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***B. Tech. Degree III Semester Supplementary Examination in
Marine Engineering December 2014***

MRE 305 FLUID MECHANICS AND MACHINERY

Time: 3 Hours

Maximum Marks: 100

(5 x 20 = 100)

- I. (a) Explain what is meant by metacentric height of a floating body. Derive an expression for it. (10)
- (b) A trapezoidal channel, 2 m wide at bottom and 1 m deep, has side slopes of 1:1, determine (i) the total pressure and (ii) the centre of pressure, on the vertical gate closing the channel when it is full of water. (10)

OR

- II. (a) Briefly explain the concept of geometric, kinematic and dynamic similitude. (10)
- (b) The pressure difference Δp in a pipe of diameter 'D' and length 'l' due to viscous flow depends on velocity 'V', viscosity ' μ ' and density ' ρ '. Using Buckingham's π theorem, obtain an expression for ' Δp '. (10)

- III. (a) State the difference between (i) rotational and irrotational flow (ii) laminar and turbulent flow (iii) stream lines and streak lines (iv) steady and unsteady flow (v) uniform and non uniform flow. (10)
- (b) If stream function for steady flow is given by $\psi = (y^2 - x^2)$. Determine whether the flow is rotational or irrotational, then determine the velocity potential ϕ . (10)

OR

- IV. (a) Derive Chezy's formula to determine loss of head due to friction in pipes. (10)
- (b) A circular pipe of 50 mm internal diameter is to convey water at the rate of 500 litres/minute. If the friction factor f is 0.002, calculate the loss of head for a length of 60 m of this pipe. (10)

- V. (a) Derive an expression for the velocity distribution of viscous fluid flow through a circular pipe and using that derive Hagen-Poiseuille formula. (8)
- (b) An oil of viscosity 0.1 Ns/m^2 and relative density 0.9 is flowing through a circular pipe of diameter 50 mm and length 300 m. The rate of flow of fluid through the pipe is 3.5 litres/s. Find the pressure drop in a length of 300 m and also the shear stress at pipe wall. (12)

OR

- VI. (a) Distinguish between forced vortex and free vortex. (8)
- (b) A cylindrical vessel 12 cm in diameter and 30 cm deep is filled with water up to the top. The vessel is open at the top. Find the quantities of water left in the vessel when it is rotated about its vertical axis with a speed of 300 rpm and 600 rpm. (12)

(P.T.O.)

- VII. (a) With the help of velocity diagram, estimate the forces acting on a curved vane, moving with a velocity 'u' and having inlet angle ' α ' and outlet angle ' β '. The velocity of jet is 'V' and 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° . The vane is moving at 6 m/s. 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 function of draft tube 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 reflects the jet through 160° . 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 is 89%. (14)

- IX. (a) Write short notes on the causes and results of cavitation in pumps. (5)
- (b) A centrifugal pump having outer diameter equal to two times the inner diameter and running at 1200 rpm works against a total head of 75 m. The velocity of flow through the impeller is constant and equal to 3 m/s. The vanes are set back at an angle of 30° at outlet. If the outer diameter of the impeller is 600 mm and width at the outlet is 50 mm, determine (i) vane angle at inlet (ii) work done per second by impeller (iii) manometric efficiency. (15)

OR

- X. (a) Explain the need for air vessels in reciprocating pump and explain its working to serve the purpose. (8)
- (b) A double acting reciprocating pump has a diameter of 18 cm and stroke 35 cm. The sump is 3 m below the pump and the tank is 45 meter above the pump. The suction and delivery pipes are 6 m and 80 m long and diameter of pipe is 10 cm. The air vessels on the suction and delivery sides are 1.5 m and 5 m from the cylinder respectively. If the pump runs at 45 rpm find the pressure difference between the two sides of the piston at the beginning of the stroke. The friction factor $f = 0.03$. (12)
