BT MRE – III – 08 – 045

B. Tech Degree III Semester Examination in Marine Engineering, December 2008

MRE 305 FLUID MECHANICS AND MACHINERY

Time : 3 Hours | Maximum Marks : 100

I. (a) (i) Distinguish between Dynamic viscosity and Kinematic viscosity.
(ii) Explain how the metacentric height of a floating body is determined. (2 x 4 = 8)

(b) A triangular plate of base 4 metres and altitude 6 metres is immersed vertically in water. Its symmetrical axis is parallel to and at a depth of 5.2 metres from the free water surface. Calculate the magnitude and location of total pressure force. (12)

OR

II. (a) (i) Explain Buckingham's Pi-theorem.
(ii) Obtain an expression for capillarity rise of a liquid. (2 x 4 = 8)

(b) A solid cylinder of diameter 3 metres has a height of 4 metres. Find the metacentric height of the cylinder when it is floating in water with axis vertical. State whether the equilibrium is stable or unstable. Assume sp. gravity of the cylinder material 0.6. (12)

III. (a) (i) Differentiate between stream function and velocity potential function.
(ii) State Bernoulli's theorem for incompressible flow. What are its limitations? (2 x 4 = 8)

(b) A two-dimensional flow is described by the velocity components; $u = 5x^3$ and $v = -15x^2y$. Evaluate the stream function, velocity and acceleration at points (1,2) and (3,5). (12)

OR

IV. (a) (i) Distinguish between notches and weirs.
(ii) Derive Darcy's formula for coefficient of friction. (2 x 4 = 8)

(b) Water flows at the rate of 50 litres/second through a 200 metre long pipe, the horizontal axis of which is 3 m. above the datum line. The pipe tapers from 30 cm. diameter to 20 cm. diameter. If the pressure at the wider end of the pipe is 98.1 kPa, calculate the pressure at the other end. (Neglect losses). (12)

V. (a) (i) Explain how Reynolds number is related to inertia force and viscous force.
(ii) Differentiate between free vortex and forced vortex. What is compound vortex? (2 x 4 = 8)

(b) Oil with a free stream velocity of 2 m/s flows over a thin plate 2 m wide and 2 m long. Calculate the boundary layer thickness and the shear stress at the trailing end, and determine the total surface resistance of the plate. The sp. gravity of oil is 0.86 and its kinematic viscosity is 10^{-5} m^2/s. (12)

OR

VI. (a) (i) Explain the features of laminar flow through a circular tube.
(ii) State and explain critical Reynolds number. (2 x 4 = 8)

(Turn Over)

(b) A cylinder whose axis is perpendicular to the stream of air having a velocity of 20 m/s, rotates at 300 rpm. The cylinder is 2 m in diameter and 10 m long. Find (i) The circulation, (ii) The theoretical Lift/unit length and (iii) Position of stagnation points. Take the value of density of air as 1.24 kg/m^3, lift coefficient as $C_L = 3.4$. (12)

VII. (a) (i) Explain the momentum equation as applied to a control volume.
(ii) Differentiate between Impulse and Reaction turbine. (2 x 4 = 8)

(b) An inward flow turbine works under a total head of 28 m. The velocity of wheel periphery at inlet is 15 m/s. The radial velocity of flow through the wheel is same as the absolute velocity in outlet pipe equal to 3.54 m/s. Neglecting friction, determine (i) the vane angle at inlet, (ii) guide vane angle and (iii) the power developed by the turbine. (12)

OR

VIII. (a) (i) What is meant by Runaway speed, and Specific speed of a turbine?
(ii) Explain the terms Speed ratio; Flow ratio and Jet ratio as applied to a turbine. (2 x 4 = 8)

(b) A reaction turbine working under a head of 30 m. produces 50000 KW. The overall efficiency is 85%. The speed ratio is 1.6 and flow ratio is 0.5. The hub diameter of the runner is 0.35 times the outer diameter. Determine runner diameter and the speed of the turbine. (12)

IX. (a) (i) What are the factors affecting cavitation in pumps?
(ii) Explain the use of Air vessel in reciprocating pumps. (2 x 4 = 8)

(b) A single cylinder single acting reciprocating pump has a bore of 25 cm and stroke of 37.5 cm. The pump runs at 100 r.p.m. and delivers 20 litres/second of water against a total head of 25 m. Determine the power required to drive the pump, and the percentage slip. (12)

OR

X. (a) (i) How are pumps classified? What are the factors deciding the selection of pump?
(ii) Explain the characteristic curves of a centrifugal pump. (2 x 4 = 8)

(b) A centrifugal pump is running at 1000 r.p.m. The outlet vane angle is 30° and velocity of flow at outlet is 3 m/s. The pump is working against a total head of 30 m and the discharge through the pump is 0.3 m^3/s. If the manometric efficiency of the pump is 75%, determine (i) the diameter of the impeller and (ii) the width of the impeller at outlet. (12)

***