H.T NO.										

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MLR INSTITUTE OF TECHNOLOGY

(An Autonomous Institution)
II B.Tech I Sem Regular Examinations- December-2016

MECHANICS OF FLUIDS
(AERO)

Time: 3 hours Max.Marks :75

Note: 1. This question paper contains two parts A and B.
2. Part A is compulsory which carries 25 marks. Answer all Questions in part A.
3. Part B consists of 5 units. Answer any one full question from each unit. Each question carries 10 Marks and may have a,b,c as sub questions.

PART A

1. a) State and explain the Newton's law of viscosity? [2]
b) Write the continuity equation for steady two dimensional incompressible flow field? [2]
c) The Reynold's number for the flow of oil in a certain pipe is 640. What is the Darcy-Weisbach friction factor 'f' for this flow? [2]
d) Draw the velocity profile for laminar flow within the boundary layer? [2]
e) Define compressibility? [2]

2. a) Calculate the Mass Density, Specific Weight, Specific Gravity and Specific Volume of an oil, 10 m^3 of which weighs 70 kN. [3]
b) Flow field is described by $V = x^2y\,i - xy^2\,j$, Is this flow irrotational? [3]
c) Define coefficient of discharge (C_d), co-efficient of contraction (C_c) and co-efficient of velocity (C_v)? Relate C_d, C_c and C_v? [3]
d) Explain the concept of Boundary layer with a neat sketch. [3]
e) What is the widely accepted condition to neglect compressibility of gases? Explain? [3]

PART B

3. a) A simple u-tube manometer contains mercury is connected to a pipe in which a fluid of specific gravity 0.8 and having vacuum pressure is flowing in the other end of the manometer is opened to atmosphere. Find the vacuum pressure in pipe, if the difference of mercury level in two limbs is 40cm and the height of the fluid in the left from the centre of the pipe is 15cm below. [5]
b) derive a expression for vertical single column manometer. [5]

OR

4. a) two large plane surfaces are 2.4cm apart. The space between the surfaces is filled with glycerine. What force is required to drag a very thin plate of the surface are 0.5m^2 between the two large plane surfaces at a speed of 0.6m/s. if
i. the thin plate is in the middle of the two plane surfaces.
ii. the thin plate is at a distance of 0.8cm from one of the plane surface? Take dynamic viscosity of glycerine =$8.1*10^{-1}$ Ns/m^2 [5]
b) determine the viscosity of liquid having kinematic viscosity 6 strokes and specific gravity 1.9. [5]

5. a) Prove that " in a two dimensional flow, if stream function satisfies Laplace equation, it is a possible case of irrotational flow". [5]

b) Consider the flow field given by $\psi = ax^2 - ay^2$, where a = 3 /s. Determine the velocity potential for this flow, if exists? (Note:ψ is stream function of the flow field) [5]

OR

6. a) Check whether the stream function $\psi = 5xy$ is irrotational and if so, determine the corresponding potential function φ. [5]

b) An unsteady velocity vector field is given by $u = t^2 + 3y$, $v = 4t + 5x$. Calculate the acceleration at the point (5, 3) at time t = 2 units. [5]

7. a) Water is coming out from a tap and falls vertically downwards. At the tap opening, the stream diameter is 20 mm and uniform velocity is 2 m/s. Assuming steady, invicid flow, determine the diameter of the stream 0.5 m below the tap? [5]

b) A liquid flows downward through a tapered vertical pipe. The pressure at section 1 and 2 are equal and the vertical distance between sections 1 and 2 is H. The diameter at section 1 is twice that at section 2. If H = 1.5 m, find the velocities at section 1 and 2 by assuming zero loss of energy between the two sections. [5]

OR

8. a) The accepted transition Reynolds number for flow in a circular pipe is $Re_{d,critical}$ = 2300. For flow through a 5cm diameter pipe, at what velocity will this occur at 20°C for (a) airflow with viscosity $1.8X10^{-5}$ kg/(m.s) and (b) water flow with viscosity 0.001 kg/(m.s)? [5]

b) Oil, with density 900 kg/m^3 and Kinematic Viscosity 0.00001 m^2/s, flows at 0.2 m^3/s through 500 m of 200 mm diameter cast-iron pipe (f = 0.0225). Determine (*a*) the head loss and (*b*) the pressure drop if the pipe slopes down at 10° in the flow direction. [5]

9. a) A flat plate of length 0.8 m and width 1.9 m is kept in a sea level air stream flowing at a velocity of 5.3 m/s. Assuming a linear velocity profile for the boundary layer over the plate, Develop an expression for boundary layer thickness and the variation of wall shear stress with distance along the flat plate? [5]

b) Obtain the expression of boundary layer thickness, in terms of Reynolds number for the laminar boundary layer having a velocity profile of the form: $\frac{u}{U} = \left(2\frac{y}{\delta} - 2\frac{y^3}{\delta^3} + \frac{y^4}{\delta^4} \right)$. [5]

OR

10. a) Explain the terms (i) Laminar Boundary Layer (ii) Turbulent Boundary Layer (iii) Laminar Sub-layer [5]

b) Air moves over a flat plate with a uniform freestream velocity of 10 m/s. At a position 15cm away from the front edge of the plate, what is the boundary layer thickness? Use The parabolic profile in the boundary layer. For air kinematic viscosity is $1.5 X 10^{-5}$ m^2/s and density is 1.23 kg/m^3. [5]

11. a) Air flows through a duct. The pressure and temperature at station 1 are $P_1 = 0.7$ atm. and $T_1 = 30^0$C, respectively. At the second station, the pressure is 0.5atm. Calculate the temperature and density at the second station. Assume the flow to be isentropic. [5]

b) Derive energy equation for one-dimensional steady compressible flow from first principle. [5]

OR

12. a) It is generally known to all of us that the speed of sound is approximately 340 m/s in the air at sea level conditions? Justify? [5]

b) Air enters a diffuser with a velocity of 200 m/s. Determine. [5]

i) the speed of sound and

ii) the Mach number at the diffuser inlet when the air temperature is 30 deg. C.