

**II B.Tech II Semester Supplementary Examinations, Nov/Dec 2005**  
**MECHANICS OF FLUIDS**  
**( Common to Mechanical Engineering and Metallurgy & Material Technology)**

Time: 3 hours

Max Marks: 80

**Answer any FIVE Questions**  
**All Questions carry equal marks**

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1. (a) Derive the equation for shear stress produced when a fluid is subjected to angular deformation. Give the units of the fluid property so obtained in the derivation.  
 (b) Calculate the velocity gradient at distances of 0,10,15 cm from the boundary if the velocity profile is a parabola given by  $u = Ay^2 + By + C$  and with the vertex 15 cm from the boundary, where the velocity is 100 cm/sec. Also calculate the shear stress at these points if the fluid has a viscosity of 8.2 poise.  
[8+8]
2. (a) Define stream function and explain its characteristics.  
 (b) If for a two dimensional potential flow, the velocity potential is given by  $\phi = x(2y - 1)$   
 Determine the velocity at the point P(4,5).  
 Determine also the value of stream function Y at the point P. [8+8]
3. (a) Define the terms
  - i. Forced vortex flow
  - ii. Free vortex flow
 Give suitable examples.  
 (b) A rectangular duct of width 25 cm has a two dimensional irrotational flow. It has an elbow made up of circular arcs of radius 40 cm and 65 cm for the inner and outer walls respectively. Calculate the discharge per unit width of the duct when the difference in pressure between outer and inner walls in the elbow is 30 kPa. [6+10]
4. (a) Why is it necessary to control the growth of boundary layer on most of the bodies? What methods are used for such a control?  
 (b) A sphere has a projected area of  $1 \text{ m}^2$ . Compare the drag force in water and in air when travelling at a speed of 30 km/hr. [8+8]
5. (a) What is sonic velocity? On what factor does it depends?.  
 (b) A gas velocity of 300 m/s is flowing through a horizontal pipe at a Section where the pressure is  $60 \text{ KN/m}^2$  and temperature  $40^\circ\text{C}$ . The pipe changes in diameter and at this section pressure is  $90 \text{ KN/m}^2$  if the flow of gas is adiabatic find the velocity of gas at this section. [6+10]

6. (a) Prove that the boundary shear stress is directly proportional to the pressure gradient and the boundary spacing for the case of laminar flow between parallel flat plates when both the plates are at rest.
- (b) What do you know about Couette flow? Explain [8+8]
7. (a) Obtain an expression for the optimum exit diameter of a nozzle to be fitted at the service end of a pipe for maximum power transmission.
- (b) Find the loss of head when a pipe of diameter 20 cm is suddenly enlarged to a diameter of 40 cm. The rate of flow of water through the pipe is 250 lit/sec. [8+8]
8. (a) A  $150\text{mm} \times 75\text{mm}$  Venturimeter with  $C_d = 0.98$  is to be replaced by an orifice meter having a value of  $C_d = 0.6$ . If both the meters are to give the same differential mercury manometer reading for a discharge of 100 lps and the inlet dia. to remain 150 mm, what should be the diameter of orifice.
- (b) What is the necessity of ventilation of weirs. [12+4]

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