

# CBCS SCHEME

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18RA44

## Fourth Semester B.Tech. Degree Examination, July/August 2022 Fluid Mechanics and Fluid Machines

Time: 3 hrs.

Max. Marks: 100

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

### Module-1

- Explain different types of fluids and plot the graph showing variation of shear stress versus velocity gradient for all types of fluid. (10 Marks)
  - Define surface tension. Prove that the relationship between surface tension and pressure inside a droplet of liquid in excess of outside pressure is given by  $P = \frac{4\sigma}{d}$ . (06 Marks)
  - The surface tension of water in contact with air at 20°C is 0.0725 N/m. The pressure inside a droplet of water is to be 0.02 N/cm<sup>2</sup> greater than the outside pressure. Calculate the diameter of the droplet of water. (04 Marks)

OR

- State and prove the Pascal's Law. (10 Marks)
  - Differentiate between (i) Absolute and gauge pressure, (ii) Simple manometer and differential manometer (iii) Manometers and Mechanical gauges. (10 Marks)

### Module-2

- Define the equation of continuity. Obtain an expression for continuity equation for a three dimensional flow in Cartesian coordinates. (10 Marks)
  - The velocity components in a two dimensional flow field for an incompressible fluid are as follows:

$$u = \frac{y^3}{3} + 2x - x^2y \quad \text{and} \quad v = xy^2 - 2y - \frac{x^3}{3}$$

Obtain an expression for the stream function ( $\psi$ ). (10 Marks)

OR

- Derive Bernoulli's equation starting from fundamental of Euler's equation of motion. (10 Marks)
  - The water is flowing through a pipe having diameters 20cm and 10cm at section 1 and 2 respectively. The rate of flow through pipe is 35 litres/s. The section 1 is 6m above datum and section 2 is 4m above datum. If pressure at section 1 is 39.24 N/cm<sup>2</sup>, find the intensity of pressure at section 2. (10 Marks)

### Module-3

- State Buckingham's  $\pi$  - theorem. Why this theorem is considered superior over the Rayleigh's method for dimensional analysis. (06 Marks)
  - Explain the term, 'dimensionally homogeneous equation'. (04 Marks)
  - What is meant by geometric, kinematic and dynamic similarities? Explain. (10 Marks)

OR

- 6 a. Discuss the relative merits and demerits of venturimeter with respect to orifice meter. (06 Marks)
- b. Describe with help of sketch the construction, operation and use of pitot static tube. (06 Marks)
- c. A right-angles V-notch is used for measuring a discharge of 30 liters/s. An error of 1.5mm was made while measuring the head over the notch. Calculate the percentage error in the discharge. Take  $C_d = 0.62$ . (08 Marks)

Module-4

- 7 a. What is a Turbomachine? Explain with neat sketch Parts of a Turbomachine. (10 Marks)
- b. List the differences between positive displacement machine and Turbomachine. (10 Marks)

OR

- 8 a. Derive an alternate form of Euler turbine energy equation and name the component of equation. (10 Marks)
- b. Derive an energy transfer equation for radial flow machines and discuss the effect of blade outlet angle on Energy transfer. (10 Marks)

Module-5

- 9 a. Explain classification of Hydraulic Turbines. (06 Marks)
- b. List the function of draft tubes. (04 Marks)
- c. A Pelton wheel has a mean bucket speed of 10 metres per second with a jet of water flowing at the rate of 700 liters/s under a head of 30 metres. The buckets deflect the jet through an angle of  $160^\circ$ . Calculate the power given by water to the runner and the hydraulic efficiency of the turbine. Assume coefficient of velocity as 0.98. (10 Marks)

OR

- 10 a. Derive maximum blade efficiency equation of Single Stage impulse steam turbine. (10 Marks)
- b. Explain need for compounding in steam turbine. Also discuss with a neat sketch velocity compounding. (10 Marks)

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