Code No. BTS 116 ($E_1$)

B.TECH. DEGREE III SEMESTER (SUPPLEMENTARY) EXAMINATION IN MECHANICAL ENGINEERING (CAD/CAM)
JUNE 2001

**ME 302 FLUID MECHANICS AND MACHINERY**
*(1995 Admissions)*

Time: 3 Hours Maximum Marks: 100

## MODULE - I

I. (a) Define the terms:
(i) Newtonian fluids
(ii) Centre of pressure of a surface submerged in a fluid
(iii) Metacentre (3x3 = 9)

(b) A vertical lock gate hinged at one vertical edge has water to a depth of 3m on one side and 2.5 m on the other. If the width of the gate is 4m, find the turning moment required to open the gate against the side with higher water level. (11)

**OR**

II. (a) State the conditions of stability of a body floating in a fluid. (5)

(b) A rectangular pontoon 10m long 4m wide and 3m deep having a weight of 100 tons floats in water. The pontoon has uniform density. Calculate the metacentric height of the body. (15)

## MODULE - II

III. (a) Distinguish between:
(i) Stream line and path line
(ii) Stream function and velocity potential
(iii) Circulation and vorticity (3 x 3 = 9)

(b) The stream function of a fluid flow field is given by $3x^2 - y^3$.
Estimate the magnitude of velocity components at the points (2, 1) and (1, 2). Verify whether the flow is rotational. If so, find the vorticity. (11)

**OR**

IV. (a) Define the term 'Boundary layer' in a flow and explain the stages of development of it in the case of flow through circular pipes. (5)

(b) What do you mean by minor losses in pipes. (4)

(c) A circular duct of 50mm internal diameter is to convey water at the rate of 500 litres per minute. If the friction factor f is .002, calculate the loss of head for a length of 60m of this pipe. (11)

## MODULE - III

V. (a) Explain the terms: Geometric, Kinematic and Dynamic similarities in respect of model studies. (8)

(b) The volume rate of flow through a circular pipe of bore 'd' and length '$\ell$' is found to depend on the bore diameter, pressure gradient, density and viscosity of the fluid.
Using Rayleigh's method, obtain an expression for the discharge rate 'Q' in terms of other parameters. (12)

**OR**

*(Turn over)*

VI. (a) State Buckingham's pi theorem and discuss its significance in model studies. (8)

(b) In an experiment with flow of water through 20 mm diameter pipe, the critical velocity is found to be 12 cm/sec. Using similarity principles, find the critical velocity of air flowing through 40 mm pipe. Assume the viscosity of water to be 65 times that of air and density of water 800 times that of air. (12)

## MODULE - IV

VII. (a) With the help of velocity diagram, estimate the forces acting on a curved vane, moving with velocity 'u' and having inlet angle ' $\alpha$ ' and outlet angle ' $\beta$ '. The velocity of jet is 'v' and the entry of jet is smooth. (8)

(b) A jet of water with velocity 12 m/s enters a concave vane smoothly and gets deflected through $120^{\circ}$. The vane is moving at 6 m/sec. Find the absolute velocity of the jet at the exit and its direction relative to the jet. Calculate the work done/kg mass of water. (12)

**OR**

VIII. (a) Discuss the functions of draft tubes in reaction turbines. (6)

(b) A pelton wheel is operating under a head of 250 m. The jet diameter is 100 mm and the ratio of bucket speed to jet velocity is 0.47. The coefficient of velocity of the jet is 0.96. The bucket deflects the jet through $160^{\circ}$. The relative velocity of the jet is reduced by 10% at exit. Calculate the runner diameter, hydraulic efficiency and shaft power if the speed is 600 rpm and mechanical efficiency 89%. (14)

## MODULE - V

IX. (a) Write short notes on the causes and results of cavitation in pumps. (5)

(b) Discuss the considerations required in the selection of pumps. (5)

(c) A double acting reciprocating pump has stroke 30 cm and diameter 20 cm. It operates at 50 rpm. If the discharge is 1000 litres/min, estimate the percentage slip. (10)

**OR**

X. (a) Define the terms:

(i) Specific speed of centrifugal pumps
(ii) Separation and
(iii) Velocity of whirl. (3 x 3 = 9)

(b) Distinguish between positive displacement pumps and rotodynamic pumps. (3)

(c) A centrifugal pump runs at 1800 rpm and delivers 3600 litres of water/min against a total head of 25 m consuming 16 kW. Using similarity principles, determine the discharge, head and power when it runs at 2000 rpm. (8)

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