

**4E 2034**

Roll No. \_\_\_\_\_

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**4E 2034****B. Tech. IV Semester (Back/Old Back) Examination - 2012****Civil Engineering****4CE3 Hydraulics and Hydraulic Machines****Time : 3 Hours****Maximum Marks : 80****Min Passing Marks : 24****Instructions to Candidates:**

Attempt any **Five questions** selecting **one question from each unit**. All questions carry **equal marks**. (Schematic diagrams must be shown wherever necessary. Any data you feel missing may suitably be assumed and stated clearly.) Units of quantities used/ calculated must be stated clearly.

**Unit - I**

1. a) State Buckingham's  $\pi$ -theorem. Why this theorem is considered superior over the Rayleigh's method for dimensional analysis. (10)
- b) Derive expressions for any two dimensionless numbers. (6)

**OR**

1. a) A 1:15 model of a flying boat is towed through water. The prototypes is moving in sea water of specific weight 1024 kg/m<sup>3</sup> at a velocity of 20m/sec. Find the corresponding speed of the model. Also determine the resistance due to waves on model if the resistance due to waves of prototype is 6000N. (10)
- b) What are the various types of similarities. Are these similarities truly attainable? If not why? (6)

**Unit - II**

2. Prove that the velocity distribution for viscous flow between two parallel plates when both plates are fixed across a section is parabolic in nature. Also prove that maximum velocity is equal to one and half times the average velocity. (16)

**OR**

2. Derive an expression for shear stress due prandte. What do you mean by Prandte mixing length theory. Also how would you distinguish between hydrodynamically smooth and rough boundaries. (6+6+4=16)

**Unit - III**

3. a) Derive the differential equations for steady gradually varied flow in an open channel and list all assumptions. (10)

$$\frac{dh}{dx} = \frac{(i_b - i_e)}{(1 - F_e^2)}$$

- b) Explain the terms (i) slope of the bed (ii) Hydraulic mean depth (iii) wetted perimeter. (6)

**OR**

3. a) A trapezoidal channel with side slopes of 1 to 1 has to be designed to convey  $10 \text{ m}^3/\text{sec}$ . at a velocity of  $2 \text{ m}/\text{sec}$ . So that the amount of concrete lining for the bed and sides is the minimum. Calculate the area of lining required for one metre length of canal. (10)
- b) Explain the terms
- i) specific energy of a flowing fluid
  - ii) critical depth
  - iii) and critical velocity as applied to non uniform flow. (6)

**Unit - IV**

4. What do you mean by hydraulic jump. Derive expressions for the depth of hydraulic jump and loss of energy due to hydraulic jump. (16)

**OR**

4. A  $7.5 \text{ cm}$  diameter jet having a velocity of  $30 \text{ m}/\text{sec}$ . Strikes a flat plate, the normal of which is inclined at  $45^\circ$  to the axis of the jet. Find the normal force on the plate.
- i) When the plate is stationary and
  - ii) When the plate is moving with a velocity of  $15 \text{ m}/\text{sec}$  and away from the jet.
- Also determine the horse power and the efficiency of the jet when the plate is moving. (6+6+2+2=16)

**Unit - V**

5. Differentiate followings in respect to turbines
- a. Gross head and net head
  - b. Impulse turbine and reaction turbine.
  - c. Specific speed and unit speed
  - d. Speed ratio and flow ratio
  - e. Draft tube and pen stock
  - f. Turbine and pump
  - g. Cavitation and watter hammer
  - h. Hydraulic efficiency and mechanical efficiency. (2x8=16)

**OR**

5. a) Obtain an expression for the workdone by impeller of a centrifugal pump on water per second per unit weight of water.
- b) Obtain an expression for the minimum speed for starting a centrifugal pump. (8+8=16)