ADDITIONAL CONTROLLER OF EXAMINATIONS
AU
CHENNAI
600 025

Roll No. | | | | | | | | | | |

ANNA UNIVERSITY (UNIVERSITY DEPARTMENTS)

B.E / B. Tech (Full Time) END SEMESTER EXAMINATIONS – NOV/ DEC 2024

MECHANICAL ENGINEERING
Third Semester
CE 5251 - FLUID MECHANICS AND MACHINERY
(REGULATION 2019)

Time: 3 hours | Answer ALL questions | Max. Marks: 100

Part – A **10 x 2 = 20 Marks**

1. A piezometer is connected to a pipe which conveys oil of specific gravity 0.76, if the height of liquid in the piezometer is 45 cm find the Pressure in the pipeline.
2. What is control volume and give an example?
3. Write the principle of a pitot tube
4. What is laminar sub layer in the boundary layer theory and write its significance.
5. What is undistorted models and give examples?
6. Is this formula dimensionally homogeneous?
$$H_f = \frac{flQ^2}{12.1d^5}$$
7. Highlight the advantages of rotary pumps.
8. Differentiate centrifugal and reciprocating pump.
9. Write the uses of characteristics curves in turbines?
10. What is breaking of jet in turbines?

Part – B **(5 x 13 = 65 marks)**

11. a) Derive an expression for Bernoulli's theorem from the basic concept of Euler's equation along a streamline and state its assumptions. (13)

(OR)

11 b) (i) A vertical gap 3.2 cm wide of infinite extent contains a fluid of viscosity 1.9 N s/m^2 and specific gravity 0.9. A Metallic plate 1.2 m x 1.2 m x 2 mm is to be lifted up with a constant velocity of 0.15 m/sec, through the gap. If the plate is in the 1/3 of the remaining gap, find the force required. The weight of the plate is 47 N. (8)
(ii) Briefly discuss the different types of manometers used in pressure measurement. (5)

12. a) A pipe line of 0.7 m diameter is 1.4 km long. To increase the discharge, another line of the same diameter is introduced parallel to the first in the second half of the length. Neglecting minor losses, find the increase in discharge if friction factor is 0.042 and head at inlet is 320 mm. (13)

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(OR)

12 b) Derive an expression for Darcy Weisbach equation to estimate the loss of head due to friction in pipes. (13)

13. a) Using Buckingham's π- theorem, show that the velocity through a circular orifice is given by $V=\sqrt{2gH}\phi\left[\frac{D}{H},\frac{\mu}{\rho VH}\right]$, where H is the head causing flow, D is the diameter of the orifice, μ is co-efficient of viscosity, ρ is the mass density and g is the acceleration due to gravity. (13)

(OR)

13 b) (i) A sonar transducer in the shape of a sphere of 200 mm diameter is used in a boat to be towed at 2.6 m/s in water. To determine the drag on the transducer a model of 100 mm diameter is tested in a wind tunnel. The drag force is measured as 15 N. Determine the speed of air for the test. Estimate the drag on the prototype. Take density of water and air as 1000 kg/m^3 and 1.24 kg/m^3 respectively. (7)

(ii) The pressure drop in an airplane model of size 1:10 of its prototype is 80 N/cm^2. The model is tested in water. Find the corresponding pressure drop in the prototype. Take density of air = 1.24 kg/m^3. Take viscosity of water is 0.01 poise and viscosity of air is 0.0018 poise. (6)

14. a) A centrifugal pump has an impeller of 50 cm outer diameter and 25 cm inner diameter. When running at 6000 rpm, the pump discharges 130 liters of water per second against a gross head of 12 m. At this discharge, water enters the impeller without stock. The vane angle at outlet is 45° to the tangent at outlet and the area of flow which is constant from inlet to outlet of the impeller is 0.61 m^2. Determine a) The manometric efficiency of the pump and b) The loss of head at inlet to the impeller when the discharge is reduced by 50% and the speed of rotation being unchanged (13)

(OR)

14 b) Derive an expression for the effect of acceleration and friction in suction and delivery pipes on reciprocating pump. Also draw its indicator diagrams. (13)

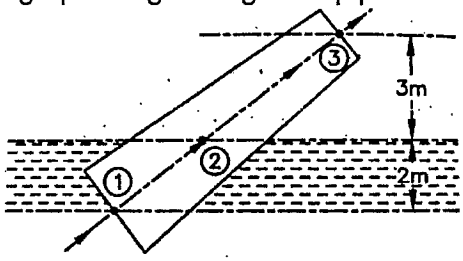
15. a) An inward flow radial turbine works under a head of 30 m and discharges 10 m^3/s. The speed of the runner is 300 rpm. At inlet tip of runner vane, the peripheral velocity of wheel is $0.9\sqrt{2gH}$ and radial velocity of flow is $0.3\sqrt{2gH}$ where H is the head on the turbine. If the overall efficiency and hydraulic efficiency of the turbine are 80% and 90% respectively, (a) determine the power developed in kW, (b) diameter and width of runner at inlet, (c) guide blade angle at inlet, (d) inlet angle of runner vane and (e) diameter of runner at outlet (assume radial flow at outlet). (13)

(OR)

15 b) A double jet impulse turbine has to develop 3000 kW at 400 rpm under a head of 270 m. if the overall efficiency is 0.90, determine the (i) diameter of the nozzle, (ii) speed ratio, (iii) specific speed. Take coefficient of velocity as 0.95 and diameter of runner as 1.5 m. (13)

Part – C (1 x 15 = 15 marks)

16 A Drainage pipe is tapered in section running full of water. The pipe diameters at the inlet and exit are 100 cm and 50 cm respectively. The water surface is 2 m above the centre of the inlet and exit is 3 m above the free surface of the water. The pressure at the exit is 25 cm of Hg vacuum. The friction loss between inlet and exit of the pipe is 1/10 of the velocity head at the exit. Determine the discharge passing through the pipe. (15)



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