

Code No.: ME404PC

R20

H.T.No.

8 R

CMR ENGINEERING COLLEGE: : HYDERABAD

UGC AUTONOMOUS

II-B.TECH-II-Semester End Examinations (Regular) - August- 2023

FLUID MECHANICS AND HYDRAULIC MACHINES

(MECH)

[Time: 3 Hours]

[Max. Marks: 70]

**Note:** This question paper contains two parts A and B.

Part A is compulsory which carries 20 marks. Answer all questions in Part A.

Part B consists of 5 Units. Answer any one full question from each unit. Each question carries 10 marks and may have a, b, c as sub questions.

**PART-A**

(20 Marks)

1. a) Name the phenomenon of capillarity. [2M]
- b) Explain Newton's law of viscosity. [2M]
- c) Name the different forces present in a fluid flow. For the Euler's equation of motion, which forces are taken into consideration? [2M]
- d) What is meant by surface and body forces? [2M]
- e) Define boundary layer and boundary layer thickness. [2M]
- f) Explain how laminar and turbulent boundary layers are formed. [2M]
- g) What is hydrodynamic force? [2M]
- h) How governing of speed is done on Pelton wheel? [2M]
- i) Define Slip, and percentage slip of a reciprocating pump. [2M]
- j) What is priming of a centrifugal pump? Why it is needed. [2M]

**PART-B**

(50 Marks)

2. Define viscosity. A plate having an area of  $0.7 \text{ m}^2$  is sliding down the inclined plane at  $45^\circ$  to the horizontal with a velocity of  $0.45 \text{ m/s}$ . there is a cushion of fluid  $2 \text{ mm}$  thick between the plane and the plate. Find the viscosity of the fluid if the weight of the plate is  $300\text{N}$ . [10M]

**OR**

3. Distinguish between:
  - a) Absolute pressure and gauge pressure. [3M]
  - b) Piezometer and simple manometer. [3M]
  - c) U-tube differential manometer and inverted U-tube differential manometer. [4M]

- 4.a) State the momentum equation. How will you apply momentum equation for determining the force exerted by a floating liquid on a pipe bend? [5M]
- b) Derive Bernoulli's equation through Euler's equation of motion. [5M]

**OR**

- 5.a) Explain the terms: (i) Path line (ii) Streak line (iii) Stream line and (iv) Stream tube. [5M]
- b) A  $40 \text{ cm}$  diameter pipe, conveying water, branches into two pipes of diameter  $30 \text{ cm}$  and  $20 \text{ cm}$  respectively. If the average velocity in the  $40 \text{ cm}$  diameter pipe is  $3 \text{ m/s}$ . Find the discharge in this pipe. Also, determine the velocity in  $20 \text{ cm}$  pipe if the average velocity in  $30 \text{ cm}$  diameter pipe is  $2\text{m/sec}$ . [5M]

6. Explain in detail laminar boundary layer, turbulent boundary layer, laminar sub-layer. [10M]

**OR**

- 7.a) At a sudden enlargement of a water main from  $240 \text{ mm}$  to  $480 \text{ mm}$  diameter, the hydraulic gradient rises by  $10 \text{ mm}$ . estimate rate of flow. [5M]
- b) Derive an expression for minor losses due to sudden contraction. [5M]

- 8.a) Define the terms 'unit power', 'unit speed' and 'unit discharge' with reference to a hydraulic turbine. Also derive expressions for these terms. [5M]
- b) A Kaplan turbine runner is to be designed to develop 9100 kW. The net available head is 5.6 m. If the speed ratio = 2.09, flow ratio = 0.68, overall efficiency = 86% and the diameter of the boss is  $\frac{1}{3}$  the diameter of the runner. Find the diameter of the runner, its speed and the specific speed of the turbine. [5M]

**OR**

- 9.a) What is specific speed? State its significance in the study of hydraulic machines. [5M]
- b) By means of a neat sketch, explain the governing mechanism of Francis Turbine. [5M]
- 10.a) Draw and discuss the characteristic curves of centrifugal pump. [5M]
- b) Enumerate the losses which occur when a centrifugal pump operates. [5M]

**OR**

11. The cylinder bore diameter of a single acting reciprocating pump is 150 mm and its stroke length 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. If the actual discharge is 4.2 liters/s, find the % Slip. [10M]

\*\*\*\*\*