marks |
|---|---|---|---|---|---|
| 1 | a) | Derive an expression for most economical trapezoidal channel when the depth of flow 'y' is varying and side slope 'n' is constant. | CO1 | PO2 | **08** |
| | b) | A trapezoidal channel of best section has an area of $50m^2$. If the side slopes be 1 vertical to 2 horizontal, find the bottom width and depth. | CO1 | PO2 | **06** |
| | c) | A trapezoidal channel of best form has a cross sectional area of $37.2m^2$ and side slopes of 0.5H:1V, if the bed slope is 1 in 2000 and Chezy's C = 65. Compute the total flow in the channel. | CO1 | PO2 | **06** |
| | | **OR** | | | |
| 2 | a) | Explain the term most economical section of a channel. Derive an expression for most economical rectangular section. | CO1 | PO2 | **08** |
| | b) | Differentiate between:<br>a) Steady and Unsteady flow<br>b) Uniform and Non-Uniform flow | CO1 | PO1 | **06** |
| | c) | A rectangular channel carries water at the rate of $2.25m^3/s$ when the slope of the channel is 0.025%, find the most economical dimensions of the channel if the Manning's N = 0.020. | CO1 | PO2 | **06** |
| | | **UNIT - II** | | | |
| 3 | a) | Explain the types and uses of hydraulic jump. | CO1 | PO1 | **10** |
| | b) | A 3m wide rectangular channel conveys $7.5m^3/sec$ of water with a velocity of 5m/s. Is there a condition for hydraulic jump to occur? If so, calculate the height, length and strength of the jump. Also determine the loss of energy per kg of water and power dissipated in the hydraulic jump. | CO1 | PO2 | **10** |
| | | **OR** | | | |
| 4 | a) | Derive an expression for gradually varied flow in a wide rectangular channel using Manning's equation. | CO1 | PO2 | **10** |

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| | | b) | A rectangular channel 7.0m wide has a uniform depth of flow 2.0m and has a bed slope of 1 in 2500. If due to a weir construction at the downstream end of the channel, the energy line is having a slope of 0.00004, determine the rate of change of water depth with respect to the channel bottom. Assume Manning's n = 0.02. | CO1 | PO2 | **10** |
| | | | **UNIT - III** | | | |
| | 5 | a) | Show that the efficiency of a free jet striking normally on a series of flat vanes mounted on the periphery of a wheel can never exceed half of full efficiency. | CO2 | PO1 | **10** |
| | | b) | A jet of 30mm radius strikes normally on a fixed plate, with a velocity of 35m/s. Calculate the force exerted by the jet on the plate. If the plate is moving with 15m/s in the direction of the plate, find the efficiency of the jet. | CO2 | PO1 | **10** |
| | | | **OR** | | | |
| | 6 | a) | Derive the expression for work done and efficiency of a jet striking a smooth curved vane at its center, when the vane is moving at a linear velocity u, along the direction of the jet. | CO2 | PO1 | **08** |
| | | b) | A jet of water 2.5cm diameter and moving at 15m/sec, strikes upon the centre of a symmetrical vane. After impingement, the jet gets deflected through $160^0$ by the vane. Assuming vane to be smooth, calculate the thrust exerted by the jet on the vane. | CO2 | PO1 | **06** |
| | | c) | A 2.5cm diameter jet of water strikes a symmetrical vane tangentially at one end and leaves at the other end. After impingement, the jet gets deflected through $160^0$ by the vane. Calculate the thrust exerted by jet on the vane if the discharge is $0.00736 m^3/s$. Presume the vane to be smooth. | CO2 | PO1 | **06** |
| | | | **UNIT - IV** | | | |
| | 7 | a) | With a neat sketch explain the parts of Pelton wheel turbine. | CO3 | PO1 | **06** |
| | | b) | Explain the types of efficiencies of a turbine. | CO3 | PO1 | **06** |
| | | c) | Design a Pelton wheel for a head of 80m and speed of 300 RPM. The Pelton wheel develops 110kW. Take co-efficient of velocity = 0.98, speed ratio = 0.48 and overall efficiency = 80%. | CO3 | PO1 | **08** |
| | | | **OR** | | | |
| | 8 | a) | Differentiate between the reaction turbine and impulse turbine. | CO3 | PO1 | **06** |
| | | b) | Explain the main types of reaction turbines. | CO3 | PO1 | **06** |
| | | c) | A turbine works at 450rpm under a head of 120m. Its diameter at inlet is 1.20m and the flow area is 0.4 $m^2$. The angles made by the absolute and relative velocities at inlet are 200m/s and 600m/s respectively with the tangential velocity. Determine:<br>i. The Volume flow rate.<br>ii. The power developed.<br>iii. The hydraulic efficiency.<br>Assume whirl at outlet to be zero. | CO3 | PO2 | **08** |

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| | | | **UNIT - V** | | | |
| | 9 | a) | Explain the efficiencies of a centrifugal pump. | CO3 | PO1 | **08** |
| | | b) | A centrifugal pump is required to handle a slurry consisting of sand and water (S = 1.08). If the quantity of slurry to be pumped is 250lps against a head of 15m, find the power required by the pump, taking its overall efficiency as 70%. Find also the pressure developed by the pump. | CO3 | PO2 | **06** |
| | | c) | The impeller of a centrifugal pump runs at 90 rpm and has vanes inclined at 120˚ to the direction of motion at exit. The manometric head is 20m and manometric efficiency is 75% of vane angles at inlet. Take the velocity of flow as 2.5m/s throughout and the diameter of the impeller at exit as twice that at inlet. Determine the diameter of the impeller at exit. | CO3 | PO2 | **06** |
| | | | **OR** | | | |
| | 10 | a) | Explain the components of a centrifugal pump with a neat sketch. | CO3 | PO1 | **08** |
| | | b) | A centrifugal pump delivers water at the rate of 1800 lpm, to a height of 20m, through a 0.1m dia, 80m long pipe. Find the power required to drive the pump, if the overall efficiency is 65%, and Darcy's friction factor = 0.02. | CO3 | PO2 | **06** |
| | | c) | The impeller of a centrifugal pump runs at 90 rpm and has vanes inclined at 120˚ to the direction of motion at exit. The manometric head is 20m and manometric efficiency is 75% of vane angles at inlet. Take the velocity of flow as 2.5m/s throughout and the diameter of the impeller at exit as twice that at inlet. Determine the diameter of the impeller at exit. | CO3 | PO2 | **06** |

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