IX. (a) Explain the outline of procedure for Buckingham method. (7)

(b) The pressure difference ΔP in a pipe of diameter D and length ℓ due to turbulent flow depends on the velocity v, viscosity μ, density ρ and roughness k. Using Buckingham's π-theorem, obtain an expression for ΔP. (13)

OR

X. (a) What is meant by geometric, kinematic and dynamic similarities? Are these similarities truly attainable? If not why? (10)

(b) The characteristics of the spill way are to be studied by means of a geometrically similar model constructed to the scale of ratio 1 : 10.

(i) If the maximum rate of flow in the prototype is $28.3 m^3$, what will be the corresponding flow in model?

(ii) If the measured velocity in the model at a point on the spill way is 2.4 m/sec, what will be the corresponding velocity in prototype?

(iii) If the hydraulic jump at the foot of the model is 5 cm high, what will be the height of jump in prototype?

(iv) If the energy dissipated per second in the model is 3.5 m/kgf, what energy is dissipated per second in the prototype? (10)

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BTS 132 (G)

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B.TECH. DEGREE IV SEMESTER (SUPPLEMENTARY) EXAMINATION IN CIVIL ENGINEERING (HABITAT ENGINEERING & CONSTRUCTION MANAGEMENT) JUNE 2001

CE 405 FLUID MECHANICS

(Before 1998 Admissions)

Time: 3 Hours Maximum Marks: 100

I. (a) Derive an expression for the depth of centre of pressure from free surface of liquid of an inclined plane surface submerged in the liquid. (8)

(b) The end gates ABC of a lock are 9 m high and when closed include an angle of 120°. The width of the lock is 10 m. Each gate is supported by two hinges located at 1 m and 6 m above the bottom of the lock. The depth of water on the two sides are 8 m and 4 m respectively. Find -

(i) Resultant water force on each gate.
(ii) Reaction between the gates AB and BC, and
(iii) Force on each hinge, considering the reaction of the gate acting in the same horizontal plane as resultant water pressure. (12)

OR

II. (a) Define flownet. Describe the use and limitations of flownets. (8)

(b) Deerive the continuity equation for variable cross-sectional area flow passage. (6)

(c) For a two dimensional flow $\phi = 3xy$ and $\psi = \frac{3}{2}\left(y^2 - x^2\right)$. Determine the velocity components at the points (1, 3) and (3, 3). Also find the discharge passing between the stream lines passing through the points given above. (6)

(Turn over)

III. (a) State the momentum equation. How will you apply momentum equation for determining the force exerted by a flowing liquid on a pipe bend. (8)

(b) In a 45° bend a rectangular air duct of 1 m^2 cross-sectional area is gradually reduced to 0.5 m^2 area. Find the magnitude and direction of the force required to hold the duct in position if the velocity of flow at the 1 m^2 section is 10 m/sec and pressure is 0.3 Kgf/cm^2. Take specific weight of air as 1.16 Kgf/m^3. (12)

OR

IV. (a) Explain the working of a pitot-tube. (8)

(b) A cylindrical tank is placed with its axis vertical and is provided with a circular orifice 40 mm in diameter in its bottom. Water flows into the tank at a uniform rate and is discharged through the orifice. It is found that it takes 107 seconds for the head in the tank to rise from 0.60 m to 0.76 m and takes 120 seconds for it to rise from 1.20 m to 128 m. Find the rate of in-flow in cubic meter and the cross-sectional area of the tank. Take $C_d = 0.62$. (12)

V (a) What is Hagen Poiseuille's formula? Derive an expression for Hagen Poiseuille's formula. (14)

(b) What power is required per kilometre of a line to overcome the viscous resistance to the flow of glycerine through a horizontal pipe of diameter 10 cm at the rate of 10 litres/sec?
Take $\mu = 8$ poise and kinematic viscosity $\upsilon = 6.0$ stokes. (6)

OR

VI. (a) Describe Nikuradse's experiments on the resistance of artificially roughened pipes. Discuss the characteristic features of the results obtained. (10)

Contd.....3.

VI. (b) A pipe of diameter 0.1 m carries water at 15°C. If sand grains of 0.75 mm in diameter are cemented on the inner surface of the pipe for test purposes, at what velocity of water will -

(i) the surface roughness just begins to distrub the laminar sublayer and

(ii) the pipe wall behaves as rough boundary.

Kinematic viscosity of water at 15°C is 1.14×10^{-2} *stokes*. (10)

VII. (a) Explain the following:

(i) Friction drag

(ii) Form drag

(iii) Deformation drag (9)

(b) Draw and explain the approximate flow pattern and the pressure distribution around a flat plate placed perpendicularly in a stream flow. (11)

OR

VIII. (a) What is a compound pipe? How would you determine the equivalent size of a compound pipe? (8)

(b) A horizontal pipe of diameter 50 cm is suddenly contracted to a diameter of 25 cm. The pressure intensities in the large and smaller pipe is given as 13.734 N/cm^2 and 11.772 N/cm^2 respectively. Find the loss of head due to contraction if $C_c = 0.62$. Also determine the rate of flow of water. (12)

Contd.....4.