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Fourth Semester B.E. Degree Examination, Jan./Feb. 2021
Fluid Mechanics

Time: 3 hrs. Max. Marks:100

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

PART – A

1 a. Distinguish the following:
   i) Liquid and Gas
   ii) Real fluid and Ideal fluid
   iii) Newtonian and Non-Newtonian fluid
   iv) Density and Relative density. **(08 Marks)**

b. One litre of crude oil weighs 9.6N. Calculate its specific weights, density and specific gravity. **(04 Marks)**

c. Derive an expression for surface tension and pressure on liquid jet. **(04 Marks)**

d. The capillary rise in the glass tube is not to exceed 0.2mm of water. Determine its minimum size, given that surface tension for water in contact with air is 0.0725N/m. **(04 Marks)**

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

b. Vessels A and B contains water under a pressure of 275kPa and 140kPa respectively. What is the deflection mercury in the differential gauge? **(08 Marks)**

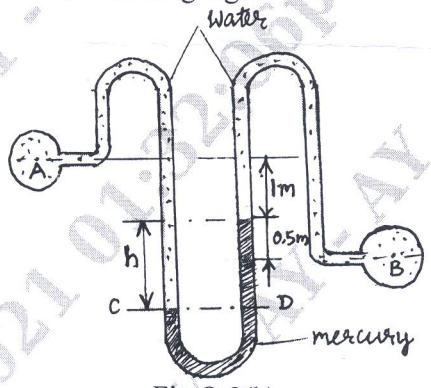

Fig.Q.2(b)

c. A circular plate 3m diameter is immersed in water in such a way that the plane of the plate makes an angle of 60° with the free surface of water. Determine the total pressure and position of centre of pressure when the upper edge of the plate is 2m below the free water surface. **(06 Marks)**

3 a. Distinguish the following:
   i) Centre of Buoyancy and Meta centre
   ii) Steady flow and uniform flow. **(04 Marks)**

b. A solid cylinder of diameter 4m has a height of 4m. Find the metacentric height of the cylinder, if the specific gravity of the material of the cylinder is 0.6 and floating in water with its axis vertical. State whether the equilibrium is stable or unstable. **(08 Marks)**

c. Derive continuity equation in three dimensional flow. **(08 Marks)**

4 a. State Bernoulli's theorem and list the assumption are made while deriving Bernoulli's equation. **(04 Marks)**

b. The oil of specific gravity 0.85 is flowing through a pipe having diameter 150mm and 225mm at section 'A' and at section 'B' respectively, the rate of flow through is 60Lps. The section 'A' is 3m above the datum and section 'B' is 1.5m above the datum and head loss from section 'A' to section 'B' is 1m. Find Intensity of pressure at section 'B' when the pressure intensity at section 'A' is 450kPa. **(08 Marks)**

c. At a certain section 'A' of pipe line carring a water, the diameter is 1m, the pressure is 98.1kN/m^2 and mean velocity is 3m/s at another section 'B' which is 2m higher than A. The diameter is 0.7m and pressure is 39.2kN/m^2. What is the direction of flow? **(08 Marks)**

PART – B

5 a. A 150mm × 75mm venturimeter with $C_d = 0.98$ is to be replaced by an orificemeter having $C_d = 0.6$. If both meters are to give the same differential mercury monometer reading for a discharge of 100 ltr/sec. Find the diameter of the orifice. **(08 Marks)**

b. Derive the expression for discharge through a rectangular notch. **(06 Marks)**

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

6 a. What is energy losses in pipes and how they are classified? **(06 Marks)**

b. Air flows through a circular pipe of 10mm diameter at an average velocity of 2m/s calculate the pressure in mm of water for flow over a length of 5m. Viscosity and density of flowing fluid are $1.983 \times 10^{-5} \frac{kg}{ms}$ and 1.1774 kg/m^3. **(08 Marks)**

c. Describe with the help of sketch, operation and use of pitot-static tube. **(06 Marks)**

7 a. Prove that the ratio of maximum velocity to average velocity in a viscous flow of fluid through a circular pipe is 2.0. **(10 Marks)**

b. An oil of viscosity 0.1N-s/m^2 and relative density 0.9 is flowing through a circular pipe of diameter 50mm and length 300mm. The rate of flow of fluid through a pipe is 3.5 ltr/s. Find the pressure drop in a length of 300m and also shear stress at the pipe wall. **(10 Marks)**

8 a. Define the following:
i) Drag
ii) Lift
iii) Boundary layer thickness
iv) Momentum thickness. **(08 Marks)**

b. Calculate the Mach number at point on jet propelled air craft which is flowing at 1100km/hr at a sea level where air temperature is 20°C. Take K = 1.4 and R = 287J/kg K. **(06 Marks)**

c. Define:
i) Sonic flow
ii) Sub sonic flow
iii) Supersonic flow. **(06 Marks)**

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