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

Fluid Mechanics (N.S.)

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 : Attempt five questions in all, select one question from each sections A, B, C and D. Section E is compulsory.

SECTION - A

1. (a) A circular disc of 300 mm diameter and weighing 50 N is kept on an inclined surface of slope 30°. The space of 2 mm between the disc and inclined surface is filled with oil of viscosity 1 Ns/m^2. What force is required to pull the disc up the inclined surface at velocity of 0.5 m/s?

   (b) Determine the absolute and gauge pressure of air in the tank shown in Figure 1. Also, find the gauge reading at A. Given, local atmospheric pressure = 755 mm of mercury.

(10+10=20)

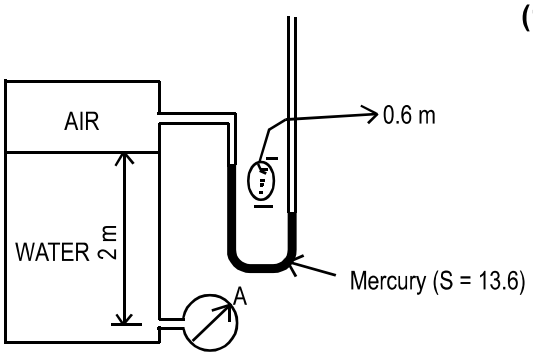

Figure 1

2. (a) A circular plate 1.5 m diameter is submerged in water, with its greatest and least depth below the surface being 2 m and 0.75 m respectively. Determine the total pressure and its location on one side of the plate.

   (b) A wooden cylinder of specific gravity 0.6 is required to float in oil of specific gravity 0.90. Determine the ratio of length to diameter of the cylinder so that it floats in stable equilibrium with longitudinal axis vertical. **(10+10=20)**

SECTION - B

3, A two dimensional flow field is given by potential function ϕ=3xy. Determine (i) the stream function (ii) velocity and acceleration at points A (2 m, 6 m) and B (6 m, 6 m) (iii) pressure difference between points A and B and (iv) flow rate between streamlines through points A and B. **(20)**

4. (a) Derive the discharge equation of a venturimeter.

   (b) A vertical water jet 80 mm diameter leaving a nozzle with a velocity of 9 m/s, strikes a horizontal moveable disc. The jet is deflected horizontally after striking the disc. Determine the vertical distance above the nozzle at which the disc will be held in equilibrium. The weight of disc is 160 N. **(10+10=20)**

SECTION - C

5. Three pipes 1, 2 and 3 are fitted in series between the two reservoirs having difference in water surface elevations as 10 m. The relevant data is:

Pipe No.	Length (m)	Diameter (mm)	Friction factor
1	300	300	0.019
2	150	200	0.021
3	200	250	0.020

Determine the rate of flow. Given, coefficient of contraction = 0.65. Also, draw HGL and TEL. **(20)**

6. (a) A liquid is pumped through a 150 mm diameter and 300 m long pipe at the rate of 20 tonnes per hour. Show that the flow is laminar and determine the power required to pump the liquid. Given, density of liquid = 910 kg/m^3 and kinematic viscosity = 0.002 m^2/s.

   (b) A 20 mm diameter lead sphere of relative density 11.4 has a terminal fall velocity of 0.30 m/s in an oil of relative density 0.90. Determine the viscosity of oil. **(10+10=20)**

SECTION - D

7. (a) Using dimensional analysis, find an expression for drag force F_D on a smooth sphere of diameter D moving with a uniform velocity U_o in a fluid of density ρ and viscosity μ.

   (b) The discharge and velocity of flow over the model of a spillway are 2.5 m^3/s and 1.5 m/s, respectively. Calculate velocity and discharge over the prototype if scale ratio is 36. **(12+8=20)**

8. The velocity in the turbulent boundary layer over a flat plate is given by 1/7th power law equation of velocity distribution. Using this velocity distribution, calculate displacement thickness, momentum thickness and energy thickness. Also, calculate energy loss and momentum flux due to boundary layer if at a particular section, boundary layer thickness is 25 mm and free stream velocity is 15 m/s. Take density of air = 1.2 kg/m^3. **(20)**

SECTION - E

9. (i) Explain the phenomenon of capillarity.

   (ii) State hydrostatic law of pressure variation.

   (iii) What is a stream line and what are the characteristics of stream lines?

(iv) Write the general equation of continuity in Cartesian coordinates. Hence deduce continuity equation for 2D, steady and incompressible fluid flow.

(v) Define fluid statics, fluid kinematics and fluid dynamics.

(vi) Differentiate weirs and notches.

(vii) What is moment of momentum equation and what are its applications?

(viii) Define equivalent pipe and what is its significance?

(ix) Draw velocity distribution for laminar and turbulent flows in a circular pipe. Write the equations of these velocity distributions.

(x) Write a short note on models study. **(2×10=20)**