PART C — (1 × 15 = 15 marks)

16. (a) A 30 cm × 15 cm venturimeter is provided in a vertical pipe carrying oil of specific gravity 0.9, the flow being upwards. The difference in elevation of the throat section and entrance section of the venturimeter is 30 cm. The differential U tube mercury manometer shows a gauge deflection of 25 cm. Calculate

(i) The discharge of oil, and

(ii) The pressure difference between the entrance section and the throat section. Take $C_d = 0.98$ and sp.gr of mercury as 13.6.

Or

(b) A Pelton wheel turbine has a mean bucket speed of 10 m per second with a jet of water flowing at the rate of 700 lit/sec under a head of 30 meters. The buckets deflect the jet through an angle of 160° after flowing past buckets. Calculate the power given by water to the runner and the hydraulic efficiency of the turbine. Assume co-efficient of velocity as 0.98.

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08/02/2024 - FN.

Reg. No. : | | | | | | | | | | | | |

Question Paper Code : 20509

B.E./B.Tech. DEGREE EXAMINATIONS, NOVEMBER/DECEMBER 2023.

Third/Fourth Semester

Mechanical Engineering

CE 3391 —FLUID MECHANICS AND MACHINERY

(Common to : Aeronautical Engineering/Aerospace Engineering/ Industrial Engineering/Industrial Engineering and Management/ Manufacturing Engineering/Materials Science and Engineering/ Mechanical Engineering (Sandwich)/Mechanical and Automation Engineering/ Production Engineering and Safety and Fire Engineering)

(Regulations 2021)

Time : Three hours Maximum : 100 marks

Answer ALL questions.

PART A — (10 × 2 = 20 marks)

1. Define specific volume.

2. Calculate the relative density of diesel weighing 7 N.

3. Write expression for entry and exit loss in a pipe.

4. Define the terms hydraulic gradient line and total energy line.

5. Prove that $h = \frac{p}{\rho g}$ is dimensionally homogeneous. Where, P is pressure, ρ is density and h is pressure head.

6. What are the three types of similarities which must exist between a model and prototype?

7. Find the force per unit area exerted on a fixed vertical plate by a water jet having velocity 15 m/s?

8. What are the functions of draft tube in reaction turbine?

9. Differentiate vortex casing and volute casing in a centrifugal pump.

10. When a pump is called as positive displacement type?

PART B — (5 × 13 = 65 marks)

11. (a) The figure 1 shows a conical vessel having a U tube manometer attached to its outlet at A. When the vessel is empty the reading of the manometer is given in the figure 1. Find the reading of manometer when the vessel has been completely filled with water.

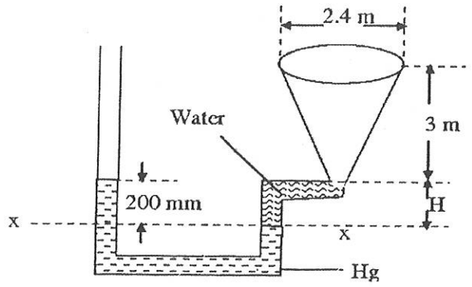

Figure. 1

Or

(b) Derive the Continuity equation in 3-Dimensional form.

12. (a) Three pipes of 400 mm, 200 mm and 300 mm diameters have lengths of 400 m, 200 m and 300 m respectively. They are connected in series to make a compound pipe. The ends of this compound pipe connected with two tanks whose difference of water levels is 16 m. If coefficient of friction for these pipes is same and equal to 0.005, determine the discharge through the compound pipe neglecting first the minor losses and then including them.

Or

(b) In the below figure. 2, when a sudden contraction is introduced in a horizontal pipe line from 50 cm to 25 cm, the pressure changes from 103500 N/m^2 to 67689 N/m^2. Calculate the rate of flow. Assume the coefficient of contraction of jet to be 0.65. Following this if there is sudden enlargement from 25 cm to 50 cm and if the pressure at the 25 cm section is 67689 N/m^2, What is the pressure at the 50 cm enlarged section?

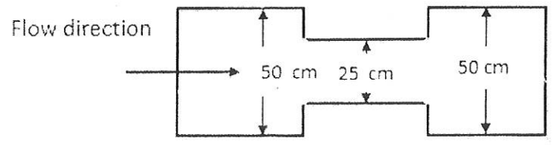

Figure. 2

13. (a) The efficiency η of a fan (figure. 3) depends on density ρ, the dynamic viscosity μ of the fluid, angular velocity ω, diameter D of the rotor and the discharge Q. Express η in terms of dimensionless parameters.

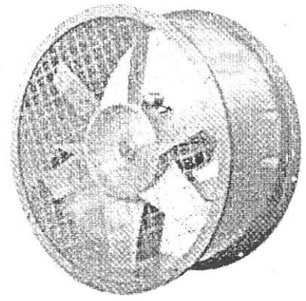

Figure. 3

Or

(b) A ship 250 m long moves in sea-water, whose density is 1030 kg/m^3. A 1:125 model of this ship is to be tested in wind tunnel. The velocity of air in the wind tunnel around the model is 20 m/s and the resistance of the model is 50 N. Determine the velocity of ship in sea-water and also the resistance of the ship in sea-water. The density of air is given as 1.24 kg/m^3. Take the kinematic viscosity of sea-water and air as 0.012 stokes and 0.018 stokes respectively.

14. (a) A jet of water having a velocity of 15 m/s strikes a curved vane which is moving with a velocity of 5 m/s. The vane is symmetrical and is so shaped that the jet is deflected through 120°. Find the angle of the jet at inlet of the vane so that there is no shock. What is the absolute velocity of the jet at outlet in magnitude and direction and the work done per unit weight of water? Assume the vane to be smooth.

Or

(b) Describe the working and the function of various components of Francis turbine with a neat sketch.

15. (a) With a neat layout, explain in detail the working of Reciprocating pump.

Or

(b) The internal and external diameters of the impeller of a centrifugal pump are 200 mm and 400 mm respectively. The pump is running at 1200 r.p.m. The vane angles of the impeller at the inlet and outlet are 20° and 30° respectively. The water enters the impeller radially and velocity of flow is constant. Determine the work done by the impeller per unit weight of water.