JAYPEE UNIVERSITY OF INFORMATION TECHNOLOGY, WAKNAGHAT

TEST -3 EXAMINATIONS-2022

B.Tech-6th Semester (Civil)

COURSE CODE (3): **18B1WCE639** MAX. MARKS: 35

COURSE NAME: **Open Channel Flow and Hydraulic Machines**

COURSE INSTRUCTORS: AKHILESH GANDHI MAX. TIME: 2 Hours

Note: *All questions are compulsory. Marks are indicated against each question in square brackets.*

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1. a) A trapezoidal channel has a bottom width of 6 Mtr. And side slope of 1:1. The depth of flow is 1.5 Mtr at a discharge of 15m^3/sec. Determine the specific energy of the flow. If critical depth is 0.9 Mtr, discuss the type of flow corresponding to the critical depth. **(2Marks)**

   b) For a constant specific energy of 2.4 Mtr., calculate the maximum discharge that may occur in a rectangular channel of 4 mtr. width. **(1.5Marks)**

2. In an open channel 1 Mtr. wide, water flows at a depth of 1 mtr, with a velocity of 1m/sec. The flow is assumed to be free of losses. Calculate the following parameters for the flow:

   a) Discharge **(0.5 Marks)**

   b) Froude Number **(0.5 Marks)**

   c) Nature of flow (Super critical/ Sub-critical) **(0.5 Marks)**

   d)Reynolds number (Kinematic Viscosity= 1.01*$10^{-6}$$m^2$/sec. Is the flow Laminar or turbulent? **(1 Mark)**

   e) Energy Head from the bottom of the channel **(0.5 Marks)**

3. In an open channel flow the width of flow is reduced from b_1 to b_2. Based upon this information explain the following scenario's (With Diagram):

   a) What is the minimum value up to which b_2 can be reduced such that the energy of the flow is not affected? **(2 Marks)**

   b) If b_2 is further reduced below the minimum value, what will be the effect on the Specific Energy of the section? **(2 Marks)**

   Explain the above cases for both Super-critical and Sub-critical state of flow.

4. Uniform flow in a open rectangular channel occurs at depth of 1.5 Mtr. The channel is 3 mtr. wide with a slope of .0009. If Manning's coefficient n = .015, Calculate the

   a) Maximum height of up to which the bottom of channel can be raised to produce a flow at critical depth **(1.5 Marks)**

   b) Minimum value up to which the width of channel can be decreased to produce a flow at critical depth in the channel. **(1.5 Marks)**

5. a) Explain the concept of hydraulic jump with appropriate graphs and diagrams. **(1.5 Marks)**

   b) Derive the expression for loss of energy in a hydraulic jump in a rectangular section. **(3 Marks)**

   c) A hydraulic jump occurs in a right-angled triangular channel. Derive the equation relating the depths before and after jump with flowrate in the channel. **(3 Marks)**

   d) In the above question, if the depths before and after the jump are .50 Mtr and 1.0 Mtr, find out the flowrate and obtain the Froude number before and after the jump **(1.5 Marks)**

6. a) For a laminar flow between two parallel plates at a distance of b , one stationary and other moving with a velocity of v, derive the expression for

   1 Velocity distribution between the plates. **(1.5 Marks)**

   2. Discharge per unit width of plates. **(1.5 Marks)**

   3. Shear stress distribution between the plates. **(1.5 Marks)**

b) In the above case, if one plate at rest and one is moving at velocity of .25 m/sec. The fluid between the plates has a viscosity = 1.472N.s/m^2. Determine the pressure gradient which corresponds to the condition of zero discharge between the plates **(2.5 Marks)**

7. A certain fluid has a velocity potential function = **1/3 (x^2) – x^2 +xy^2 +y^2** . Determine the Stream function for this flow. **(2.5 Marks)**

8. A pump is installed in a pipeline 5 cm in diameter, carrying oil of specific gravity 0.83. It returns the oil to a 5 cm diameter pipe at same elevation with a pressure increase of 13.7 KN/m^2. The quantity of oil flowing in the pipeline is 10 Liters/ sec. The motor driving the pump delivers 2.8 KW to the pump shaft. Calculate the loss of energy in the pump. **(3 Marks)**