INSTITUTE OF AERONAUTICAL ENGINEERING

(Autonomous) Dundigal-500043, Hyderabad

B.Tech IV SEMESTER END EXAMINATIONS (REGULAR/SUPPLEMENTARY) - AUGUST 2023

Regulation: UG-20

FLUID MECHANICS AND HYDRAULIC MACHINES

Time: 3 Hours

(MECHANICAL ENGINEERING)

Max Marks: 70

Answer ALL questions in Module I and II Answer ONE out of two questions in Modules III, IV and V All Questions Carry Equal Marks All parts of the question must be answered in one place only

$\mathbf{MODULE}-\mathbf{I}$

- 1. (a) Summarize the following terms
 - i) Mass density
 - ii) Surface tension
 - iii) Specific volume
 - iv) Specific gravity

- [BL: Understand] CO: 1|Marks: 7]
- (b) If the velocity profile of a fluid over a plate is parabolic with the vertex 20 cm from the plate, where the velocity is 120 cm/sec. Calculate the velocity gradients and shear stresses at a distance of 0,10 and 20 cm from the plate, if the viscosity of the fluid is 8.5 poise.

[BL: Apply] CO: 1|Marks: 7]

$\mathbf{MODULE}-\mathbf{II}$

- (a) Classify the different types of fluid flow. Explain in detail about the various forces acting on the fluid flow.
 [BL: Understand| CO: 2|Marks: 7]
 - (b) A 30 cm diameter pipe, conveying water, branches into two pipes of diameters 20 cm and 15 cm respectively. If the average velocity in the 30 cm diameter pipe is 2.5 m/s, find the discharge in this pipe. Also determine the velocity in 15 cm pipe if the average velocity in 20 cm diameter pipe is 2 m/s.
 [BL: Apply] CO: 2|Marks: 7]

$\mathbf{MODULE}-\mathbf{III}$

3. (a) State boundary layer thickness. Describe the characteristics of boundary layer in detail.

[BL: Understand| CO: 3|Marks: 7]

- (b) The velocity distribution in the boundary layer is given by $u/U = 2(y/\delta) 2(y/\delta)^2 \delta$ being boundary layer thickness. Calculate the displacement thickness, momentum thickness and energy thickness. [BL: Apply] CO: 3|Marks: 7]
- 4. (a) Determine an expression for Darcy's equation for the frictional loss in flow through circular pipes. [BL: Understand] CO: 4|Marks: 7]
 - (b) Find the head lost due to friction in a pipe of diameter 300 mm and length 50 m, through which water is flowing at a velocity of 3 m/s using
 - i) Darcy formula
 - ii) Chezy's formula for which C = 60. Take v for water = 0.01 stoke.

[BL: Apply| CO: 4|Marks: 7]

$\mathbf{MODULE}-\mathbf{IV}$

- 5. (a) Classify turbines. Demonstrate the working principle of Francis turbine and its advantages in detail. [BL: Understand| CO: 5|Marks: 7]
 - (b) A Francis turbine has an inlet diameter of 2.0m and an outlet diameter of 1.2m. The breadth of the blades is constant at 0.2 m. The runner rotates at a speed of 250 RPM with a discharge of 8 m^3 /sec. The vanes are radial at the inlet and the discharge is radially outwards at the outlet. Calculate the angle of guide vane at the inlet and blade angle at the outlet.

[BL: Apply] CO: 5|Marks: 7]

6. (a) Differentiate the impulse and reaction turbine with its advantages and limitations.

[BL: Understand] CO: 5|Marks: 7]

(b) An outward flow reaction turbine has internal and external diameters of the runner as 0.5m and 1.0m respectively. The turbine is running at 250 RPM and rate of flow of water through the turbine is $8m^3$ /sec. The width of the runner is constant at inlet and outlet and is equal to 30cm. The head on the turbine is 10m and discharge at outlet is radial, determine vane angle at inlet & outlet and velocity of flow at inlet & outlet. [BL: Apply] CO: 5|Marks: 7]

$\mathbf{MODULE}-\mathbf{V}$

7. (a) Briefly discuss the phenomenon of priming and cavitation in centrifugal pump.

[BL: Understand] CO: 6|Marks: 7]

(b) It is required to deliver 0.048 m^3 /s of water to a height of 24 m through a 150 mm diameter pipe and 120 m long, by a centrifugal pump. If the overall efficiency of the pump is 75 percent and co-efficient of friction is 0.01 for the pipe line, find the power required to drive the pump.

[BL: Apply] CO: 6|Marks: 7]

8. (a) Explain the working of single acting reciprocating pump with a neat sketch.

[BL: Understand] CO: 6|Marks: 7]

(b) A double acting reciprocating pump, running at 40 RPM is discharging 1.0 m³ of water per minute. The pump has a stroke of 400 mm. The diameter of piston is 200 mm, the delivery and suction head are 20m and 5m respectively. Find the slip of the pump and power required to drive the pump. [BL: Apply] CO: 6|Marks: 7]

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