Total No. of printed pages = 6

END SEMESTER (REGULAR/RETEST) EXAMINATION, NOVEMBER/DECEMBER – 2024

Semester : 3rd

Branch : Mechanical

Subject Code : Me-302

FLUID MECHANICS AND FLUID MACHINES

Full Marks – 70

Time – Three hours

The figures in the margin indicate full marks for the questions.

Instructions :

(i) Objective Question Nos. 1, 2 and 3 are compulsory.

(ii) Answer Question Nos. 4 to 6 as per direction.

1. Fill in the blanks with appropriate answers : $1 \times 5 = 5$

   (a) The reciprocal of mass density is known as _____.

   (b) The S.I unit of kinematic viscosity is _____.

   (c) The point where total pressure acts is known as _____.

[Turn over

(d) In _____ flow, the fluid parameters at any point in the flow field do not change with time.

(e) Venturimeters are used to measure _____ through a pipe line.

2. State whether the statements are True or False : 1×5=5

(a) A draft tube is used with reaction turbine.

(b) Vena-contracta is the section of a jet where the cross-sectional area is maximum.

(c) In case of laminar flow, the Reynold's number is more than 2000.

(d) Chezy's formula is used to calculate major head loss during the flow through pipes.

(e) Hydraulic pump converts mechanical energy into hydraulic energy.

3. Choose the correct answers : 1×5=5

(a) In a reaction turbine, water at inlet possess

(i) only K.E

(ii) only Pressure energy

(iii) Both (i) and (ii)

(iv) None of these

(b) Priming is done in order to

(i) run the pump satisfactorily

(ii) remove air from impeller and casing

(iii) completely fill the impeller and casing

(iv) All of the above

(c) Loss due to friction in pipe is treated as

(i) Minor loss

(ii) Major loss

(iii) Moderate loss

(iv) Minimum loss

(d) Pitot tube is used to measure

(i) Discharge

(ii) Average Velocity

(iii) Velocity at a point

(iv) Pressure at a point

(e) The value of normal atmospheric pressure is

(i) 10.33 m of water

(ii) 1.01325 bar

(iii) 760 mm of Hg

(iv) All of the above.

4. Answer any *three* of the following questions : 3×3=9

(a) State and prove Pascal' law.

(b) Explain hydraulic gradient line and total energy line.

(c) State Archimedes principle. On which principle is the continuity equation based on ?

(d) Define the following terms :

(i) Compressibility

(ii) Specific gravity

(iii) Specific weight.

5. Answer any *four* of the following questions : 4×4=16

(a) State Newton's law of viscosity. Explain how temperature affects the viscosity of a fluid.

(b) Calculate the specific weight, density, specific volume and specific gravity of 1.5 litres of a fluid which weights 5.5N.

(c) Differentiate between

(i) Real fluid and Ideal fluid

(ii) Steady and Unsteady flow.

(d) With the help of a sketch, explain the working of a venturimeter.

(e) A pipe 0.6m diameter branches into two pipes of diameters 0.4m and 0.3m. The average velocity in the main pipe is 4.5m/sec. Determine the velocity in the 0.3m diameter pipe if the average velocity in the 0.4m diameter pipe is 3.5m/sec.

6. Answer any *five* of the following questions : 6×5=30

(a) A plate 0.025 mm distant from a fixed plate, moves at 60cm/sec and requires a shear stress of $2N/m^2$ to maintain this speed. Determine the fluid viscosity between the plate in poise.

(b) Determine the total pressure and depth of pressure on a plane rectangular surface of 1m wide and 3m deep when it supper edge is horizontal and coincides with water surface.

(c) A differential manometer was connected with two points at the same level in a pipe containing liquid of sp. gravity 0.85. Find the difference of pressure at the two points, if the difference of mercury levels be 150 mm.

(d) A horizontal venturimeter with inlet diameter 30 cm and throat diameter 15 cm is used to measure the flow of a oil with a specific gravity 0.8. The discharge through the venturimeter is 50litre/sec. Find the readings of the oil mercury differential manometer. Take $C_d = 0.98$.

(e) Find the diameter of a pipe of length 2500 m when the rate of flow through the pipe is 0.25 m^3/sec and head lost due to friction is 5m. Take C = 50 in Chezy's formula.

(f) A jet of water of diameter 50 mm strikes a fixed plate in such a way that the angle between the plate and the jet is 30°. The force exerted in the direction of the jet is 1471.5N. Determine the rate of flow of water.

(g) A pelton wheel is having a mean busket diameter of 0.8 m and is running at 1000 rpm. The net head on the pelton wheel is 400m, if the side clearance angle is 15° and discharge through the nozzle is 150litre/sec, find

(i) Power available at the nozzle

(ii) Hydraulic efficiency of the turbine. Take $C_v = 0.98$