

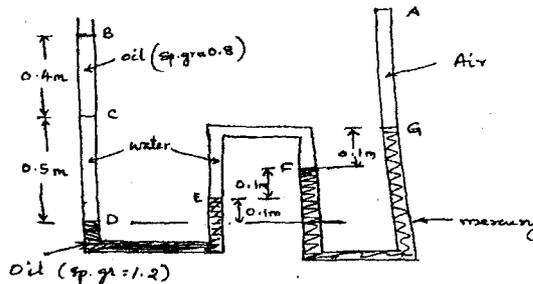
**B.Tech. Degree III Semester Examination in Marine Engineering
December 2013**

MRE 305 FLUID MECHANICS & MACHINERY

Time : 3 Hours

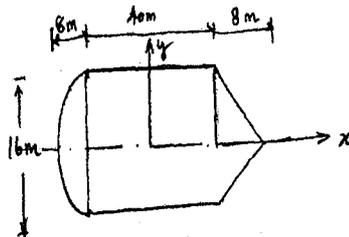
Maximum Marks : 100

- I. (a) The bearing of an engine is 10cm in diameter and 5cm long. The engine runs at 3000rpm. The clearance between the bearing and the journal is 0.5mm and the viscosity of the lubricating oil is 0.44 NS/m^2 . Assume that the velocity of the oil film varies linearly with radius. Calculate the power lost in the bearing, neglecting the eccentricity of the shaft. (8)
- (b) Calculate the pressure difference between A&B in a manometer shown. (12)

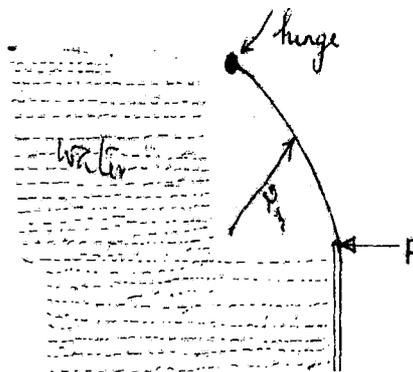


OR

- II. (a) A ship weighs 5000 ton has a cross section at the water line as shown. The centre of buoyancy is 1.5m below the free surface and the centre of gravity is 0.6m above the free surface. Compute the metacentric height for the x&y axes (10)



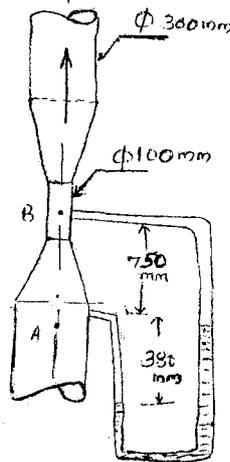
- (b) Calculate the force required to hold the gate in a closed position. (10)



- III. (a) Derive the general continuity equation for a 3.D flow. (10)
- (b) The velocity potential for a 2D flow field is given by $Q = 2x^3y - 2xy^3$. Calculate the velocity and value of the stream function at (2,1) (10)

OR

- IV. (a) In a hydroelectric power station, the catchment surface area is $10\text{km} \times 10\text{km}$. Two rivers are bringing water in to the area at the rate of $8 \times 10^3 \text{ m}^3/\text{min}$ and $6 \times 10^3 \text{ m}^3/\text{min}$ respectively. The out flow rate is $12 \times 10^3 \text{ m}^3/\text{min}$. Estimate the rate of level rise if evaporation and seepage losses are negligible. (10)
- (b) For the venturimeter shown, the level difference in mercury is 380mm. Determine the flow of water if there is no loss between A&B. (10)



- V. (a) A cyclone is approximated as a free vortex flow. The wind velocity at a distance of 10km from the centre of the cyclone is 50km/hr. Calculate the pressure gradient at that point. What should be the difference in pressure over a radial distance of 5km from that point towards the centre of cyclone ($f_{\text{air}} = 1.2\text{kg/m}^3$) (12)
- (b) Distinguish between free vortex and forced vortex. (8)
- OR**
- VI. (a) In a refinery, crude oil of specific gravity 0.85 and viscosity 0.1 poise, flow through a pipe of 30cm diameter with an average velocity of 3m/s. Calculate the pumping power required to maintain this flow per km length of the pipe. (12)
- (b) Derive an expression for the velocity distribution of viscous fluid flow through circular pipe and using that derive Hagen Poiseuille formula. (8)
- VII. (a) A jet of water 25mm in diameter and velocity 100 m/s strikes a series of moving blades. The nozzle angle is 20° , and the peripheral speed of the blade is 45m/s. The water leaves the blades in an axial direction and 10% of the kinetic energy of water jet is lost in overcoming the friction while it moves over the blades. Calculate the blade angles and the axial thrust. (12)
- (b) Water at the rate of 40 lit/s is flowing through a 150mm diameter fire hose, at the end of which a 50mm diameter nozzle is fixed. Calculate the force exerted by the nozzle if the pressure at the inlet of the nozzle is 200 kPa. (8)

OR

Contd.....3

VIII. (a) A pelton wheel turbine works under a head of 400m and rotating at 720 rpm. (10)
Calculate the power produced and the hydraulic efficiency when the discharge through the machine is 300 lit/sec and the jet is deflected by 170° . Take $c_v = 0.97$ and the blade velocity coefficient $K=0.9$

(b) Estimate the main dimensions for a Francis turbine to suit the following conditions. (10)

Head	=	100m
Power	=	2.5MW
Speed	=	500 rpm
η_{hyd}	=	0.9
η_{overall}	=	0.85
Flow ratio	=	0.15

Ratio of wheel width to wheel diameter at inlet = 0.1. The outer diameter is twice the inner diameter, and velocity of flow is constant.

IX. (a) Explain what is meant by specific speed of a pump. (8)

(b) A centrifugal pump has an impeller of 80cm diameter and it delivers $1\text{m}^3/\text{s}$ against a head of 80m. The impeller runs at 1000 rpm and the width at outlet is 8cm. If the leakage losses are 3% of the discharge, external mechanical loss is 10KW, and the hydraulic efficiency is 8%, calculate the blade angle at outlet the power required and the overall efficiency of the pump. (12)

OR

X. (a) Describe the use of indicator diagrams in reciprocating pump. (8)

(b) A reciprocating pump has piston diameter 30cm and stroke 45cm. The suction pipe is 12.5 cm in diameter and 8m long. The centre line of the pump is 4m above the level of water in the sump. Calculate the maximum speed of the pump if the atmospheric pressure is 10.3m of water and vapour pressure is 2.5m of water. At this speed, calculate the discharge and the pressure head at the middle and the end of suction stroke. Take friction factor $4f = 0.02$ (12)
