Printed Pages – 5 Roll No. : .....

B037412(037)

B. Tech. (Fourth Semester) Examination, Nov.-Dec. 2021

(Mechanical Engg. Branch) AICTE

FLUID MECHANICS

Time Allowed : Three hours

Maximum Marks : 100

Minimum Pass Marks : 35

Note : *Attempt all questions. From each question part (a) is compulsory each are 4 marks & attempts any two from (b), (c) and (d) each are 8 marks.*

Unit-I

1. (a) Define :

(i) Specific Gravity

(ii) Weight Density

(iii) Viscosity

(iv) Mass Density

(b) Explain briefly the following :

(i) Surface tension

(ii) Compressibility

(c) Derive expressions for total pressure and centre of pressure for a vertically Immersed surface.

(d) A solid of 200 mm diameter and 800 mm length has its base 20 mm thick and of specific gravity 6. The remaining part of the cylinder is of specific gravity 0·6. State if it can float vertically in water.

Unit-II

2. (a) What is fluid kinematics and types of fluid flow.

(b) Derive the continuity equation in cartesian coordinates.

(c) If the velocity field is given by $u = (16y - 8x)$, $v = (8y - 7x)$ find the circulation around the closed

curve defined by $x = 4$, $y = 2$, $x = 8$, $y = 8$.

(d) For the following flows find the equation of the streamline passing through (2, 2) :

(i) $V = 3xi - 3yj$

(ii) $V = y^2 i - 6xj$

Unit-III

3. (a) What is the moment of momentum equation?

(b) State and prove Bernoulli's equation.

(c) Derive the expression for Euler's equation in cartesian coordinates.

(d) In a 45° bend a rectangular air duct of 1 m^2 cross sectional area is gradually reduced to 0·5 m^2 area. Find the magnitude and direction of force required to Hold the duct in position if the velocity of flow at 1m^2 section is 10m/s. And pressure is 30 kN/m^2. Take the specific weight of air as 0·0116 kN/m^3.

Unit-IV

4. (a) What is the difference between a laminar flow and

a turbulent flow?

(b) Derive an expression for loss of head due to friction in pipe flow.

(c) Derive an expression for flow of viscous fluid in circular pipes-Hagen Poiseuille law.

(d) In a pipe of diameter 300 mm the centre line velocity and the velocity at a point 100 mm from the centre, as measured by pitot tube are 2·4m/s and 2·0m/s respectively. Assuming the flow in the pipe to be turbulent, find :

(i) Discharge through the pipe

(ii) Co-efficient of friction

(iii) Height of roughness projections

Unit-V

5. (a) What is Reynolds Model Law.

(b) Define the following terms :

(i) Froude's Number

(ii) Euler's Number

(iii) Weber's Number

(iv) Mach Number

(c) The pressure difference Δp in a pipe of diameter D and length 1 due to turbulent flow depends on the velocity V, viscosity μ, density ρ and roughness k. Using Buckingham's π-theorem, obtain an expression for Δp.

(d) A 1:40 model of an ocean tanker is dragged through fresh water at 2 m/s with a Total measured drag of 117·7N. The skin (fractional) drag co-efficient 'f' for model and prototype are 0·3 and 0·02 respectively in the equation $R_f = fAV^2$. The wetted surface area of model is 25 m^2. Taking the densities for the prototype and the model as 1030 kg/m^3 and 1000 kg/m^3 respectively determine :

(i) The total drag on the prototype

(ii) Power required to drive the prototype