[03–3210]

III/IV B.E. DEGREE EXAMINATION.

Second Semester

Mechanical Engineering

FLUID MECHANICS

(Common with Dual Degree Programme in Mechanical Engineering)

(Effective from the admitted batch of 2006–2007 credit system)

Time : Three hours Maximum : 70 marks

Question No. 1 is compulsory.

Answer any FOUR questions from the remaining.

Answer to question No.1 must be at one place.

Assume suitable missing data wherever necessary.

All questions carry equal marks.

$(7 \times 2 = 14)$

1. (a) Define specific volume and specific gravity.

   (b) What do you understand by total pressure and centre of pressure?

   (c) Write merits and demerits of manometers.

7. (a) Derive the momentum equation for compressible fluid flow with adiabatic process. (7)

(b) An aero plane is flying at 1000 Km/h through a still air having a pressure of 98.1 KPa (absolute) and temperature of 320 K. Compute the Mach number and also the stagnation properties i.e. pressure, temperature density on the nose of the plane. (7)

8. (a) Derive equation for a Venturimeter discharge in an incompressible flow. (7)

(b) A supersonic nozzle is to be designed for airflow with Mach number 3 at the exit section which is 200 mm in diameter. The pressure and temperature of air at the nozzle exit are 7.85 KPa and 200 K respectively. Determine the reservoir pressure and temperature and the throat area taking R = 287 J/Kg-K. (7)

(d) What is the condition for the flow to be irrotational?

(e) Define Bernoulli's equation.

(f) State Buckingham's π-theorem.

(g) Define displacement thickness.

2. (a) An oil film of thickness 10 mm is used for lubrication between the two square parallel plates of size 0.9 in each, in which the upper plate moves at 2 m/s required a force of 100 N to maintain this speed.

Determine

(i) dynamic viscosity of oil and

(ii) kinematic viscosity of oil, if the specific gravity of the oil is 0.95. (7)

(b) State Bemoullis theorem for steady flow of an incompressible fluid. Derive an expression for Bernoulli's theorem from first principle. (7)

3. (a) State the principal of working of a venturimeter and obtain an expression for the actual discharge through the venturimeter. (7)

(b) Test the flow represented by $u = 3x + 4y$ and $v = 2x - 3y$ is rotational or irrotational. Find the potential function. (7)

4. (a) Obtain expression for Darcy-Weishbach friction factor for flow in a pipe. (6)

(b) In a pipe of 80 mm diameter an oil of specific gravity 0.8 is flowing at the rate of 0.0125 m^3/s. A sudden enlargement takes place into a second pipeline of such diameter that maximum pressure rise is obtained.

Find (i) Loss of energy in sudden enlargement (ii) Differential gage length indicated by oil mercury connected between the two pipes. (8)

5. (a) Discuss the reasons for boundary layer separation and the methods for its control. (7)

(b) For the given velocity profile $(u/U_{max}) = (y/\delta)^{1/7}$ determine (i) boundary layer thickness (ii) wall shear stress (iii) coefficient of drag (iv) drag force and average drag coefficient. (7)

6. (a) Show that the resistance to motion R of an object moving in a fluid can be given by the following expression $R = \rho V^2 d\phi(\rho V d/\mu)$ where is density is ρ, velocity is V and viscosity is μ. (7)

(b) Describe the term similarity and what is required to achieve geometric similarity, kinematic similarity and dynamic similarity. (7)