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

ANNA UNIVERSITY (UNIVERSITY DEPARTMENTS)

B.E / B. Tech (Full Time) END SEMESTER EXAMINATIONS – APRIL/ MAY 2024

MECHANICAL ENGINEERING
Third Semester
CE 7352 - FLUID MECHANICS AND MACHINERY
(REGULATION 2015)

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

Part – A **10 x 2 = 20 Marks**

1. Write the applications of conservation laws.
2. What is control volume and give an example?
3. How to find the value of friction factor for a circular pipe using Moody diagram?
4. Distinguish between pipes connected in series and parallel
5. List the methods of dimensional analysis.
6. Is this formula dimensionally homogeneous?

$$H_f = \frac{flQ^2}{12.1d^5}$$

7. What is negative slip in reciprocating pumps?
8. What is cavitation in a centrifugal pump?
9. Enlist the different types of efficiencies in turbine?
10. Write the significance of draft tube 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)

b) In a 45° bend, a rectangular air duct of 1 m^2 cross sectional area is gradually reduced to 0.5 m^2 area. Find the magnitude and direction of the force required to hold the duct in position, if the velocity of flow at the 1 m^2 section is 10 m/s, and pressure is 2.943 N/cm^2. Take density of air as 1.23 kg/m^3. (13)

12. a) The rate of flow of water pumped into a pipe ABC, which is 300 m long, is 30 lit/s. The pipe is laid on an upward slope of 1 in 50. The length of the portion AB is 150 m and its diameter is 10 cm, while the length of the portion BC is also 150 m and its diameter is 20 cm. The change of diameter at B is sudden. The flow is taking place from A to C where the pressure at A is 20 kgf/cm^2 and end C is connected to a tank. Neglect the inlet and outlet losses. Find the pressure at B and C, also draw the hydraulic gradient and total energy line. Take friction factor as 0.032. (13)

(OR)

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

13. a) The lift force F on an airfoil is a function of the angle of attack α, velocity of flow V, chord length C, span L, density ρ, viscosity μ and bulk modulus of elasticity E. Show that the functional relationship is

$$\frac{F}{\rho V^2 C^2} = \phi\left(\frac{\rho VC}{\mu}, \frac{V\sqrt{\rho}}{\sqrt{E}}, \frac{L}{C}, \alpha\right)$$ (13)

(OR)

b) (i) A model 1/10 of prototype of a flying boat is towed in freshwater. The prototype moving in a sea water of density 1030 kg/m^3 with a speed of 72 km/hr. Find the corresponding speed of the model. Also find out the resistance due to waves on model if the wave resistance experienced by prototype is 750 N. (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 0.00018 poise. (6)

14. a) A centrifugal pump impeller has an outer diameter of 30 cm and an inner diameter of 15 cm. The pump runs at 1200 rpm. The impeller vanes are set at a blade angle of 30^o at the outlet. If the velocity of flow is constant at 2 m/s, calculate (a) the velocity and direction of the flow at outlet, (b) the head developed by assuming a manometric efficiency of 0.85 and (c) the blade angle at the inlet. (13)

(OR)

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) The velocity of whirl at inlet to the runner of an inward flow reaction turbine is 3.15 √H m/s and the velocity of flow at inlet is 1.05 √H m/s. The velocity of whirl at exit is 0.22 √H m/s in the same direction as at inlet and the velocity of flow at exit is 0.83 √H m/s, where H is head of water 30 m. The inner diameter of the runner is 0.6 times the outer diameter. Assuming hydraulic efficiency of 80 %. Compute angles of the runner vanes at inlet and exit. (13)

(OR)

b) A Kaplan turbine develops 15MW power at a head of 30 m. The diameter of the boss is 0.35 times the diameter of the runner. Assuming the speed ratio of 2, flow ratio of 0.65 and an overall efficiency of 95%. Determine diameter of the runner, rotational speed and specific speed. (13)

Part – C (1 x 15 = 15 marks)

16 A 90° elbow is used to direct water flow at a rate of 25 lit/s in a horizontal pipe upward. The diameter of the entire elbow is 10 cm. The elbow discharges water into the atmosphere and thus the pressure at the exit is the local atmospheric pressure. The elevation difference between the centres of the exit and the inlet of the elbow is 35 cm. The weight of the elbow and the water in it is considered to be negligible. Determine (a) the gage pressure at the centre of the inlet of the elbow and (b) the anchoring force needed to hold the elbow in place. (15)