

**II B.Tech II Semester Supplementary Examinations,
November/December 2005
FLUID MECHANICS AND MACHINERY
(Aeronautical Engineering)**

Time: 3 hours**Max Marks: 80**

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

1. (a) Define surface tension. Derive the relationship between surface tension and pressure inside a droplet of liquid in excess of outside pressure.
(b) A Newtonian fluid is filled in the clearance between a shaft and concentric sleeve. When a force of 490N is applied to the sleeve parallel to the shaft, the sleeve attains a speed of 70 cm/sec. If 2450N force is applied, what speed will the sleeve attain. The temperature of the sleeve remains constant. [8+8]
2. (a) Derive from first principles, the condition for irrotational flow. Prove that for potential flow, both the stream function and velocity potential function satisfy the Laplace equation.
(b) In a two dimensional incompressible flow, the fluid velocity components are given by $U = x - 4y$; $V = -y - 4x$. Show that velocity potential exists and determine its form as well as stream function [8+8]
3. (a) Derive an expression for the difference of pressure between two points in a free vortex flow. Does the difference of pressure satisfy Bernoulli's equation. Can Bernoulli's equation be applied to a forced vortex flow.
(b) A 40 cm diameter pipe conveying water branches into two pipes of diameters 30cm and 20cm respectively. Find the discharge in this pipe. Also determine the velocity in 20cm pipe if the average velocity in 30cm diameter pipe is 2m/sec. [8+8]
4. (a) State the momentum equation. How will you apply momentum equation for determining the force exerted by a flowing liquid on a pipe bend.
(b) A vertical jet of water 7.5cm in diameter leaving the nozzle with a 9.2m/sec velocity strikes a horizontal and movable disc weighing 172N. The jet is then deflected horizontally. Determine the vertical distance above the nozzle tip at which the disc will be held in equilibrium. [8+8]
5. (a) Define laminar and turbulent boundary layers, laminar sub-layer and boundary layer thickness.
(b) A smooth flat plate 1m wide and 1.5m long is towed lengthwise through still air with a velocity of 10m/sec. Assuming the boundary layer to be fully laminar, estimate its thickness at the trailing edge. Mass density and kinematic viscosity of the air are 0.124m³/m³ and 0.15cm²/sec respectively. Also calculate the shear stress at that point. [8+8]

6. (a) What is a pitot tube? How will you determine the velocity at any point with the help of a pitot tube?
(b) Explain how Hot-wire anemometer is used for measuring the velocity of flow of a compressible fluid. [8+8]
7. (a) Explain what do you mean by transonic flow, shock wave, Mach angle and hypersonic flow.
(b) Show that for sub-sonic flow in a pipe the velocity must increase in the downstream direction . Take into account the losses in the pipes. [8+8]
8. Write short notes on the following.
 - (a) Ideal and Real fluids.
 - (b) 1D, 2D, 3D flows.
 - (c) Lift and drag coefficients. [5+5+6]

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