CBCS SCHEME

USN | | | | | | | | | |

15AE35

Third Semester B.E. Degree Examination, June/July 2019
Mechanics of Fluids

Time: 3 hrs. Max. Marks: 80

Note: Answer any FIVE full questions, choosing ONE full question from each module.

Module-1

1 a. Define the following properties of fluid and mention their S.I. units.
i) Specific weight ii) Surface tension iii) Specific volume. **(06 Marks)**

b. Determine the viscosity of a liquid having kinematic viscosity 6 stokes and specific gravity 1.9. **(04 Marks)**

c. A differential manometer is connected at the two points A and B as shown in Fig.Q.1(c). At B air pressure is 9.81 N/cm^2 (abs), find the absolute pressure at A. **(06 Marks)**

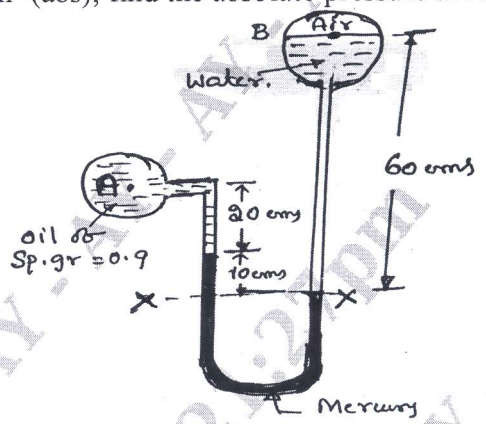

Fig.Q.1(c)

OR

2 a. Define the following properties of fluid and mentioned their S.I. units.
i) Absolute viscosity ii) Capillarity iii) Mass density. **(06 Marks)**

b. A body of dimensions 1.5m × 1.0m × 2m weights 1962 N in water. Find its weight in air. What will be its specific gravity? **(04 Marks)**

c. A circular plate 3m diameter is immersed in water in such a way that its greatest and least depth below the free surface are 4m and 1.5m respectively. Determine the total pressure on one face of the plate and position of the centre of pressure. **(06 Marks)**

Module-2

3 a. Distinguish between:
i) Steady flow and unsteady flow
ii) Uniform and nonuniform flow
iii) Compressible and incompressible flow. **(06 Marks)**

b. A 25cms diameter pipe carries oil of specific gravity 0.9 at a velocity of 3m/s. At another section the diameter is 20cms. Find the velocity at this section mass rate of flow. **(04 Marks)**

c. The following cases represent the two velocity components, determine the third component of velocity such that they satisfy the continuity equation.
$u = x^2 + y^2 + z^2$; $v = xy^2 - yz^2 + xy$ **(06 Marks)**

OR

4 a. Define the terms:
   i) Velocity potential function
   ii) Stream function
   iii) Laminar flow. **(06 Marks)**

   b. Obtain an expression for continuity equation for a three dimensional flow. **(06 Marks)**

   c. A pipe convey's 0.25 kg/s of air at 300K and under an absolute pressure of 2.25 bar. Calculate the minimum diameter of pipe necessary of the velocity of flow is limited to 7.5 m/s. **(04 Marks)**

Module-3

5 a. Obtain an expression for Bernoullis equation from Eulers equation of motion and also mention the assumptions made. **(10 Marks)**

   b. A pipe of diameter 400mm carries water at a velocity of 25 m/s. The pressure at the points A and B are given as 29.43 N/cm^3 and 22.563 N/cm^2 respectively while the datum head at A and B are 28m and 30m. Find the loss of head between A and B. **(06 Marks)**

OR

6 a. State Buckingham's π-Theorem. Why this theorem is considered superior over the Rayleigh's method for dimensional analysis. **(06 Marks)**

   b. Derive on the basis of dimensional analysis suitable parameters to present the thrust developed by a propeller. Assume that the thrust P depends upon the angular velocity W, speed of advance V, diameter D, dynamic viscosity μ, mass density ρ, elasticity of the fluid medium which can be denoted by the speed of sound in the medium C. **(10 Marks)**

Module-4

7 a. Define:
   i) Laminar boundary layer
   ii) Turbulent boundary layer. **(06 Marks)**

   b. For the velocity profile in Laminar boundary layer are $\frac{u}{U}=\frac{3}{2}\left(\frac{y}{\delta}\right)-\frac{1}{2}\left(\frac{y}{\delta}\right)^3$ find the thickness of the boundary layer and the shear stress 1.5m from the leading edge of a plate. The plate is 2m long and 1.4m wide and is placed in water which is moving with a velocity of 200mm/second. Find the total drag force on the plate if μ for water 0.01 Poise. **(10 Marks)**

OR

8 a. Derive an expression for Drag and lift. **(06 Marks)**

   b. Experiments were conducted in a wind tunnel with a wind speed of 50km/hour on a flat plate of size 2m long and 1m wide. The density of air is 1.15 kg/m^3. The coefficient of lift and drag are 0.75 and 0.15 respectively. Determine:
   i) The lift force
   ii) The drag force
   iii) The resultant force
   iv) Direction of resultant force
   v) Power exerted by air on the plate. **(10 Marks)**

Module-5

9 a. Define Mach number. What is the significance of Mach number in compressible fluid flows? **(06 Marks)**

b. Find the Mach number when an aeroplane is flying at 1100km/hour through still air having a pressure of 7 N/cm^2 and temperature -5°C. Wind velocity may be taken as zero. Take R = 287.14 J/kg °K. Calculate the pressure, temperature and density of air at stagnation point on the nose of the plane. Take K = 1.4. **(10 Marks)**

OR

10 a. Define the terms: i) Subsonic flow ii) Supersonic flow iii) Sonic flow. **(06 Marks)**

b. Calculate the stagnation pressure, temperature and density at the stagnation point on the nose of a plane, which is flying at 800 km/hour through still air having a pressure 8N/cm^2 (abs) and temperature -10°C. Take R = 287 J/kg °K and K = 1.4. **(10 Marks)**

* * * * *