INDIAN MARITIME UNIVERSITY

B.Tech (MARINE ENGINEERING)

June 2013 Examinations
FOURTH SEMESTER

FLUIDS MECHANICS-I

Old Subject Code: UG/ME/BS/T/225 **QP Code: T0511405**
Date: 20.06.2013 **Max. Marks: 100**
Time: 3 Hrs

PART A **(10 x 3 = 30 M)**
Compulsory Question

1. a. Derive the expression for Reynold's Number and Froudes number, Euler's Number.

   b. Define Total pressure and centre of pressure.

   c. Explain the term meta centre and what is metacentric height.

   d. State Bernoullis theorm for steady flow of an incompressible fluid.

   e. Write the expression for Euler's equation of motion and Bernoullis equation of motion.

   f. Explain the term – Major Energy loss and Minor energy loss in pipes.

   g. Define the term (i) Hydraulic Gradient line (ii) total energy line.

   h. State Darcey's & chezy's Formula.

   i. What is viscous flow? Name the different methods of determination of coefficient of viscosity.

   j. What are different types of vortex flow. Give examples of different types of Vorten flow.

PART B (5 x 14 = 70 M)

Answer any 5 of the following.

2. a. A 1:20 model of a flying boat is towed through water. The prototype is moving in sea water of density 1024 kg/m^3 at a velocity of 15 m/sec. Find the corresponding speed of the model. Also determine the resistance due to waves on the model, if the resistance due to waves of prototype is 500N.

   b. Resistance R, to the motion of a completely submerged body is given by $R = \rho v^2 l^2 \emptyset \left(\frac{vl}{\gamma}\right)$, where P and γ are density and kinematic viscosity of the fluid where l is the length of the body and v is the velocity of the flow. If the resistance of a one eighth scale air-ship model when tested in water at 12m/sec is 22N, What will be the resistance in air of the air ship at the corresponding speed. Kinematic viscosity of air is 13 times that of water and density of water is 810 times that of air.

(7 + 7 marks)

3. a. A cylindrical gate of 4m diameter 2m long has water the upstream side to the full height as diameter and the down stream side to half the height as radius. Determine the magnitude, location and direction of the resultant force exerted by the water on the gate. Find also the best weight of the cylinder so that it may not be lifted away from the floor.

   b. Find the magnitude and direction of the resultant water pressure acting on a curved face of a dam which is shaped according to the relation $y = \frac{x^2}{\epsilon}$. The height of water retained by the dam is 12m. Take the width of dam as unity.

(8+6 marks)

4. a. Derive an expression for the rate of flow through venturimeter.

   b. Determine the rate of flow of water through a pipe 300 mm diameter placed in an inclined position where a Venturimeter is inserted, having a throat diameter of 150mm. The difference of pressure between the main and throat is measured by a liquid of specific gravity 0.7 in an inverted U-tube which gives a reading of 260mm. The loss of head between the main and throat is 0.3 times the Kinetic head of the pipe.

(6 + 8 marks)

5. a. Derive an expression for the minimum height attained by a jet.

b. A nozzle is situated at a distance of 1.2m above the ground level and is inclined at 60 ° to the horizontal. The diameter of the nozzle is 40 mm and the jet of water from the nozzle strikes the ground at a horizontal distance of 5m. Find the flow rate

(6 + 8 marks)

6. a. A 150 mm diameter pipe reduces in diameter abruptly to 100 mm diameter. If the pipe carries water at 30 liters per second. Calculate the pressure loss across the contraction. Take the coefficient of contraction as 0.6

b. A horizontal pipe line 40m long is connected to a water tank at one end discharges freely into the atmosphere at the other end. For the first 25 m of its length from the tank, the pipe is 150 mm diameter and its diameter is suddenly enlarged to 300mm. The height of water level in the tank is 8 m above the entre of the pipe. Considering all losses of head which occur, determine the rate of flow. Take $f = .01$ for both sections of the pipe.

(6 + 8 marks)

7. a. Crude oil of $\mu = 1.5$ poise and relative density of 0.9 flows through a 20 mm diameter vertical pipe. The pressure gauges fixed 20 m apart read 58.86N/cm^2 and 19.62N/cm^2. Find the direction and rate of flow through the pipe.

b. Calculate (i) the pressure gradient along flow (ii) the average velocity, and (iii) the discharge for an oil of viscosity 0.02 NS/m^2 flowing between 2 stationary parallel plates 1m wide maintained 10 mm apart. The velocity midway between the plates in 2m/s.

(8 + 6 marks)

8. A vessel, cylindrical in shape and closed at the top and bottom, contains water up to a height of 80 cm. The diameter of the vessel is 20 cm and length of vessel is 120 cm. The vessel is rotated at a speed of 700 r.p.m. around its vertical axis. Find the area uncovered at the bottom of the tank.

(14 marks)

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