CBCS SCHEME

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21MR43

Fourth Semester B.E. Degree Examination, June/July 2024
Fluid Mechanics and Machinery

Time: 3 hrs. Max. Marks: 100

Note: Answer any FIVE full questions, choosing ONE full question from each module.

Module-1

1 a. Define and explain : (i) Total pressure (ii) Centre of pressure (iii) Buoyancy (iv) Centre of buoyancy (v) Metacentric height. **(10 Marks)**

b. A solid cylinder of diameter 4 m has a height of 3 m. Find the metal centric height of the cylinder when it is floating in water with its axis vertical. The specific gravity of the cylinder = 0.6. **(10 Marks)**

OR

2 a. Derive an expression for continuity equiaton for the three dimensional steady incompressible flow. **(10 Marks)**

b. A 25 cm diameter pipe carries oil of specific gravity 0.9 at a velocity of 3 m/s. At another section, the diametr is 20 cm. Find the velocity at this section and also mass rate of flow of oil. **(10 Marks)**

Module-2

3 a. Derive Bernoulli's equation from fundamentals. List all the assumptions made. **(10 Marks)**

b. A pipe through which water is flowing is having diameters 20 cm and 10 cm at the cross sections 1 and 2 respectively. The velocity of water at section 1 is given as 4 m/s. Find the velocity head at sections 1 and 2. Also find the rate of discharge. **(10 Marks)**

OR

4 a. Derive an expression for rate of flow through Venturimeter. **(10 Marks)**

b. A horizontal venturimeter with inlet and throat diameters 30 cm and 15 cm respectively is used to measure the flow of water. The reading of differential manometer connected to the inlet and the throat is 20 cm of mercury. Determine the rate of flow. Take $C_d = 0.98$. **(10 Marks)**

Module-3

5 a. Obtain Chezy's equation for loss of head due to friction in pipes from Darcy Weisbach equation. **(10 Marks)**

b. Find the head lost due to friction in a pipe of diameter 300 mm and length 50 m through which water is flowing at a velocity of 3 m/s using (i) Darcy formula (ii) Chezy's formula for which C = 60. Take Kinematic viscosity of 0.01 stoke. **(10 Marks)**

OR

6 a. Derive Hagen-Poisulle equation for the circular pipes, when the flow through the pipe is laminar. **(12 Marks)**

b. Derive an expression for, (i) Drag (ii) Lift. **(08 Marks)**

Module-4

7 a. Obtain the relationship between Degree of reaction and utilization factor. **(10 Marks)**

b. With usual notations and velocity triangle derive alternate Euler's turbine equation, identify the components of energy transfer. **(10 Marks)**

OR

8 a. Define the following terms with respect to hydraulic turbine:

(i) Gross head and effective head.
(ii) Hydraulic efficiency
(iii) Volumetric efficiency
(iv) Mechanical efficiency
(v) Overall efficiency. **(10 Marks)**

b. A Pelton wheel develops 5800 kW under a net head of 180 m at a speed of 195 rpm. Find the discharge through the turbine, the wheel diameter, the number of jets required and specific speed. Use the following assumptions :
Overall efficiency = 86%
D/d = 12
$\Phi = 0.45$
$C_V = 0.985$ **(10 Marks)**

Module-5

9 a. What is Minimum starting speed? Derive an expression for minimum starting speed of a centrifugal pump. **(10 Marks)**

b. Write a note on the following with respect to centrifugal pump:

(i) Cavitation
(ii) Need for priming.
(iii) NPSH
(iv) Pumps in series and parallel **(10 Marks)**

OR

10 a. Derive an expression for Head Capacity (H – Q) characteristics curve for a centrifugal pump. Discuss the H-Q curve for the forward, radial and backward curved vanes. **(10 Marks)**

b. A centrifugal pump having outer diameter equal to two times the inner diameter and running at 1200 rpm works against a total head of 75 m. The velocity of flow through the impeller is constant and is equal to 3 m/s. The vanes are set back at an angle of 30° at outlet. If the output diameter of impeller is 60 cm and width at outlet is 5 cm, determine (i) Vane angle at inlet (ii) Workdone per second by impeller (iii) Manometric efficiency. **(10 Marks)**

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