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B. M. S. College of Engineering, Bengaluru - 560019

Autonomous Institute Affiliated to VTU

September / October 2023 Supplementary Examinations

Programme: B.E. **Semester: III**
Branch: Mechanical Engineering **Duration: 3 hrs.**
Course Code: 19ME3DCFME/15ME3DCFME **Max Marks: 100**
Course: Fluid Mechanics **Date: 27.09.2023**

Instructions: 1. Answer any FIVE full questions, choosing one full question from each unit.
2. Missing data, if any, may be suitably assumed.

UNIT - I

1. a) What is the Concept of continuum. Explain Newtons law of viscosity. **08**

b) A closed cylindrical tank filled with water has a hemispherical dome and is connected to an inverted piping system as shown in Fig 1 below. The liquid in the top part of the piping system has a specific gravity of 0.8, and the remaining parts of the system are filled with water. If the pressure gage reading at A is 60 kPa, determine (i) the pressure in pipe B, and (ii) the pressure head in millimeters of mercury, at the top of the dome (point C). **12**

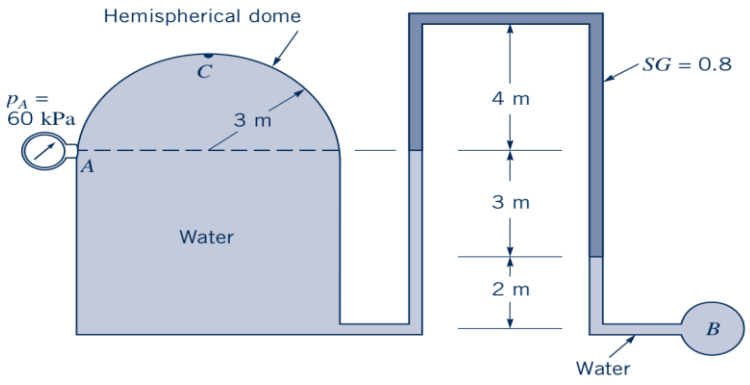

Fig 1

UNIT - II

2. a) Derive an expression for the meta-centric height by analytical method. **10**

b) Gate AB as shown in Fig 2 is 1.2 m long and 0.8 m width into the paper. Neglecting atmospheric pressure, compute the force F on the gate and its center of pressure at the position X. **10**

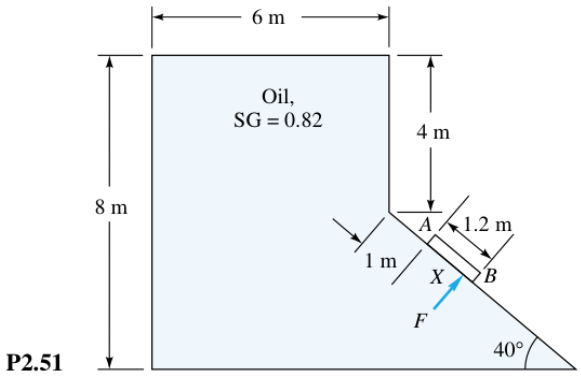

Fig 2

UNIT - III

3. a) Derive an expression for continuity equation in three dimensions. **10**

b) The velocity vector in a fluid flow is given as $V=4x^3i-10x^2$ yj+ 2tk. Find the velocity and acceleration of a fluid particle at (2,1,3) at time t=1. **10**

OR

4. a) Obtain an expression for Euler's equation of motion. **10**

b) A submarine fitted with a pitot tube moves horizontally in sea. Its axis is 12m below the surface of water. The pitot tube fixed in front of the submarine and along its axis is connected to the two limbs of a U-tube containing mercury, the reading of which is found to be 200 mm. Find the speed of the submarine. Specific gravity of sea water=1.205 times the fresh water. **10**

UNIT - IV

5. a) Derive an expression for Darcy's Weisbach formula. **10**

b) Water is flowing through a pipe at the end of which a nozzle is fitted. The diameter of the nozzle is 100 mm and the head of water at the Centre nozzle is 100 m. Find the force exerted by the jet of water on a fixed vertical plate. The coefficient of velocity is given as 0.95. **10**

OR

6. a) The drag coefficient of a car at the design conditions of 1 atm, 25°C, and 90km/h is to be determined experimentally in a large wind tunnel in a full-scale test. The height and width of the car are 1.25 m and 1.65 m, respectively. If the horizontal force acting on the car is measured to be 220 N, determine the total drag coefficient of this car. Assume density of the air = 1.164 kg/m^3. **10**

b) An oil of viscosity 0.1 Ns/m^2 and relative density 0.9 is flowing through a circular pipe of diameter 50 mm and length 300 m. Find the pressure drop in a length of 300 m and the shear stress at the pipe wall. Find the maximum velocity and velocity at 4 mm from the wall. Also, find the power required (Take discharge as 3.5 L/ s) **10**

UNIT - V

7. a) Using Rayleigh's method Find an expression for the drag force (F) on smooth sphere of diameter D, moving with a uniform velocity V in a fluid density ρ and dynamic viscosity μ. **10**

b) Using Buckingham's π theorem, show that the velocity through a circular orifice is given by V= $\sqrt{2gH}\ \phi[\frac{D}{H}, \frac{\mu}{\rho VH}]$, where H is the head causing flow, D is the diameter of the orifice, μ is co-efficient of viscosity, ρ is the mass density and g is the acceleration due to gravity. **10**

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