USN | | | | | | | | | | |

10ME/AU46B

Fourth Semester B.E. Degree Examination, June/July 2013
Fluid Mechanics

Time: 3 hrs. Max. Marks:100

Note: ***Answer FIVE full questions, selecting at least TWO questions from each part.***

PART – A

1 a. Define the following properties of fluid:
   i) Specific weight.
   ii) Specific gravity.
   iii) Vapour pressure.
   iv) Capillarity.
   v) Surface tension. **(10 Marks)**

b. A shaft of 250mm diameter rotates inside a sleeve of 120mm long at 200 rpm. If the thickness of oil film between shaft and sleeve is 1.5mm, find the power lost in friction. The dynamic viscosity of oil used is 8 poise. **(10 Marks)**

2 a. Obtain the total pressure and the centre of pressure on an inclined plain surface immersed in a fluid. **(10 Marks)**

b. A differential U-tube mercury manometer is used to measure the difference of pressure between two water pipes A and B. Find the pressure at A if the level difference in mercury in the manometer is 150mm as shown in figure. The pressure at B is 300 kPa. **(10 Marks)**

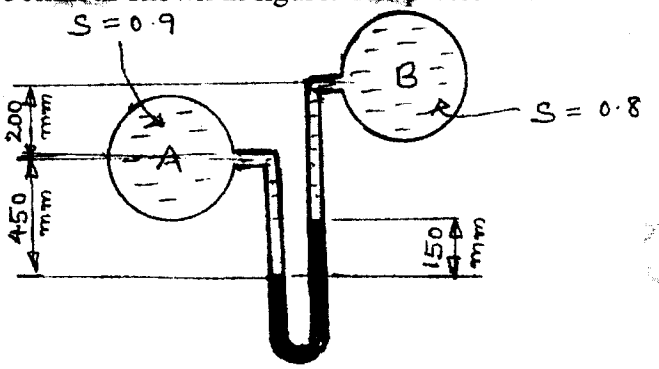

Fig.Q.2(b)

3 a. Explain the method to find the metacentric height experimentally. **(08 Marks)**

b. The stream function for a two-dimensional flow is given by $\psi = 2xy$. Find the velocity at the point P(4, 2). Also find the velocity potential function. **(12 Marks)**

4 a. Obtain the Euler's equation of motion along a stream line and hence derive Bernaulis equation for a steady incompressible fluid flow. **(10 Marks)**

b. A 10m long water pipe is laid at a slope of 3 in 4. The diameters of the lower end and upper end are 120mm and 180mm respectively pressure gauges fixed at the lower end and upper end reads 0.2MPa and 0.3MPa respectively. Determine the flow rate of water through the pipe. **(10 Marks)**

PART – B

5 a. Derive an expression for discharge through a rectangular notch. **(10 Marks)**

b. Using Buckingham's π-theorem prove that the frictional torque T of a disc of diameter D rotating at a speed N in a fluid of viscosity μ and density ρ in a turbulent flow is given by

$$T = D^5 N^2 \rho \phi \left[\frac{M}{D^2 N \rho}\right].$$ **(10 Marks)**

6 a. Derive Darcy's equation for the loss of head due to friction in a circular pipe. **(10 Marks)**

b. Water is supplied to a town having a population of 1 lakh from a reservoir 6km away from the town and is stipulated that half of the daily supply of 180 litres per head should be delivered in 8 hrs. What should be the diameter of the supply pipe? The loss of head due to friction in the pipe line is 12m. Take f = 0.002. **(10 Marks)**

7 a. Derive Hagen-Poiseuille's equation for viscous flow through a circular pipe. **(10 Marks)**

b. A pipe of diameter 240mm and length 20km is laid at a slope of 1 in 250. An oil of specific gravity 0.85 and viscosity 180cp is pumped up at a rate of 18 litres/sec. Find the head lost due to friction and the power required to pump the oil. **(10 Marks)**

8 a. Explain the following:

i) Drag
ii) Lift
iii) Momentum thickness
iv) Mach number
v) Mach cone. **(10 Marks)**

b. A flat plate 2m × 2m moves at 40 km/hr in a stationary air of density 1.2 kg/m^3. If the coefficients of drag and lift are 0.15 and 0.75 respectively determine:

i) The lift force
ii) The drag force
iii) The resultant force
iv) The power required to keep the plate in motion. **(10 Marks)**

* * * * *