BIRLA INSTITUTE OF TECHNOLOGY, MESRA, RANCHI
(END SEMESTER EXAMINATION)

CLASS: BE **SEMESTER : V**
BRANCH: CIVIL **SESSION : MO/18**

SUBJECT: CE5003-FLUID MECHANICS II

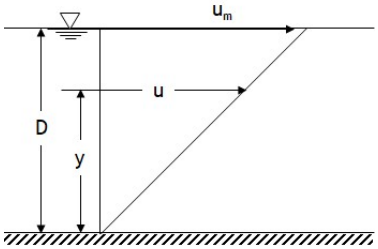
TIME: 03:00 **FULL MARKS: 60**

INSTRUCTIONS:
1. The question paper contains 7 questions each of 12 marks and total 84 marks.
2. Candidates may attempt any 5 questions maximum of 60 marks.
3. The missing data, if any, may be assumed suitably.
***4*. Before attempting the question paper, be sure that you have got the correct question paper.**
5. Tables/Data hand book/Graph paper etc. to be supplied to the candidates in the examination hall.

Q.1(a) What is open channel flow? How it is different than free surface flow? [2]

(b) A sluice gate in a 2 m wide horizontal rectangular channel is discharging freely. If the depths a small distance upstream (y_1) and downstream (y_2) are 2.5 m and 0.2 m respectively, estimate the discharge in the channel (i) by neglecting energy losses at the gate, and (ii) by assuming the energy loss at the gate to be 10% of the upstream depth y_1. [4]

(c) The velocity distributions along the vertical in an open channel are shown below. Determine the kinetic energy correction factor α and momentum correction factor β for both the velocity profiles. [6]



Q.2(a) Derive the parameters of best hydraulic cross-section for trapezoidal channel. [2]

(b) An earthen trapezoidal channel (n = 0.025) has a bottom width of 5 m, side slopes of 1.5 horizontal: 1 vertical and a uniform flow depth of 1.1 m. If the lining of the above channel is to be done with smooth concrete (n = 0.012), determine the equivalent roughness of the lined channel by using Horton's formula, if the channel is (i) to line the sides only, and (ii) to line the bed only. [4]

(c) A circular channel, 2.5 m in diameter is made of concrete (n = 0.014) and is laid on a slope of 1 in 200. Calculate (i) the discharge if the normal depth is 1.5 m, and (ii) the depth of flow for a discharge of 15 m^3/s. [6]

Q.3(a) Find the alternate depths corresponding to a specific head of 2 m and a discharge of 6 m^3/s in a trapezoidal channel having channel width = 0.9 m and m = 1. [2]

(b) A 2.5 m wide rectangular channel carries 6 m^3/s of flow at a depth of 0.5 m. Calculate the minimum height of a streamlined, flat-topped hump required to be placed at a section to cause critical flow over the hump. The energy loss over the hump can be taken as 10% of the upstream velocity head. [4]

(c) A triangular channel has an apex angle of 60^o and carries a flow with a velocity of 2 m/s and depth of 1.25 m. Find (i) the state of the flow, (ii) critical depth, (iii) specific energy, and (iv) possible alternate depth. [6]

Q.4(a) Derive the differential equation of Gradually Varied Flow. [2]

(b) In a 4 m wide rectangular channel (n = 0.017) the bed slope is 0.0006. When the channel is conveying 10 m^3/s of flow, estimate the nature of GVF profiles at two far away sections in this channel where the depth of flow is measured as 1.6 m and 2.1 m. [4]

(c) What are the various classifications of flow profiles? Show with neat sketches. [6]

Q.5(a) What is hydraulic jump? What are its various classifications? [2]

(b) A hydraulic jump takes place in a horizontal triangular channel having side slopes of 1.5 H: 1 V. The depths before and after the jump are 0.3 m and 1.2 m, respectively. Estimate the (i) flow rate, (ii) Froude number at the beginning and end of the jump, and (iii) energy loss in the jump. [4]

(c) Derive the expression of sequent depth ratio and energy loss for hydraulic jump in a horizontal rectangular channel. [6]

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Q.6(a) What is the difference between positive and non-positive displacement types of hydraulic pumps. [2]

(b) A multistage centrifugal pump has four identical impellers, attached to the same shaft. The shaft is running at 400 rpm and the total manometric head developed by the pump is 40 m. The discharge through the pump is 0.2 m^3/s. The vanes of each impeller are having outlet angle as 45°. If the width and diameter of each impeller at outlet is 5 cm and 60 cm respectively, find the manometric efficiency. [4]

(c) A three stage centrifugal pump has impellers 40 cm in diameter and 2 cm wide at outlet. The vanes are curved back at the outlet at 45° and reduce the circumferential area by 10%. The manometric efficiency is 90% and the overall efficiency is 80%. Determine the head generated by the pump when running at 1000 rpm delivering 50 l/s. What will be the shaft horse power? [6]

Q.7(a) Define cavitation in hydraulic turbines? What are its causes and effects? How it can be avoided? [2]

(b) A Pelton wheel is revolving at a speed of 190 rpm and develops 5150.25 kW when working under a head of 220 m with an overall efficiency of 80%. Determine unit speed, unit discharge and unit power. The speed ratio for the turbine is given as 0.47. Find the speed, discharge and power when this turbine is working under a head of 140 m. [4]

(c) A Pelton turbine has a mean bucket speed of 10 m/s with a jet of water flowing at the rate of 700 l/s under a head of 30 m. The buckets deflect the jet through an angle of 160°. Calculate the power given by water to the runner and the hydraulic efficiency of the turbine. Assume co-efficient of velocity as 0.98. [6]

********28.11.18******E**