

Code No: 154AZ

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD

B. Tech II Year II Semester Examinations, February - 2024

FLUID MECHANICS AND HYDRAULIC MACHINES

(Mechanical Engineering)

Time: 3 Hours

Max. Marks: 75

Note: i) Question paper consists of Part A, Part B.

ii) Part A is compulsory, which carries 25 marks. In Part A, answer all questions.

iii) In Part B, Answer any one question from each unit. Each question carries 10 marks and may have a, b as sub questions.

**PART – A****(25 Marks)**

- 1.a) State Newton's law of viscosity and write the S.I unit for dynamic and kinematic viscosities. [2]
- b) Find the surface tension in a soap bubble of 40 mm diameter when the inside pressure is  $2.5 \text{ N/m}^2$  above the atmospheric pressure. [3]
- c) List the different types of fluid flows. [2]
- d) Write Bernoulli's equation for flow through a streamline and discuss the terms involved. [3]
- e) List the various devices for flow measurements. [2]
- f) Define drag and lift force of an object immersed in a fluid. [3]
- g) What is the purpose of needle valve used in Pelton turbines? [2]
- h) Write a note on cavitation and its effect. [3]
- i) What is slip in reciprocating pumps? [2]
- j) What is priming in centrifugal pumps? Why is it necessary? [3]

**PART – B****(50 Marks)**

- 2.a) Describe the effect of pressure and temperature on viscosity of fluids.
- b) The dynamic viscosity of oil used for lubrication between a shaft and sleeve is 6 Poise. The shaft is of 0.4 m diameter and rotates at 190 rpm. Calculate the power lost in the bearings for a sleeve length of 90 mm. The thickness of the oil film is 1.5 mm. [4+6]

**OR**

- 3.a) How manometers differ from mechanical devices in measuring fluid pressure?
- b) A U-tube manometer is used to measure the pressure of oil of specific gravity 0.85 flowing in a pipeline. Its left end is connected to the pipe and the right limb is open to the atmosphere. The Centre of the pipe is 100 mm below the level of mercury ( $S=13.6$ ) in the right limb. If the difference of mercury level in the two limbs is 160 mm, determine the absolute pressure of the oil in the pipe. [3+7]
4. Derive Euler's equation of motion stating clearly the assumptions made. [10]

**OR**

- 5.a) Distinguish between path lines, stream lines and streak lines.
- b) Velocity for a 2D flow field is given by  $V = (3+2xy+4t^2)\mathbf{i} + (xy^2=3t)\mathbf{j}$ . Find the velocity and acceleration at a point (1,2) after 2 seconds. [3+7]

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- 6.a) Define momentum thickness and energy thickness.  
b) The velocity distribution in a boundary layer is given by  $u / U = [y / \delta]^{(1/7)}$ . Calculate the displacement thickness, momentum thickness, shape factor and energy thickness. [3+7]

**OR**

- 7.a) Discuss the working principle of pitot tube with a neat sketch.  
b) In a pipe of 300 mm diameter and 800 m length an oil of specific gravity 0.8 is flowing at the rate of  $0.45 \text{ m}^3/\text{s}$ . Find head lost due to friction and power required to maintain the flow. Assume kinematic viscosity of oil as 0.3 Stoke. [3+7]

- 8.a) Define unit speed and unit discharge.  
b) A Pelton wheel is to be designed for a head of 60 m when running at 200 rpm. The wheel develops 95.75 kW shaft power. The velocity of the buckets = 0.45 times the velocity of jet, overall efficiency = 0.85 and coefficient of velocity is equal to 0.98. [2+8]

**OR**

- 9.a) Write a critical note on selection of hydraulic turbines.  
b) With a neat diagram explain the construction and working of a Pelton turbine. [3+7]

10. The cylinder bore diameter of a single acting reciprocating pump is 150 mm and its stroke is 300 mm. The pump runs at 50 rpm and lifts water through a height of 25 m. The delivery pipe is 22 m long and 100 mm in diameter. Find the theoretical discharge and theoretical power required to run the pump. If the actual discharge is 4.2 lits /s, find the percentage of slip. [10]

**OR**

- 11.a) Classify centrifugal pumps.  
b) Explain the constructional details and function of main parts of a single acting reciprocating pump. [3+7]

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