

II B.Tech II Semester Supplementary Examinations, April/May 2005
MECHANICS OF FLUIDS AND HYDRAULIC MACHINES
 (Common to Electronics & Instrumentation Engineering and Electronics & Control Engineering)

Time: 3 hours

Max Marks: 70

Answer any FIVE Questions
All Questions carry equal marks

1. (a) Define specific weight, specific volume and vapour pressure and mention their units.
 (b) A metal plate 0.5mX0.5m and 1mm thick and weighing 20N is to be lifted up edge wise with a uniform velocity 0.25m/s in the gap between two flat surfaces. The plate is in the middle of the gap of 2mm wide and the gap contains oil of relative density 0.85 and viscosity 1.6 poise. Calculate the vertical force required to lift the plate.
2. (a) Show that the center of pressure of a plane area immersed in a liquid in an inclined position is always below the centroid of the area.
 (b) A simple manometer is used to measure the pressure of oil (specific gravity 0.8) flowing in a pipe. Its right limb is open to the atmosphere and the left limb is connected to the pipe. The centre of the pipe is 90 cm below the level of mercury (spe. gravity 13.6) in the right limb. If the difference of the mercury levels in the two limbs is 15cm, determine the absolute pressure of the oil in the pipe in kN/m².
3. (a) Derive the expression for continuity equation in two dimensional flow.
 (b) The velocity components in an incompressible flow are given by
 $u = 6xt + yz^2$
 $v = 3t + xy^2$
 $w = xy - 2xyz - 6tz$
 - i. Verify whether the continuity equation is satisfied
 - ii. Determine the acceleration vector at a point (1,1,1) at t=1
4. (a) With a neat sketch, obtain the expression for the discharge through an orifice meter.
 (b) A sharp edged notch is in the form of a symmetrical trapezium. The horizontal base is 10cm wide, the top is 50 cm wide and the depth is 30cm. Assuming the coefficient of discharge to be 0.60 and the velocity of approach to be negligible, calculate height of water level above base of the notch if the discharge is 0.043m³/s.
5. (a) Derive the expression for the loss of head due to sudden enlargement in pipe flow.

- (b) A pipe 7.5 cm.in diameter and 250m. long has a nozzle fitted at the discharge end. The total head at the inlet to the pipe is 40m. Taking the friction coefficient for the pipe, $4f$ to be 0.01, determine the maximum power transmitted.
6. A rectangular plate weighing 60N is suspended vertically by a hinge on the top horizontal edge. The center of gravity of the plate is 100mm. from the hinge. A horizontal jet of water 200mm. diameter whose axis is 150mm below the hinge impinges normally on the plate with a velocity of 5m/s. Find the horizontal force applied at the center of gravity to maintain the plate in the vertical position. Find the alteration of the velocity of the jet, if the plate is deflected through 30° and the same force continues to act at the center of gravity of the plate.
7. (a) Define specific speed of a turbine. Derive an expression for the same.
(b) An inward flow reaction turbine works under a head of 25m. The external and internal diameter of the runner are 1.35 m and 1 m respectively. The angle of guide vanes is 15° and the moving vanes are radial at the inlet radial velocity of flow through the runner is constant and there is no velocity of whirl at the outlet. Determine the speed of the vanes and the angle of the runner at the outlet. If the turbine develops 375H.P., find the specific speed of the turbine.
8. (a) With a neat sketch, mention the various parts of a centrifugal pump.
(b) Find the minimum starting speed of a centrifugal pump against a head of 10m. The diameters of the impeller at the inlet and outlet are 45 cm and 90 cm respectively.

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