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# MANIPAL INSTITUTE OF TECHNOLOGY

MANIPAL

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VI SEMESTER B.TECH (CIVIL) END SEMESTER EXAMINATIONS

APRIL/MAY 2019

SUBJECT: HYDRAULICS AND HYDRAULIC MACHINES (CIE 4007)

Date of Exam: **/ /2019** Time of Exam: Max. Marks: **50**

**Instructions to Candidates:**

- Answer ALL the questions & missing data may be suitably assumed

| Q.No | Questions | Marks | CO |
|---|---|---|---|
| **1A.** | A 3.6m wide rectangular channel carries water to a depth of 1.8m. In order to measure the discharge, the channel width is reduced to 2.4m and a hump of 0.30m height is provided in the bottom. Calculate the discharge, if water surface in the contracted section drops by 0.15m. Assume no losses. | **03** | **CO1** |
| **1B.** | Explain the hydrostatic pressure distribution profile in open channel flow with neat sketch. | **02** | **CO1** |
| **1C.** | A weir is installed across a rectangular open channel, thereby raising the depth from 1.5m in a normal flow of 2.5m at the weir. The width of the channel is 10m and it is laid at the slope of 1 in 10,000. Find an approximate length of the backwater curve. (Use single step method). Take Chezy's C=51.2. | **05** | **CO2** |
| **2A.** | Explain the case of hydraulic jump as an energy dissipater with a neat sketch. | **03** | **CO2** |
| **2B.** | List the 6 characteristics of critical flow occurring in rectangular channels. | **03** | **CO2** |
| **2C.** | In the form of a table give neat sketches related to the steep sloped profile. Sketch the instances of physical occurrence of GVF profile in the following cases;<br>i. Behind an overflow weir<br>ii. Over a free overfall<br>iii. Downstream of a sluice gate | **04** | **CO2** |
| **3A.** | Design a regime channel for a discharge of 50 cumecs and silt factor 1.1 | **03** | **CO3** |
| **3B.** | List the drawbacks in Lacey's theory of unlined canal design on alluvial soil. (4 points ) | **02** | **CO3** |
| **3C.** | Prove that, for maximum efficiency<br>i. in a jet striking at the centre of moving curved vane, the vane velocity should be equal to one third of the jet velocity.<br>ii. in a jet striking a series of flat vanes mounted on the periphery of the wheel, the jet velocity should be twice the vane velocity. | **05** | **CO4** |
| **4A.** | Define the following terms in connection with the operation of a hydraulic turbine<br>(a) Unit speed (b) Unit power<br>(c) Specific speed (d) Unit discharge | **02** | **CO5** |

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| **4B.** | Distinguish between Centrifugal pump and reciprocating pump (8 points) | **04** | **CO5** |
| **4C.** | The impeller of a centrifugal pump has 30cm outside diameter and 15cm inside diameter. The impeller vane angles are 30 and 25 at the inner and outer peripheries respectively and the speed is 1450 rpm. The velocity of flow through the impeller is constant. Assume radial entry. Find the work done by the impeller? | **04** | **CO5** |
| **5 A.** | The following data are given for Francis turbine;<br>Net head = 60m<br>Runner speed = 700 rpm<br>Shaft power = 294.3 kW<br>Overall efficiency =84%<br>Hydraulic efficiency = 93%<br>Flow ratio = 0.20<br>Breadth ratio = 0.1<br>Thickness of vane occupies 5% of circumferential area of runner<br>Velocity of flow is constant at inlet and outlet<br>Discharge is radial at outlet<br>Inner runner diameter is 2 times the outer runner diameter.<br>Find<br>i. Guide blade angle<br>ii. Diameter of runner at inlet and outlet | **05** | **CO5** |
| **5B.** | A Pelton wheel has a mean bucket speed of 10 m/s and the jet discharges $0.70m^3/s$ under a head of 30m. If the deflection angle is $160^\circ$ and the co-efficient if velocity for the nozzle is 0.98, estimate the power developed and the wheel efficiency. Sketch the velocity triangles. | **05** | **CO5** |