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

10ME/AU36B

Third Semester B.E. Degree Examination, Dec.2014/Jan.2015

Fluid Mechanics

Time: 3 hrs. Max. Marks:100

Note: 1. ***Answer FIVE full questions, selecting at least TWO questions from each part.***
2. ***Missing data can be assumed suitably.***

PART – A

1 a. Define the following fluid properties:
i) Density ii) Specific volume
iii) Viscosity iv) Specific gravity **(06 Marks)**

b. Define surface tension. Prove that the relation between surface tension and pressure inside a droplet of liquid in excess of outside pressure is given by $P = \frac{4\sigma}{d}$. **(06 Marks)**

c. The space between two flat parallel plates is filled with oil. Each side of the plate is 60 cm. The thickness of the oil film is 12.5 mm. The upper plate which moves at 2.5 m/s requires a force of 98.1 N to maintain the speed. Determine the following:
i) The dynamic viscosity of the oil in poise.
ii) The kinematic viscosity of the oil in strokes if the specific gravity of the oil is 0.95.
(08 Marks)

2 a. State and prove the Pascal's law. **(06 Marks)**

b. An inverted U-tube manometer is connected to two horizontal pipes A and B through which water is flowing. The vertical distance between the axes of these pipes is 30 cm, when an oil of specific gravity 0.8 is used as a gauge fluid. The vertical height of water columns in the two limbs of the inverted U-tube manometer are found to be same and equal to 35 cm. Determine the difference of pressure between the pipes. **(06 Marks)**

c. A rectangular surface is 2m wide and 3m deep it lies in vertical plane in water. Determine the total pressure and position of centre pressure on the plane surface when its upper edge is horizontal and (i) coincides with water surface, (ii) 2.5 m below the free water surface.
(08 Marks)

3 a. Derive the continuity equation in Cartesian coordinates. **(06 Marks)**

b. A block of wood of specific gravity 0.7 floats in water. Determine the metacentric height of the block if its size is 2m × 1m × 0.8m. **(08 Marks)**

c. Define the following terms:
i) Meta centre and meta centric height
ii) Buoyancy and centre of buoyancy **(06 Marks)**

4 a. Derive the Euler's equation of motion along a stream line. Also derive Bernoulli's equation from Euler's equation of motion and list the assumptions made for deriving Bernoulli's equation. **(10 Marks)**

b. A pipe line carrying oil of specific gravity 0.87, changes in diameter from 200 mm diameter at position A to 500 mm diameter at a position B which is 4m at a higher level. If the pressure at A and B are 9.81 N/cm^2 and 5.886 N/cm^2 respectively and the discharge is 200 litres/sec. Determine the loss of head and direction of flow. **(10 Marks)**

PART – B

5 a. Derive an expression for discharge through V-notch. **(06 Marks)**

b. A 30 cm × 15 cm venturimeter is provided in a vertical pipe line carrying oil of specific gravity 0.9. The flow being upwards. The difference in elevation of the throat section and entrance section of the venturimeter is 30 cm. The differential U-tube mercury manometer shows a gauge deflection of 25 cm. Calculate the:

i) Discharge of the oil.

ii) Pressure difference between the entrance section and the throat section. Take the coefficient of meter as 0.98 and specific gravity of mercury is 13.6. **(10 Marks)**

c. State Buckingham's π theorem. **(04 Marks)**

6 a. Derive Chezy's equation for loss of head due to friction in pipes. **(06 Marks)**

b. Define the following terms:

i) Hydraulic gradient line

ii) Total energy line **(04 Marks)**

c. A pipe line 300 mm in diameter and 3200 m long is used to pump up 50 kg/s of an oil whose density is 950 kg/m^3 and whose kinematic viscosity is 2.1 stokes. The centre of the pipe line at the upper end is 40 m, above than that at the lower end. The discharge at the upper end is atmospheric. Find the pressure at the lower end and draw the hydraulic gradient line and the total energy line? **(10 Marks)**

7 a. Prove that the maximum velocity in a circular pipe for viscous flow is equal to two times the average velocity of the flow. **(10 Marks)**

b. An oil of specific gravity 0.7 is flowing through a pipe of diameter 300 mm at the rate of flow 500 lit/s. Find the following:

i) Head lost due to friction

ii) Power required to maintain the flow. **(06 Marks)**

c. Define the following:

i) Viscosity gradient

ii) Pressure gradient **(04 Marks)**

8 a. Differentiate between:

i) Pressure drag and friction drag

ii) Stream body and bluff body

iii) Lift and drag **(08 Marks)**

b. Define Mach number and derive the same. **(04 Marks)**

c. A flat plate 1.5 m × 1.5 m moves at 50 km/hr in stationary air of density 1.15 kg/m^3. If the coefficient 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) Power required to keep the plate in motion. **(08 Marks)**

* * * * *