[Total No. of Questions - 9] [Total No. of Printed ges - 4]
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B. Tech 3rd Semester Examination

Fluid Mechanics (NS)

CE-213

Time : 3 Hours **Max. Marks : 100**

The candidates shall limit their answers precisely within the answer-book (40 pages) issued to them and no supplementary/continuation sheet will be issued.

Note : Candidates are required to attempt five questions in all selecting one question from each of the Sections A, B, C & D of the question paper and all the subparts of the questions in Section-E.

SECTION - A

1. (a) A U-tube is made of two capillaries of diameter 1.0 mm and 1.5 mm respectively. The tube is kept vertically and partially filled with water of surface tension 0.0736 N/m and zero contact angle. Calculate the difference in the levels of miniscii caused by the capillarity. (10)

   (b) A circular disc of diameter 'd' is slowly rotated in a liquid of larger viscosity 'μ' at a small distance 'h' from a fixed surface. Derive an expression for torque 'T' necessary to maintain an angular velocity 'ω'. (10)

2. (a) A vertical gate supports water on one side to a depth of 7.2 meters. Horizontal load on the gate is taken by three beams placed parallel to the water surface. Determine the position of the beam such that each beam carries one-third of the total load. (10)

   (b) An empty tank (with all sides closed) is rectangular in plan, side elevation and end elevation with sides 12.5 m long,

0.7 m broad and 0.6 m high. If the sheet metal weighs 363 N/m^2 of the surface and the tank is allowed to float in fresh water with 0.6 m edges vertical, prove that the equilibrium is stable or otherwise. Derive the equation you may use. Weight of water is 9810 N/m^3. (10)

SECTION - B

3. The velocity along a circular streamline having its centre at the origin and radius of 1.5 m is constant at 2 m/s. Determine the radial and tangential components of acceleration at any point on the streamline. Calculate the horizontal, vertical, tangential and normal acceleration at (1.5, 30°) expressing these quantities in Cartesian and Polar co-ordinates. (20)

4. (a) Derive a relationship between Stream function and Velocity potential and also explain utilities of a Flownet. (10)

   (b) A vertical Venturimeter has an area ratio of 5. It has throat diameter of 1.0 cm. When oil of specific gravity 0.8 flows through it, the mercury in the differential gauge, connected between inlet and throat indicates a difference in height of 12.0 cm. Find the discharge flowing through the Venturimeter. (10)

SECTION - C

5. (a) A pipe of 15 cm diameter, 15 meter long is connected to the bottom of a tank, 15 meter long and 12 meter wide. The original head over the open end of the pipe is 5.0 meter. Find the time of emptying the tank, assuming the entrance to the pipe is sharp edged. (10)

   (b) Two pipes of diameter 40 cm and 20 cm are each 300 m long. When the pipes are connected in series and discharge through pipe line is 0.10 m^3/sec, find the loss of head incurred. What would be the loss of head in the system to pass the same total discharge when the pipes are connected in parallel. (10)

[P.T.O.]

6. (a) If a conduit of 2.0 meter diameter is to carry a flow of 4.25m^3/sec of water at 20°C ($v = 1 \times 10^{-6}$ m^2/s) with minimum loss of energy, determine the permissible height of surface roughness. (10)

   (b) What power will be required, per one kilometre length of pipe line to overcome the viscous resistance to the flow of crude oil ($\mu = 0.19$ Pa.s) through a horizontal 10 cm diameter pipe at the rate of 650 li/hr. (10)

SECTION - D

7. (a) For a linear distribution of velocity in the boundary layer on a flat plate, find the value of δ^*/θ. (10)

   (b) How was it possible for Prandtl to divide the flow field into zones of dominant viscous and inertial forces? How is the flow analysis simplified this way? (10)

8. (a) Assuming that the drag force exerted by a flowing fluid is a function of the fluid density, viscosity, velocity of the fluid and a characteristic length of the body, develop a general equation by dimensional analysis. (10)

   (b) State Buckinghm's π-theorem. Explain the terms geometric, kinematic and dynamic similitude. Is it always possible to have complete similarity for model and prototype analysis? If not, what best approximation is resorted to? (10)

SECTION - E

9. (i) Write-down some examples where compressibility of water should be considered.

   (ii) Does a (i) barometer, (ii) Bourdon gauge, (iii) piezometer tube, measure absolute or gauge pressure?

   (iii) Sketch the typical velocity distribution for a uniform ir-rotational flow.

   (iv) Cite examples of unsteady flow. How can the unsteady flow be transformed to steady one?

   (v) What are the limitations of Bernoulli's equations?

   (vi) Why we should use momentum correction factor 'β' while study dynamic fluid phenomenon?

   (vii) List the factors which affects the transition of flow from Laminar to Turbulent.

   (viii) List distinguishing characteristics of a laminar flow.

   (ix) What are the causes which result in separation of boundary layer?

   (x) Define the Mach number as ratio of which forces? (2×10=20)