CBCS SCHEME

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21AE/AS33

Third Semester B.E. Degree Examination, Jan./Feb. 2023
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. State Newton's Law of Viscosity and explain different types of Fluids. **(06 Marks)**

b. Two large plane surfaces are 2.4 cm apart. Space between those surfaces is filled with glycerine whose dynamic viscosity is 8.1×10^{-1} NS/m^2. The surface area of the plate is 0.5 m^2 and determine the force required to drag that plate at a speed of 0.6 m/s to the below conditions :

(i) Thin plate is at middle of two plane surface.

(ii) Thin plate is at a distance of 0.8 m from one of the plane surface. **(08 Marks)**

c. Define Capillarity. Obtain the relation for the capillary rise and capillary fall. **(06 Marks)**

OR

2 a. State and prove Pascal's law. **(08 Marks)**

b. Explain the following terms with sketch:

(i) Absolute pressure

(ii) Gauge pressure.

(iii) Vacuum pressure. **(06 Marks)**

c. A Stone weighs 392.4 N in air and 196.2 N in water. Compute the volume of stone and its specific gravity. **(06 Marks)**

Module-2

3 a. Describe various types of Fluid flow. **(06 Marks)**

b. In a Two dimensional Incompressible flow, the velocity components are given by, $u = x - 4y$ and $v = -y - 4x$ for the above velocity component. Show that velocity potential exists and determine its form. Also find the stream function. **(08 Marks)**

c. Draw and explain the following :

(i) Source flow (ii) Sink flow (iii) Doublet flow **(06 Marks)**

OR

4 a. Derive the differential form of momentum equation for steady, incompressible flow. **(10 Marks)**

b. Obtain the energy equation in Integral form. **(10 Marks)**

Module-3

5 a. Derive the relation for Euler's equation of motion and obtain Bernoulli's equation from the Euler's equation. Also write the assumptions made for the derivation. **(10 Marks)**

b. A horizontal venturimeter with inlet diameter 20 cm and throat diameter 10 cm is used to measure the flow of oil of specific gravity 0.8. The discharge of oil through venturimeter is 60 lit/s. Find the reading of oil-mercury differential manometer. Take $C_d = 0.98$. **(06 Marks)**

c. Draw and explain about pit of tube and obtain the relation to measure velocity. **(04 Marks)**

OR

6 a. An aircraft is equipped with a propeller engine. The thrust (P) developed by the propeller depends upon the following parameters. Angular velocity (ω), Speed (V), Diameter of the propeller (D), Dynamic Viscosity (μ), Density of air (ρ) and the speed of sound (C). Obtain an expression for thrust using Buckingham's π – theorem. (D, V, ρ). **(10 Marks)**

b. Write about types of similarities in fluid mechanics. **(06 Marks)**

c. Define Reynold's number and write the expression. **(04 Marks)**

Module-4

7 a. Obtain the expression for Drag force and Lift force. **(06 Marks)**

b. Explain about Boundary layer concept and different types of boundary layer. **(08 Marks)**

c. The velocity distribution in the boundary layer is given as $\frac{u}{U} = \frac{y}{\delta}$, find the displacement thickness, momentum thickness and energy thickness. **(06 Marks)**

OR

8 a. Obtain the relation of Von-Karman momentum Integral equation for a flow over a flat plate. **(10 Marks)**

b. A kite has an effective area of 0.8 m^2 and weighs 7.848 N. The string attached to the kite makes an angle of 45° to the horizontal position. Co-efficient of drag and lift are 0.6 and 0.8 respectively. Find the speed of the wind and the tension in the string. Take $\rho = 1.25\ kg/m^3$. **(10 Marks)**

Module-5

9 a. Derive the Bernoulli's equation for compressible flow. **(08 Marks)**

b. With neat sketch, explain the propagation of pressure waves in a compressible fluid. **(06 Marks)**

c. An aircraft is flying at a Mach number of 1.6. Obtain the speed of the aircraft and Mach angle (α). Take air as a flowing medium. Temperature at the altitude is 223 K. **(06 Marks)**

OR

10 a. Derive the relation for velocity of sound wave in a fluid. Deduce the relation for adiabatic process. **(10 Marks)**

b. Calculate the stagnation pressure, temperature and density on an airfoil, which is having free. Stream velocity of 800 km/hr and pressure of $8 \times 10^4\ N/m^2$. Take K = 1.4, R = 287 J/kgK and Temperature = $-10°$ C. **(10 Marks)**

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