CHIKODI

CBCS SCHEME

USN | | | | | | | | | | 17ME44

Fourth Semester B.E. Degree Examination, June/July 2019
Fluid Mechanics

Time: 3 hrs. Max. Marks: 100

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

Module-1

1 a. Define the following properties of fluids with their SI units:
(i) Mass Density (ii) Weight Density (iii) Dynamic viscosity (iv) Kinematic viscosity. **(08 Marks)**

b. Derive an expression for pressure intensity in case of a soap bubble. **(04 Marks)**

c. A cubical block of sides 1m and weighing 350 N slides down on inclined plane with a uniform velocity of 1.5 m/s. The inclined plane is laid on a slope of 5 vertical to 12 horizontal and has an oil film of 1.0mm thickness. Calculate the dynamic viscosity of oil in poise. **(08 Marks)**

OR

2 a. Define (i) Buoyancy (ii) Centre of Buoyancy (iii) Meta-centre (iv) Meta-centric height. **(08 Marks)**

b. Explain the method to find the Meta-centric height experimentally. **(04 Marks)**

c. A block of wood of specific gravity 0.7 floats in water. Determine to Meta-centric height of the block, if its size is 2m x lm x 0.8m. **(08 Marks)**

Module-2

3 a. Explain different types of fluid flows with examples. **(08 Marks)**

b. Derive the continuity equation for the 3-Dimensional flow in Cartesian co-ordinates. **(08 Marks)**

c. A stream function is given by kif = 3 xy. Determine whether the flow is possible or not. **(04 Marks)**

OR

4 a. Derive an expression for force exerted by the jet on stationary flat vane. **(04 Marks)**

b. Derive Euler's equation of motion along a stream line and deduce Bernoulli's equation. State the assumptions made. (10 **Marks)**

c. A sub-marine moves horizontally in sea, A pitot static tube placed in front of sub-marine and along its axis is connected to the two limbs of U-tube manometer containing mercury. The difference of mercury level is found to be 200mm. Find the speed of the sub-marine in km/hr. take specific of gravity of mercury as 13.6 and sea water as 1.026, Cv = 0.98. **(06 Marks)**

Module-3

5 a. Derive Hagen-Poiseuille's equation for laminar flow through a circular pipe. **(10 Marks)**

b. Oil is to be transported from a tanker to the shore at the rate of 5 It/sec, using a 300mm diameter pipe for 20km length. If $\mu = 0.1$ N-m/s^2 and $p = 900$ kg/m^3 for the oil, calculate the power required to maintain the flow. **(10 Marks)**

OR

6 a. Write a short note on Moody's diagram. **(04 Marks)**

b. Three pipes of lengths 800m, 500m and 400m and diameters 500mm, 400mm and 300mm respectively are connected in series. These pipes are replaced by a single pipe of 1700m length. Find the diameter of the single pipe. **(06 Marks)**

c. Water is supplied to the inhabitants of a college campus through a supply main. The following data is obtained:
- Distance of the reservoir from the campus = 4 km
- Number of inhabitants = 3000
- Consumption of water per day of each inhabitant = 180 litre.
- Loss of head due to friction = 18 m
- Co-efficient of friction for the pipe, f= 0.007

If half of the daily supply is pumped in 08 hours, determine the size (diameter) of the supply main. **(10 Marks)**

Module-4

7 a. Define the drag force and lift force. Also derive their expressions. (10 **Marks)**

b. Derive an expression for displacement thickness and momentum thickness of a flow over a plat. **(10 Marks)**

OR

8 a. Explain the dimensional homogeneity with examples. **(04** Marks)

b. Check whether the following equations (with their usual notations) are dimensionally homogeneous or not:

(i) V = V2gh (ii) $h_i = \frac{4f\,LV2}{2gd}$ (iii) P = WQH **(06 Marks)**

c. Show by the method of dimensional analysis that, for a screw propeller, the relation between the thrust 'F', torque 'T', diameter 'D', speed of travel IF, speed of rotation 'N', density `p' and viscosity 't.t' may be put in the form

$F = pD^2U^2 4) \frac{pDiU^{-}DN}{T} \frac{pUD}{U}$

[Hint: take D, U and p as repeating variables.] (06 Marks)

Module-5

9 a. Define the following terms:
(i) Sub-Sonic flow (ii) Sonic flow (iii) Super-Sonic flow (iv) Mach Number (08 Marks)

b. Derive an expression for velocity of sound in terms of Bulk modulus. **(06 Marks)**

c. An aeroplane flying at a height of 15 km, where the temperature is — 50°C. The speed of the plane corresponding to Mach number is 2.0. Assuming K = 1.4 and R = 287 J/kg.K, find the speed of the plane. **(06 Marks)**

OR

10 a. Explain the necessity of CFD. Mention its applications and limitations. **(10 Marks)**

b. What are normal and oblique shocks? Explain. **(04 Marks)**

c. Find the velocity of a bullet fired in air, if the Mach angle is 30°. Temperature of air is 15°C. Assume K = 1.4 and R = 287.14 J/kg.K. **(06 Marks)**

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