INSTITUTE OF AERONAUTICAL ENGINEERING
(Autonomous)
B.Tech IV Semester End Examinations (Regular/Supplementary) - July, 2021
Regulation: R18
FLUID MECHANICS
Time: 3 Hours   **(CE)**   **Max Marks: 70**

Answer FIVE Questions choosing ONE question from each module
(NOTE: Provision is given to answer TWO questions from any ONE module)
All Questions Carry Equal Marks
All parts of the question must be answered in one place only

UNIT – I

1. (a) Define the following properties of fluid: (i) Mass density, (ii) Specific weight, (iii) Specific volume and (iv) Viscosity. Give their dimensions. **[7M]**

   (b) A vertical cylinder of diameter 16 cm rotates concentrically inside another cylinder of diameter 16.1 cm. The clearance space between the cylinders is filled with a liquid of unknown viscosity which has a linear viscosity profile and both cylinders are 24 cm high. Find the viscosity of the liquid if a torque of 10 Nm is required to rotate the inner cylinder at a speed of 50 rpm. **[7M]**

2. (a) Derive expressions for internal pressure inside a droplet and soap bubble. **[7M]**

   (b) Determine the power required to convert 1.2 litres of water per minute at a temperature of 20^0C into a mist having an average drop size of $3.5 * 10^{-6}$ m. Also determine the pressure intensity inside the mist droplets and neglect any thermal effects. **[7M]**

UNIT – II

3. (a) Define the following terms:
   i) Atmospheric pressure
   ii) Gauge pressure
   iii) Vacuum pressure
   iv) Absolute pressure.
   v) Center of pressure **[7M]**

   (b) A cuboidal wooden block (specific gravity = 0.65) that is 3.5 m long, 1.3 m wide and 2 m deep floats horizontally in sea water (specific gravity = 1.025). Determine (i) The volume of liquid displaced and (ii) The position of centre of buoyancy. **[7M]**

4. (a) Define and classify the manometers. How do you measure the pressure by using manometers and mechanical gauges? **[7M]**

   (b) The difference in height of the centres of two pipes connected to a differential mercury manometer is 2.5 m. The pipe at higher level carries a liquid (specific gravity = 0.9) at a pressure of 1.75 bar while the pipe at lower level carries a liquid (specific gravity = 1.45) at a pressure of 1 bar. The centre of pipe having low pressure liquid is 1.5 m above the higher mercury level in the manometer. Determine the difference in mercury level in the manometer. Take specific gravity of mercury as 13.6. **[7M]**

UNIT – III

5. (a) Define the equation of continuity. Determine an expression for continuity equation in a three-dimensional flow. **[7M]**

   (b) In a two-dimensional flow, the stream function is given by $\psi = 2xy$. Show that the flow is irrotational and it also determines the corresponding velocity potential **[7M]**

6. (a) Define stream function and velocity potential function. Show that the lines of constant stream function and velocity potential function must intersect orthogonally. **[7M]**

   (b) A cylindrical container of radius 3 m and height 9 m is to be filled completely with water by a number of pipes in 50 minutes. Determine the required water inflow of the container in m^3/s and also determine the number of pipes required if the container is to be filled by 5 cm diameter water pipes in which water flows with a velocity of 5 m/s. **[7M]**

UNIT – IV

7. (a) What is the difference between the pitot tube and pitot static tube? Determine an expression for velocity of a fluid flowing through pitot-tube? **[7M]**

   (b) A pitot tube placed at the centre of the pipe of 0.35 m diameter pipe indicates stagnation pressure and static vacuum pressure as *10kPa* and *0.11mHg*, respectively. If the coefficient of velocity is 0.975 and the mean velocity of flow is *0.82* times the velocity at the centre of pipe, then find the discharge through the pipe. Take specific gravity of mercury as 13.6. **[7M]**

8. (a) Prove that in case of forced vortex, the rise of liquid level at the ends is equal to the fall of liquid level at the axis of rotation when there is no spillage. **[7M]**

   (b) A venturimeter has a diameter of 0.2 m at the inlet and 0.1 m diameter at the throat. It is fitted in a horizontal pipeline to measure the flow of oil of specific gravity 0.82. If *5900* kg of oil is collected in 2 minutes and the difference of levels in the U-tube differential manometer reads 0.185m Hg, then determine the discharge coefficient for the pipe venturimeter. Take specific gravity of mercury as 13.6 **[7M]**

UNIT – V

9. (a) Determine the steps involved in Buckingham Pi theorem. **[7M]**

   (b) A liquid of specific gravity 0.925 and viscosity 0.032poise is to be transported through a pipe of diameter 1 m at the rate of 2250 litres per second. Tests were performed on a 10 cm diameter pipe using water at ambient conditions. If the viscosity and density of water at the given conditions is 0.01poise and 1000 kg/m^3, respectively, then determine the velocity and rate of flow in the model. **[7M]**

10. (a) Give the physical significance of Reynolds number, Froude number, Euler number, Weber number and Mach number for fluid flow problems **[7M]**

    (b) The resistance [R] is experienced by a partially submerged body depends upon the velocity, length of the body, viscosity of the fluid, density of the fluid and gravitational acceleration. Obtain a dimensionless expression for resistance[R] **[7M]**

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