Code No. BTS 096(D)

B.Tech. Degree (F.T) III Semester Examination in Mechanical Engineering (CAD/CAM), March 1999

ME 302 FLUID MECHANICS AND MACHINERY

(All questions carry equal marks)

Time: 3 Hours *Max. Marks: 100*

I a) Distinguish between the following
(i) Steady flow and unsteady flow
(ii) Uniform flow and nonuniform flow
(iii) Rotational and irrotational flow

b) Verify whether the following flow field is rotational. If so, determine the components of rotation about various axes.

$u = xyz,\ v = zx,\ w = \frac{1}{2}\ yz^2 - xy$

OR

c) Derive an expression for measurement of pipe flow using a venturimeter

d) A venturimeter of throat diameter 5 cm is fitted to a 12.5 cm diameter water pipe line. The coefficient of discharge is 0.96. Calculate the flow in the pipe line when the reading on a mercury-water differential u-tube manometer connected to the upstream and throat sections shows a reading of 20 cm.

II a) Explain the terms:
cohesion, adhesion, Newtonian fluid, kinematic viscosity.

b) The velocity distribution in a viscous flow over a plate is given by $u = 4y - y^2$ where u is the velocity in m/s at distance y from the plate. Given coefficient of dynamic viscosity is 1.5 Pa.s , determine the shear stress at $y = 0$ and $y = 2.0$ m

OR

(PTO)

c) Derive expressions for the total pressure and centre of pressure on an inclined plane immersed surface.

d) A rectangular plate 0.6 m wide and 1.2 m deep lies with in water such that the plane is inclined at 45° to the horizontal and tap edge is 0.70 m below water surface. Determine the total pressure force on one side of the plate and the location of the centre of pressure.

III a) Briefly explain the concept of geometric, kinematic and dynamic similitude.

b) Show by dimensional analysis, for a completely submerged body, the drag force is $F_D = \rho l^2 V^2 \phi\left(\frac{\rho v l}{\mu}\right)$ *where*

ρ = mass density of fluid
l = characteristic length
v = velocity of flow
μ = viscosity of the fluid

OR

c) The discharge through a pump (Q) depends on shaft work (gH), power (p), speed (N), characteristic length (D), fluid density (p) and viscosity (μ). Obtain a set of significant dimensional parameters.

d) The capillary rise h in a tube of radius R depends on specific weight γ and surface tension σ of the fluid. Perform dimensional analysis.

IV a) Derive an expression for the force of a jet impinging on a moving curved vane.

b) A jet of water having a velocity of 30 m/s impinges on a series of vanes with a velocity of 15 m/s. The jet makes an angle 30° to the direction of motion of vanes while entering and leaves at an angle of 120°. Sketch the velocity triangles at entrance and exit and determine

(i) the angle of vane tips so that water enters and leaves without shock

(ii) the work done per kg of water entering the vanes.

OR

c) Derive an expression for the work done by an impulse turbine.

d) A pelton wheel working under a head of 500 m produces 13,000 kw at 430 rpm. The efficiency of the wheel is 85%. Determine the discharge of the turbine and the diameter of the wheel. Assume suitable data.

V a) Explain the working of a centrifugal pump.

b) A centrifugal pump delivers water against a net head of 10 m at a design speed of 1000 rpm. The vanes are curved backwards and make an angle of 30° with the tangent at the outer periphery. the impeller diameter is 30 cm and has a width of 5 cm at the outlet. Determine the discharge of the pump if the manometric efficiency is 95%

OR

c) Briefly describe cavitation in pumps and its significance.

d) Write a note on gear pumps and rotary piston pumps.

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