[Total No. of Questions - 9] [Total No. of Printed Pages - 4]

Dec-22-0124

ME-302 (Fluid Mechanics)

B.Tech-3rd (CBCS)

Time : 3 Hours **Max. Marks : 60**

The candidates shall limit their answers precisely within the answer-book (40 pages) issued to them and no supplementary/continuation sheet will be issued.

Note: Answer one question from each of the sections A, B, C, D. Section E is compulsory. Non-programmable calculator is allowed. All questions carry equal marks.

SECTION-A

1. (a) Describe the following

   (i) Newton's law of viscosity

   (ii) Surface tension

   (iii) Capillarity (6)

   (b) A rectangular surface measuring 4 x 4 m lies in water in such a way that its plane makes an angle of 30° with the free surface of water. If the upper edge of rectangular plane is 2 m below the free surface, then determine the total pressure and position of center of pressure. (Density of water = 1000 kg/m^3) (6)

2. (a) A rectangular pontoon is 4 m long, 3 m wide and 1.4 m high. The depth of immersion of the pontoon is 1 m in sea water. If the center of gravity is 0.7 m above the bottom of the pontoon, determine the meta-centric height. (Density of sea water 1030 kg/m^3) (6)

   (b) Differentiate between:

   (i) Absolute and gauge pressure

   (ii) Simple and differential manometer

   (iii) Piezometer and pressure gauges. (6)

SECTION-B

3. (a) Define the following and give one practical example of each:

   (i) Laminar flow

   (ii) Turbulent flow

   (iii) Steady flow (6)

   (b) A horizontal Venturimeter with inlet and throat diameters 30 cm and 15 cm respectively, is used to measure the flow of an oil having specific gravity 0.8. The pressure at inlet is 17.658 N/cm^2 and the vacuum pressure at the throat is 30 cm of mercury. Find the discharge of oil through venturimeter. Take Coefficient of discharge of venturimeter = 0.98. (Specific gravity of mercury = 13.6) (6)

4. (a) Differentiate between:

   (i) Stream function and velocity potential function

   (ii) Steam line and streak line

   (iii) Rotational and irrotational flow. (6)

   (b) An orifice meter with orifice diameter 20 cm is inserted in a pipe of 40 cm diameter. The pressure difference measured by the mercury oil differential manometer on the two sides of the orifice meter gives a reading of 60 cm of mercury. Find the rate of flow of oil (specific gravity = 0.9) when the coefficient of discharge of the orifice meter = 0.64. (6)

SECTION-C

5 (a) What is Euler's equation of motion? How will you obtain Bernoulli's equation from it? (6)

(b) The hydraulic gradient rises by 15 mm due to a sudden enlargement of a water main from 250 mm to 500 mm diameter. Estimate the rate of flow. (6)

6. (a) Derive an expression for the continuity equation for 3D Cartesian coordinates. (6)

(b) Two tanks are connected with the help of two pipes in series. The length of the pipes are 1000 m and 800 m whereas the diameters are 400 mm and 200 mm respectively. The coefficient of friction for both the pipes is 0.008. The difference of water level in the two tanks is 15 m. Find the rate of flow of water through the pipes, considering all the losses. (6)

SECTION-D

7. (a) What is meant by geometrical, kinematic and dynamic similarities in model analysis? (6)

(b) A thin plate is moving in still atmospheric air at a velocity of 7 m/sec. The length and width of the plate are 0.5 m each. Calculate the thickness of the boundary layer at the end of the plate and the drag force on one side of the plate. Take the density of air as 1.24 kg/m^3 and kinematic viscosity 0.15 Stokes. (6)

8. (a) Define the following dimensionless numbers: Reynold's number, Froude's number and Mach's number. What is their significance for the fluid flow problems? (6)

(b) Explain the different methods to prevent the boundary layer separation. (6)

SECTION-E

9. Explain briefly:

(a) Specific gravity

(b) Viscosity

(c) Expression for capillary rise

(d) Cavitation

(e) Absolute pressure

(f) Archimedes' principle

(g) Meta-centric height

(h) Difference between orifice and mouthpiece

(i) Assumptions made while deriving Bernoulli's equation

(j) Notches

(k) Reynold's number

(l) Euler's number (12×1=12)