

# CBCS SCHEME

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21AE/AS33

## Third Semester B.E. Degree Examination, Dec.2023/Jan.2024 Fluid Mechanics

Time: 3 hrs.

Max. Marks: 100

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

### Module-1

- 1 a. State Newton's law of viscosity and explain Newtonian and Non-Newtonian fluids with suitable plot. (06 Marks)
- b. Define absolute, gauge and vacuum pressure. Also bring out the relation between the same. (04 Marks)
- c. An oil of viscosity 5 poise is used for lubrication between a shaft and sleeve. The diameter of the shaft is 0.5 m and it rotates at 200 rpm. Calculate the power lost in oil for a sleeve length of 100 mm. The thickness of oil film is 1.0 mm. (10 Marks)

OR

- 2 a. Give reasons for the following:
  - (i) Viscosity of liquid decreases with increase in temperature whereas viscosity of gas increases with increase in temperature.
  - (ii) Rain drops and tiny dew drops are spherical in shape. (06 Marks)
- b. Define:
  - (i) Buoyancy and centre of buoyancy (04 Marks)
  - (ii) Meta-centre and meta-centric height. (04 Marks)
- c. State and prove Pascal's law. (10 Marks)

### Module-2

- 3 a. List and explain different types of fluid flow. (08 Marks)
- b. With usual notations derive momentum equation in integral form for a compressible fluid flow. (12 Marks)

OR

- 4 a. Define velocity potential, stream function and prove that the product of the slope of the equipotential line and the constant stream line at a point of intersection is equal to  $(-1)$ . (12 Marks)
- b. Explain source, sink and doublet flow. (08 Marks)

### Module-3

- 5 a. State and prove Bernoulli's theorem and also state the assumptions made for the same. (10 Marks)
- b. A pump has a tapering pipe running full of water. The pipe is placed vertically with the diameter at the base and top being 1.2 m and 0.6 m respectively. The pressure at the upper end is 240 mm of Hg vacuum, while the pressure at the lower end is  $15 \text{ kN/m}^2$ . Assume the head loss to be 20% of difference of velocity head. Determine the discharge, the flow is vertically upwards and difference of elevation is 3.9 m. (10 Marks)

Important Note : 1. On completing your answers, compulsorily draw diagonal cross lines on the remaining blank pages.  
2. Any revealing of identification, appeal to evaluator and /or equations written eg, 42+8 = 50, will be treated as malpractice.

OR

- 6 a. The efficiency ( $\eta$ ) of a fan depends on density, dynamic viscosity of the fluid, angular velocity, diameter of the rotor and discharge. Express efficiency in terms of dimensionless parameter using the Buckingham's  $\pi$  theorem. (10 Marks)
- b. Define similitude and briefly explain types of similarities. (10 Marks)

Module-4

- 7 a. Define lift, drag and derive expression for the same. (10 Marks)
- b. Define displacement thickness, momentum thickness, energy thickness and determine the same for the velocity distribution in the boundary layer given by  $(u/U = 2(Y/\delta) - (Y/\delta)^2)$  (10 Marks)

OR

- 8 a. State and explain Kutta-Joukowski theorem. (05 Marks)
- b. With a neat sketch, briefly explain boundary layer theory. (05 Marks)
- c. A kite  $0.8 \text{ m} \times 0.8 \text{ m}$  weighing  $3.924 \text{ N}$  assumes an angle  $12^\circ$  to the horizontal. The string attached to the kite make an angle of  $45^\circ$  to the horizontal. The pull on the string is  $24.525 \text{ N}$ , when the wind is flowing at a speed of  $30 \text{ km/hr}$  if the density of the air is  $1.25 \text{ kg/m}^3$ . Find the corresponding coefficient of drag and lift. (10 Marks)

Module-5

- 9 a. Derive an expression for:  
 (i) Velocity of sound in terms of bulk modulus  
 (ii) Velocity of sound in isothermal process  
 (iii) Velocity of sound for adiabatic process (12 Marks)
- b. Define stagnation point and derive an expression for stagnation pressure for a compressible flow. (08 Marks)

OR

- 10 a. Define and explain briefly hydraulic system. List out advantages and disadvantages of fluid power system. (10 Marks)
- b. Name the types of gear pump and explain any two with neat sketch. (10 Marks)

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