VIII (a) Derive an expression for the force of jet impinging on a moving curved vane and also for the work done by the jet entering the vane. (10)

(b) Explain the servomotor method of governing a Pelton wheel. (10)

IX (a) What are the different efficiencies of a centrifugal pump? (4)

(b) Which part of a centrifugal pump is most susceptable to cavitation? What are the undesirable effects of cavitation? (6)

(c) A single acting reciprocating pump runs at 60 rpm. The diameter of plunger is 15 cm and crank radius is 15 cm. The suction pipe is 10 cm in diameter and 5 m long. Calculate the maximum permissible value of suction lift if the separation takes place at 2.6 m of water absolute. (10)

OR

X (a) What factors governs the speed of a reciprocating pump? (5)

(b) Draw the indicator diagram for a single cylinder single acting reciprocating pump when air vessel is provided only on the suction side. (5)

(c) The impeller of a centrifugal pump has 1.2m outside diameter. It is used to lift 1800 litres of water per second against a head of 6m. The vanes make an angle of 150° with the direction of motion at outlet and runs at 200 rpm. If the radial velocity of flow at outlet is 2.5 m/s, find the manometric efficiency. Also find the lowest speed to start the pump, if the diameter of the impeller at inlet is equal to half the diameter at exit. (10)

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

ME

ME 302 FLUID MECHANICS AND MACHINERY

(1998 Admissions)

Time: 3 Hours Maximum Marks: 100

I (a) What are the units of viscosity and kinematic viscosity? (2)

(b) How does the viscosity vary with temperature and pressure for
(i) dilute gases
(ii) liquids. (3)

(c) What is meant by the term 'non-Newtonian'? What types of substance exhibit this behaviour? (5)

(d) A barge has a uniform rectangular cross-section of width 2L and vertical draft of height H. (10)
Determine
(i) the metacentric height for a small tilt angle and
(ii) the range of ratio L/H for which the barge is statically stable.
Assume that the centre of mass G of the barge is exactly at the waterline as shown in Figure below:

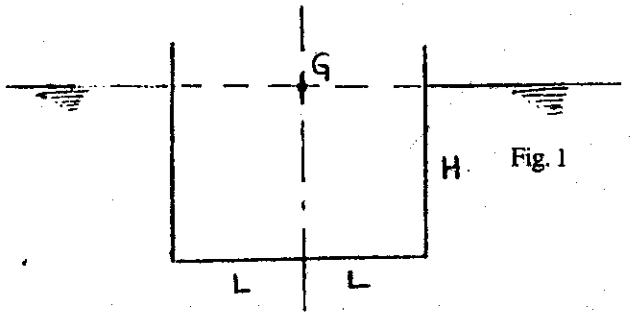

Fig. 1

OR

II. (a) Define total pressure on a surface and centre of pressure of a surface. (4)

(b) Prove that the centre of pressure of fully submerged uniformly thick plane lamina is always below the centre of gravity of the lamina. (6)

(c) A cylinder of 0.3 m diameter rotates concentrically inside a fixed cylinder of 0.31 m diameter. Both the cylinders are 0.3 m long. Determine the viscosity of the liquid which fills the space between the cylinders if a torque of 0.98 N-m is required to maintain an angluar velocity of 60 rpm. (10)

III. (a) Distinguish between a stream line and a streak line. (4)

(b) A uniform stream flows downward, $u = 0$, $v = -u_\infty$. Write the stream function and velocity potential for this flow in Cartesian co-ordinates. (6)

(c) A two-dimensional velocity field is given by

$$v = (x^2 - y^2 + x)\,i - (2xy + y)\,j$$

in arbitrary unit. At $x = 2$, and $y = 1$, compute

(i) the acceleration a_x and a_y,

(ii) the velocity component in the direction $\theta = 30°$, and

(iii) the direction of maximum acceleration and maximum velocity. (10)

OR

IV. (a) Distinguish between the following:

(i) Steady flow and unsteady flow

(ii) Uniform flow and Non-uniform flow

(iii) Rotational flow and irrotational flow, and

(iv) Circulation and vorticity (10)

(b) Determine the percentage error that will be made if a 0.3m deep and 0.7 m wide rectangular orifice in the side of a tank with 1 m head over its centre line is treated as a small orifice. (Neglect velocity of approach). (10)

Contd.....3.

V. (a) Define the following:-

(i) Critical Reynolds number (ii) Hydraulic radius, and (iii) Turbulent flow (6)

(b) Briefly explain the concept of equivalent pipes. (4)

(c) A viscous drag pump delivers high pressure fluid by utilizing viscosity of the fluid to draw it through small clearance passage. Assuming that the rise in presure Δp depends on ρ, μ, rotor diameter D, clearance space b and rotational speed N of the shaft, obtain expression for Δp through dimensional analysis. (10)

OR

VI. (a) Give both the kinematic and dynamic significance of Reyhnolds number Re, Weber Number W and Mach Number M. (6)

(b) Define the following with regard to boundary layer:

(i) Displacement thickness , δ^* and

(ii) Momentum thickness, θ^*. (4)

(c) If two pipes of diameter D and d and equal length L are arranged in parralel the loss of head for a flow of Q is h. If the same pipes are arranged in series the loss of head for the same flow Q is H. If d = 0.5D, find the percentage of total flow through each pipe when placed in parallel and the ratio (H/h). Neglect minor losses and assume F to be constant. (10)

VII. (a) A two dimensional jet of water carrying a discharge of $q m^3/s$ with velocity u strikes a stationary plate at an angle θ with the normal to the plate. Show that the discharge divides in the two directions as

$$q_1 = \frac{q}{2}(1 - \sin\theta) \quad \textit{and} \quad q_2 = \frac{q}{2}(1 + \sin\theta)$$

What will be the force exerted by the plate on the fluid? (10)

(b) Distinguish between the following giving examples:

(i) an impulse turbine and a reaction turbine

(ii) radial flow and axial flow turbines

(iii) inward flow and outward flow turbines (10)

OR

Contd.....4.