



***B. Tech. Degree III Semester Examination in
Marine Engineering December 2015***

MRE 1305 FLUID MECHANICS AND MACHINERY

Time: 3 Hours

Maximum Marks: 100

(5 × 20 = 100)

- I. (a) Discuss: (10)
- Buoyancy.
 - non-newtonian fluid.
 - centre of pressure.
 - contact angle.
 - gauge pressure.
- (b) An open tank contains water upto a depth of 2 m and above it an oil of specific gravity 0.9 for a depth of 1 m. Find the pressure intensity (i) at the interface of the two liquids, and (ii) at the bottom of the tank. (10)
- OR**
- II. (a) Define the terms: model, prototype and similitude. (6)
- (b) Define the following non-dimensional numbers: (6)
- Reynold's number, Froude's number and Weber number. What are their significances for fluid flow problems?
- (c) A ship model of scale $\frac{1}{50}$ is towed through sea water at a speed of 1 m/s. A force of 2 N is required to tow the model. Determine the speed of ship and the propulsive force on the ship, if prototype is subjected to wave resistance only. (8)
- III. (a) Differentiate: (10)
- Stream function and velocity potential function.
 - Stream line and streak line.
 - Laminar flow and turbulent flow.
 - Rotational and irrotational flow.
 - Steady and unsteady flow.
- (b) A tank has two identical orifices on one of its vertical sides. The upper orifice is 3 m below the water surface and lower one is 5 m below the water surface. If the value of C_v for each orifice is 0.96, find the point of intersection of the two jets. (10)
- OR**
- IV. (a) Derive the expression $C_d = C_v \times C_c$. (5)
- (b) An oil of specific gravity 0.8 is flowing through a venturimeter having inlet diameter 20 cm and throat diameter 10 cm. The oil-mercury differential manometer shows a reading of 25 cm. Calculate the discharge of oil through the horizontal venturimeter. Take $C_d = 0.98$. (10)
- (c) What do you understand by the terms major energy loss and minor energy losses in pipes? (5)

- V. (a) Distinguish between forced vortex and free vortex. (8)
 (b) In a free cylindrical vortex flow, at a point in the fluid at a radius of 200 mm and at a height of 100 mm, the velocity and pressure are 10 m/s and 117.72 kN/m² absolute. Find the pressure at a radius of 400 mm and at a height of 200 mm. The fluid is air having density equal to 1.24 kg/m³. (12)

OR

- VI. (a) What do you mean by 'Viscous flow'? (4)
 (b) Define the terms: Kinematic viscosity; velocity gradient and pressure gradient. (6)
 (c) Derive an expression for the velocity distribution for viscous flow through a circular pipe. Also sketch the velocity distribution and shear stress distribution across a section of the pipe. (10)

- VII. (a) Obtain an expression for the force exerted by a jet of water on a fixed vertical plate in the direction of the jet. (7)
 (b) A jet of water of diameter 50 mm strikes a fixed plate in such a way that the angle between the plate and the jet is 30°. The force exerted in the direction of the jet is 1471.5 N. Determine the rate of flow of water. (7)
 (c) Show that the efficiency of a free jet striking normally on a series of flat plates mounted on the periphery of a wheel can never exceed 50%. (6)

OR

- VIII. A jet of water having a velocity of 20 m/s strikes a curved vane, which is moving with a velocity of 10 m/s. The jet makes an angle of 20° with the direction of motion of vane at inlet and leaves at an angle of 130° to the direction of motion of vane at outlet. Calculate: (20)
 (i) Vane angles, so that the water enters and leaves the vane without shock.
 (ii) Work done per second per unit weight of water striking (or work done per unit weight of water striking) the vane per second.

- IX. (a) What is an air vessel? Describe the function of the air vessel for reciprocating pump. (5)
 (b) The diameter and stroke length of a single-acting reciprocating pump are 12 cm and 20 cm respectively. The lengths of suction and delivery pipes are 8 m and 25 m respectively and their diameters are 7.5 cm. If the pump is running at 40 r.p.m and suction and delivery heads are 4 m and 14 m respectively, find the pressure head in the cylinder: (15)
 (i) at the beginning of the suction and delivery stroke.
 (ii) in the middle of suction and delivery stroke.
 (iii) at the end of the suction and delivery stroke.

Take atmospheric pressure head = 10.30 metres of water and $f = 0.008$ for both pipes.

OR

- X. (a) A centrifugal pump is to discharge 0.118 m³/s at a speed of 1450 rpm against a head of 25 m. The impeller diameter is 250 mm, its width at outlet is 50 mm and manometric efficiency is 75%. Determine the vane angle at the outer periphery of the impeller. (8)
 (b) The diameter of a centrifugal pump, which is discharging 0.03 m³/s of water against a total head of 20 m is 0.40 m. The pump is running at 1500 rpm. Find the head, discharge and ratio of powers of a geometrically similar pump of diameter 0.25 m when it is running at 3000 rpm. (12)