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 π-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/m³ 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 m³/sec. at a velocity of 2m/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 cm diameter jet having a velocity of 30 m/sec. Strikes a flat plate, the normal of which is inclined at 45⁰ 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 m/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)

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