2005 JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY

III B.TECH I SEMESTER SUPPLEMENTARY EXAMINATIONS
HYDRAULICS AND HYDRAULIC MACHINARY
(CIVIL ENGINEERING)

/NAVEMBER 2005

TIME: 3 HOURS
MAX MARKS: 80

Answer any FIVE Questions
All Questions carry equal marks

1. (a) Explain the terms rapidly varied flow and gradually varied flow.

(b) A trapezoidal channel with side slopes of 1:1 has to be designed to convey 10 m3/s at a velocity of 2 m/s, so that the amount of concrete lining for the bed and sides is the minimum.

i. Calculate the area of lining required for one metre length of the canal.

ii. If the Rugosity coefficient n = 0.015, calculate the bed slope of the canal for uniform flow.
[8+8]

2. (a) What is Froude number? Show that in an open channel flow minimum specific energy at a given flow and maximum flow at a given specific energy occurs when Froude number is unity.

(b) For purpose of discharge measurement, the width of a rectangular channel is reduced gradually from 3m to 2m and floor is raised by 30cm at a given section. When approaching depth of flow is 2m, what rate of flow will be indicated by a drop of 15cm in the water surface elevation at the contracted section? [8+8]

3. Water flows at a steady and uniform depth of 2 m in an open channel of rectangular cross - section having base width equal to 5 m and laid at a slope of 1 in 100. It is desired to obtain critical flow in the channel by providing a hump in the bed. Calculate hump height and sketch the flow profile. Consider the value of Mannings rugosity coefficient n = 0.02 for the channel surface. [16]

4. Using Buckingham's Pi theorem show that velocity through a circular orifice is given by: $V = p2gH – Hd H , \mu \quad V H I$ [16]

5. (a) Define the term: impact of jets. Obtain an expression for the force exerted by a jet of water on a fixed vertical plate in the direction of the jet.

(b) Find the force exerted by a jet of water of diameter 100mm on a stationary flat plate, when the jet strikes the plate normally with a velocity of 30m/sec. [8+8]

6. (a) Differentiate between Reaction turbines and hydraulic turbines.

(b) Draw a neat diagram of pelton turbine and explain its working. [8+8]

7. (a) A hydraulic turbine develops 120 KW under a head of 10 m at a speed of 90 rpm and gives an efficiency of 92%. Find the water consumption and the specific speed. If a model of scale 1: 30 is constructed to operate under a head of 8m what must be its speed, power and water consumption to run under the conditions similar to prototype. [10]

(b) What are the constant head characteristic curves of a turbine? What is the use to develop them? [6]

8. (a) What do you understand by the following :

i. Minimum starting speed of a pump

ii. Priming of pump

iii. Manometric head

iv. Stage of a pump

(b) A centrifugal pump has an impeller of 40 cm diameter. The discharge at the outlet is radial. The diameter ratio is 2. Calculate the manometric efficiency of the pump if the total lift is 25 m. Also calculate the blade angle and relative velocity at the inlet. [4*3+4]