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B.TECH.
(SEM III) THEORY EXAMINATION 2022-23
FLUID MECHANICS

Time: 3 Hours ***Total Marks: 100***

Note: Attempt all Sections. If require any missing data; then choose suitably.

SECTION A

1. Attempt *all* questions in brief. **2 x 10 = 20**

(a) Define no slip condition.
(b) One liter of petrol weighs 7.0N. Calculate the specific weight, density, specific volume and relative density.
(c) What are the difference between Path line and Streak line?
(d) Define reversible flow.
(e) What do you mean by sink flow?
(f) Write the assumptions made for Euler's equation of motion.
(g) What do you mean by turbulent flow?
(h) What is the laminar boundary layer?
(i) What is the requirement for dynamic similarity?
(j) Give the name of four important dimensionless numbers in fluid mechanics.

SECTION B

2. Attempt any *three* of the following: **10x3=30**

(a) The local atmospheric pressure at a place at 30^0 C is 1 bar. Determine the pressure at an altitude of 5 km if (i) the air density is assumed to be constant (ii) if the temperature is assumed to be constant and (iii) if with altitude the temperature decreases linearly at a rate of 0.005 ^{0} C per meter. Gas constant R = 287 J/kg K.
(b) In a two dimensional flow, determine a possible x component give $v = 2y^2 + 2x - 2y$. Assume steady incompressible flow.
(c) Water is flowing through a pipeline of 50 cm dia at 30^0 C. An orifice is placed in the pipeline to measure the flow rate. Orifice meter is 20 cm. If the manometer reads 30 cm of Hg, Calculate the water flow rate and velocity of the fluid through the pipe. ρ_{water} at 30^0 C=987 kg/m^3 , ρ_{Hg} = 13600 kg/m^3 , orifice co-efficient = 0.6
(d) Fluid is in laminar motion between two parallel plates under the action of motion of one of the plates and also under the presence of pressure gradient in such a way that the net forward discharge across any section is zero. (i) Find out the point where minimum velocity occurs ant its magnitude. (ii) Draw the velocity distribution graph across the section.
(e) Using the method of dimensional analysis obtain an expression for the discharge Q over a rectangular weir. The discharge depends on the Head H over the weir, acceleration due to gravity g, length of weir crest L, height of the weir crest over the channel bottom Z and the kinematic viscosity ν of the liquid.

SECTION C

3. Attempt any *one* part of the following: 10x1=10

(a) Find the range of b/h for the stable equilibrium of a floating body of relative density S, where b is the width and h is the height of the body. A right circular cylinder of 0.3 m dia and 0.6 m length with a specific weight of 7500 N/m ^{3} is to float vertically in kerosene of specific weight of 8900 N/m^3. Determine the stability of cylinder.

(b) Derive the expression for the ratio of base diameter to the height of a cone to float in a stable condition given the relative density between the solid and the fluid as S.

4. Attempt any *one* part of the following: 10x1=10

(a) Prove that the stream function and potential function lead to orthogonality of stream lines and equipotential flow lines.

(b) Describe the method of determination of the stream function given the velocity relationship and also determine the stream function given u=4xy and v = c-2y^2.

5. Attempt any *one* part of the following: 10x1=10

(a) Find the time taken to raise the water level in a tank of uniform cross- sectional area A when an orifice of area 'a' at the bottom is discharging while there is a constant inflow of Q into the tank.

(b) A pipe line 200 mm dia. And 4000 m long connects two reservoir with a difference in level of 60 m. Water is drawn at 1500 m point at a rate of 500 l/s. Friction coefficient f = 0.024 . Determine the flow rates in two sections. Neglect minor losses.

6. Attempt any *one* part of the following: 10x1=10

(a) Prove that in case of force vortex, the rise of liquid level at the ends is equal to the fall of liquid level at the axis of rotation.

(b) In a pipe of 300 mm diameter the maximum velocity of flow is found to be 2 m/s. If the flow in the pipe is laminar find:

(i) The average velocity and the radius at which occurs

(ii) The velocity at 50 mm from the wall of the pipe.

7. Attempt any *one* part of the following: 10x1=10

(a) Stokes derived the drag F_D experienced by a sphere of diameter D moving at a uniform velocity U through a fluid viscosity μ to be $F_D = 3\mu\pi DU$. State the validity of this expression in relation to the particular Reynolds number. Derive the coefficient of drag C_D from Stoke's law.

(b) A 1: 64 model is constructed an open channel in concrete which has Manning's N=0.014. Find the value of N for the model.