Exam.Code:0945
Sub. Code: 6353

1078

B.E. (Civil Engineering) Third Semester
CIV-305: Fluid Mechanics – I

Time allowed: 3 Hours

Max. Marks: 50

NOTE: *Attempt five questions in all, selecting two questions from each Section. Assume missing data suitably, if any.*

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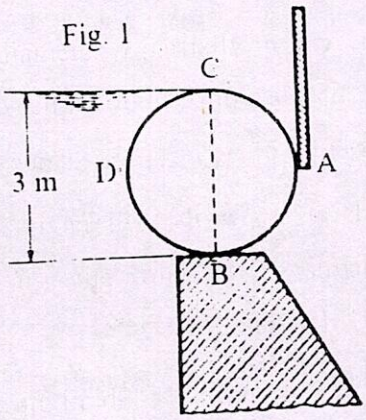
SECTION-A

Q.1. (a) The cylindrical gate of a canal headworks, having a diameter of 3 m and length of 6m, is subjected to water pressure upto its top as shown in the **Fig. 1.** The gate resting on the concrete floor, is laterally supported at A where coefficient of friction is 0.15. Assuming water tight condition at B, and no rotation of cylinder, find the minimum weight of the cylinder so that it may have no upward motion resulting from the water pressure. **[5 marks]**

Fig. 1



(b) Derive an expression for metacentric height of a ship model using theoretical procedure.

[5 marks]

Q.2. (a) An oil of viscosity 0.5 Ns/m^2 is used for lubrication between a shaft and a sleeve. The diameter of the shaft is 0.5 m and it rotates at 200 rpm. Find the power lost in oil for a sleeve of length of 100 mm. The thickness of the oil film is 1 mm. **[5 marks]**

(b) Derive an expression for capillary rise in a thin tube of diameter d partially immersed vertically in a liquid of surface tension λ. Angle of contact between liquid and tube is θ.

[5 marks]

Q.3. (a) For a two-dimensional flow, the velocity potential is given by, $\Phi = x\,(2y - 1)$. Determine the velocity at the point P (4, 5). Determine also the value of the stream function ψ at the point P. **[5 marks]**

(b) What are flow-nets? How are they useful in Civil Engineering field? **[5 marks]**

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Q.4. (a) State and prove Euler's equation of motion. Also derive Bernoulli's equation from Euler's equation. **[5 marks]**

(b) A hollow cylinder of outside diameter 1.25 m, length 3.5 m and unit weight 75537 N/m^3, floats just in stable equilibrium in sea water. Find the minimum permissible thickness of the cylinder. Sea water weighs 10055 N/m^3. **[5 marks]**

SECTION-B

Q.5. (a) State Stokes' law. What are its applications? **[5 marks]**

(b) Two large plane surfaces are 25 mm apart. This space is filled with glycerine of dynamic viscosity 0.804 Ns/m^2. Find what force is required to drag a very thin plate of area 0.5 m^2 between the two surfaces at a speed of 0.6 m/sec: (i) If the plate is equidistant from the two surfaces, and (ii) if the plate is 10 mm from the lower surface. **[5 marks]**

Q.6. (a) Describe briefly the different types of head losses in fluid flow through pipes. **[5 marks]**

(b) An oil of specific gravity 0.85 is pumped through a horizontal pipe, 150 mm in diameter and 1220 metres long. The discharge is 22.5 Litres/sec. when the pump which has an efficiency of 65%, takes 7.35 kW to drive it. Find the viscosity of the oil. Take, $f = 16/R_e$. **[5 marks]**

Q.7. (a) What is boundary layer? Also describe and derive expression for energy thickness of the boundary layer. **[5 marks]**

(b) Differentiate between laminar boundary layer from turbulent boundary layer. **[5 marks]**

Q.8. (a) Explain the Buckingham's Pi Method of Dimensional Analysis with a suitable example. **[5 marks]**

(b) The efficiency η of a fan depends on the density ρ, the dynamic viscosity μ of the fluid, the angular velocity ω, diameter D of the rotor and the discharge Q. Express η in terms of dimensionless parameters. Use Rayleigh's method of dimensional analysis. **[5 marks]**

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