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B. Tech. EXAMINATION, 2020

(Third Semester)

(B Scheme) (Re-appear Only)

(ME, AER)

ME207B

FLUID MECHANICS

Time : 2½ *Hours*] [*Maximum Marks :* 75

Before answering the question-paper candidates should ensure that they have been supplied to correct and complete question-paper. No complaint, in this regard, will be entertained after the examination.

Note : Attempt *Four* questions in all. All questions carry equal marks. Candidate may use only non-programmable scientific calculator. Assume suitably any missing data, if any.

1. (a) Elaborate the difference between Dynamic viscosity and Kinematic viscosity. Find the kinematic viscosity in stokes of a liquid whose specific gravity is 0.95 and viscosity is 0.011 poise.

(b) Find the smallest diameter of a manometer tube such that error due to capillary action in the measured gauge pressure of 100 N/m is less than 5 per cent. The manometric liquid is water. Assume for water, surface tension = 0.073 N/m, angle of contact = 0° and weight density = 9810 N/m^3.

(c) At a certain location in the flow filed, pressure equals 50 m of water column. Obtain the equivalent pressure head in terms of (i) kerosene of specific gravity 0.8; (ii) carbon-tetra-chloride of specific gravity 1.5.

2. (a) A rectangular plate 3 m × 5 m is immersed vertically in water such that the 3 m side is parallel to the water surface. Determine the hydrostatic force and the centre of pressure if the top edge of the surface is (i) flush with the water surface; (ii) 2 m below the water surface. Comment of the result.

(b) A cone of base radius R and height H floats in water with vertex downwards. If the specific gravity of the cone material is 0.8, find the apex angle of the cone for just stable equilibrium.

3. (a) The one dimensional steady state flow through a converging nozzle is stated to have linear velocity distribution $u = u(x)$ with velocities $u = V_0$ at the nozzle base, and $u = 3V_0$ at the nozzle tip. Set up the expression for the acceleration as a general function of distance x from the nozzle base. If the nozzle has a length of

500 mm and the velocity V_0 = 5 m/s, make calculations for the acceleration at the base and the tip of the nozzle.

(b) Water flows through a pipe AB 1.2 m diameter at 3 m/s and then passes through a pipe BC 1.5 m diameter. At C, the pipe is branches into as CD and CE. The branch CD is 0.8 m in diameter and carries one-third of the flow in AB. The flow velocity in branch CE is 2.5 m/s. Find the volume rate of the flow in AB, the velocity in BC and CD and the diameter of CE.

4. Establish the Bernoulli's theorem from the Euler equation of the motion through a stream tube. Mention the assumptions made. A horizontal water pipe of diameter 15 cm converges to 7.5 cm diameter. If the pressure at the two sections are 400 kPa and 150 kPa respectively. Calculate the flow rate of the water.

5. Two fixed parallel plates kept 8 cm apart have laminar flow of oil between them with a maximum velocity 1.5 m/s. Assuming dynamic viscosity of oil to be 2.0 Ns/m^2, compute :

(i) the discharge per meter width

(ii) the shear stress at the plates

(iii) the pressure difference between two points 25 m apart

(iv) velocity at 2 cm from the plate

(v) the velocity gradient at the plates end.

6. Explain, how the equivalent diameter of a compound pipe is determined ? An old water supply distribution pipe 25 cm diameter of a city is to be replaced by two parallel pipe of smaller diameter having equal length and identical friction factor values. Find out the new diameter required.

7. The velocity distribution in the boundary layer of a flat plate is prescribed by relation $\frac{u}{U_0} = \sin\left(\frac{\pi y}{2\delta}\right)$. Use momentum integral equation to develop an expression for the boundary layer thickness, wall shear stress and skin friction coefficient, drag force on one side of the plate and the drag coefficient in terms of *Reynolds* number.

8. What type of drag predominates in the motion of (i) a blunt body; (ii) stream-lined body; (iii) a tennis ball; (iv) an arrow; (v) a parachute ? A truck having a projected area of 6.5 m^2 travelling at 70 km/hr has a total resistance of 2 kN. Of this 20% is due to rolling friction and 10% due to surface friction. The rest is due to form drag. Make calculations for the coefficient of form drag. Assume density of air as 1.22 kg/m^3.