B. Tech Degree III Semester Examination in Marine Engineering December 2010

MRE 305 FLUID MECHANICS OF MACHINERY

Time : 3 Hours Maximum Marks : 100

I. (a) Define metacentric height. Derive an expression for it. (8)

(b) A wooden block of specific gravity 0.75 floats in water. If the size of the block is 1m x 0.5m x 0.4m. Find its metacentric height. (7)

(c) What are the types of equilibrium of floating bodies. (5)

OR

II. (a) State Buckingham's π theorem. What are repeating variables? How are the repeating variables selected in dimensional analysis? (8)

(b) The pressure difference ΔP in a pipe of diameter D and length 'ℓ' due to viscous flow depends on the velocity V, viscosity μ and density ρ. Using Buckingham's π theorem, obtain an expression for ΔP. (8)

(c) Write short notes on :

(i) Newtonian & Non-Newtonian fluids
(ii) Absolute & Gauge pressure (4)

III. (a) State the difference between

(i) Rotational and irrotational flow
(ii) Laminar and Turbulent flow
(iii) Stream lines and streak lines. (3 x 2 = 6)

(b) Define stream function.

If stream function for steady flow is given by $\psi = \left(y^2 - x^2\right)$, determine whether the flow is rotational or irrotational. Then determine the velocity potential ϕ. (14)

OR

IV. (a) What are the minor energy losses of flow through pipes? (5)

(b) Derive Chezy's formula to determine loss of head due to friction in pipes. (8)

(c) Derive an expression for the volumetric flow rate of a fluid flowing through an orifice meter. (7)

V. (a) What power is required per kilometer of a line to overcome the viscous resistance to the flow of glycerine through a horizontal pipe of diameter 100mm at the rate of 10 litres/s.? Take viscosity , $\mu = 8$ poise and kinematic (V) = 6.0 stokes. 12)

(b) Distinguish between forced vortex and free vortex. (8)

OR

VI. (a) An oil of viscosity 10 poise flows between two parallel fixed plates which are kept apart at a distance of 50 mm. Find the rate of flow of oil between the plates if the drop of pressure in a length of 1.2 m be $0.3 N/cm^3$. The width of the plates is 200 mm. (12)

(b) Write notes on :

(i) Reynold's number
(ii) Resistance coefficient (8)

(P.T.O)

VII. (a) Differentiate between
(i) Impulse and reaction turbines
(ii) Radial and axial flow turbines.

(b) Draw a schematic diagram of a Francis-turbine and explain briefly its construction and working.

OR

VIII. Obtain an expression for the work done per second by water on the runner of a pelton wheel. Hence derive an expression for maximum efficiency of the pelton wheel giving the relationship between the jet speed and bucket speed. Draw inlet and outlet velocity triangles for a pelton turbine and indicate the direction of velocities.

IX. (a) Define cavitation. What are the effects of cavitation? Give necessary precautions against cavitation.

(b) A centrifugal pump delivers water against a net head of 14.5m and a design speed of 1000 r.p.m. The vanes are curved back to an angle of 30^0 with the periphery. The impeller diameter is 300 mm and outlet width 50 mm. Determine the discharge of the pump if manometric efficiency is 95%.

OR

X. (a) How will you classify reciprocating pumps?

(b) Define indicator diagram.

(c) Describe the principle and working of a reciprocating pump with a neat sketch. Explain the need for air vessels in a reciprocating pump.

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