B.Tech. 4th Semester (ME) F-Scheme Examination,
May–2018
FLUID MECHANICS
Paper–ME–208–F

Time allowed : 3 hours] *[Maximum marks : 100*

Note : *This Q. 1 is compulsory and of short answers type. Each question carries equal marks (20 marks). Students have to attempt 5 questions in total at least one question from each section.*

1. (a) Show graphically the variation of shear stress with velocity gradient for-ideal plastic, ideal, Newtonian, Pseudo plastic fluids.
   (b) State Pascal Law.
   (c) What is the value of mach number for subsonic and hypersonic flow.
   (d) Discuss the limitations and characteristics of flow net.
   (e) State the assumptions used in derivation of Bernoulli's theorem.
   (f) What is Prandtl's number ? State its significance.
   (g) Write the Darcy equation for head loss due to friction in turbulent flow.
   (h) Classify turbulent motion.
   (i) What are the advantages of using Venturimeter and Orifice meter in fluid flow measurements ?

(j) Why is a triangular weir more suitable than a rectangular weir for measuring discharge ?

$2 \times 10 = 20$

Section–A

2. (a) Enunciate Newton's law of viscosity. Explain the importance of viscosity in fluid motion. What is the effect of temperature on viscosity of water and that of air ? 10

(b) Prove that the total pressure exerted by a static liquid on an inclined plane submerged surface is same as the force exerted on a vertical plane surface as long as the depth of centre of gravity of the surface is unaltered. 10

3. (a) Describe briefly different methods of drawing flow nets. 10

(b) The velocity vector in an incompressible flow is given by

$$V = (6xt + yz^2)\,i + (3t + xy^2)\,j + (xy - 2xyz - 6tz)\,k$$

(i) Verify whether the continuity equation is satisfied

(ii) Determine the acceleration vector at point A (1, 1, 1) at t = 1.0. 10

Section–B

4. (a) State and derive Bernoulli's theorem, mentioning clearly the assumptions underlying it. 10

(b) A 45° reducing bend is connected in a pipe line, the diameters at the inlet and outlet of the bend being 40 cm and 20 cm respectively. Find the force exerted by water on the bend if the intensity of pressure at inlet of bend is 21.58 N/cm^2. The rate of flow of water is 500 lit/sec. 10

5. (a) Find the maximum power transmitted by a jet of water discharging freely out of nozzle fitted to a pipe = 300m and 100mm diameter with co-efficient of friction as 0.01. The available head of the nozzle is 90m. 10

(b) Explain how the friction in a constant area duct affects the flow if the flow is (i) initially subsonic (ii) initially supersonic. 10

Section–C

6. (a) Draw a neat sketch of Reynolds Apparatus and explain how the laminar flow can be demonstrated with the help of the apparatus. 10

(b) Two parallel plates kept 100 mm apart have laminar flow of oil between them with a maximum velocity of 1.5 m/sec. Calculate discharge per metre width, shear stress at the plates and the difference in pressure between two points 20m apart. Assume viscosity of oil to be 24.5 poise. 10

7. (a) Derive the Darcy-Weisbach equation for friction head loss in a pipe. 10

(b) Water is flowing through a horizontal pipeline 1500 m long and 200 mm in diameter. Pressure at the two ends of the pipeline are respectively 12 kpa and 2 kpa. If f = 0.015, determine the discharge through the pipe in litres per minute. Consider only friction loss. 10

Section–D

8. (a) Explain how laminar and turbulent boundary layers are formed and distinguish between their characteristics. 10

(b) A thin flat plate measuring 75 cm × 25 cm is exposed parallel to a stream of water of uniform velocity 1.2 m/sec. The flow takes place parallel to 25 cm side of the plate. If the kinematic viscosity of water is 1.1 centistokes, determine the maximum boundary layer thickness, shearing stress at the trailing edge and the drage on both sides of the plate. 10

9. (a) How are the drag and lift forces caused on a body immersed in a moving fluid. 10

(b) A cylindrical tower has a diameter of 2.5 m and 50m high. Estimate the drag force on the tower and ending moment at its bottom when a wind at 80 km/hr blow across it. Take $C_1 = 0.33$ and assume density = 1.3 kg/m^3 for air. 10