Code No: R2021032 **R20** SET - 1

II B. Tech I Semester Regular/Supplementary Examinations, December - 2023
FLUID MECHANICS & HYDRAULIC MACHINES
(Com to ME, AME)

Time: 3 hours Max. Marks: 70

Answer any **FIVE** Questions each Question from each unit
All Questions carry **Equal** Marks
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UNIT-I

1 a) Explain the phenomena of Surface Tension. Derive the expression for pressure inside the liquid droplet and soap bubble. [7M]

b) The space between two square flat parallel plates is filled with oil. Each side of the plate is 670mm. The thickness of the oil film is 10mm. The upper plate, which moves at 2m/s requires a force of 100N to maintain the speed. Determine (i) The dynamics viscosity of the oil (ii) The kinematics viscosity. [7M]

OR

2 a) State and derive the expression for Hydrostatic law. [7M]

b) In a pipeline water is flowing. A Manometer is used to measure the pressure drop for flow through the pipe. The difference in level was found to be 20 cm. If the manometric fluid in CCl4, find the pressure drop in S.L units (density of CCl4 = 1.596 g/cubic cm). If the manometric fluid is changed to mercury (p= 13.6 gm/cubic cm) what will be the difference in level? [7M]

UNIT-II

3 a) What are different types of fluid flow? Explain with neat sketch. [7M]

b) A fluid flow field is given by $V= x^2yi+y^2zj-(2xyz+yz^2)$ k Prove that it is a case of possible steady incompressible fluid flow. Calculate the velocity and acceleration at the point (3,1, 2). [7M]

OR

4 a) Derive Euler's equation of motion along with their assumption. [7M]

b) In a pipe of 90 mm diameter is flowing with a mean velocity of 2 m/s and at a gauge pressure of 350 kN/sq.m. Determine the total head, if the pipe is 8 metres above the datum line. Neglect friction. [7M]

UNIT-III

5 a) Explain the concept of growth of boundary layer in thin flat plate and discuss about various types of region in boundary layer with neat sketch. [7M]

b) Find the displacement thickness, momentum thickness and energy thickness for the velocity distribution in the boundary layer given by $(u/v) = 2(y/\delta) – (y/\delta)^2$ [7M]

OR

6 a) What are different methods of dimensional analysis? Explain in detail about Buckingham's Pi- theorem method. [7M]

b) The pressure difference Δp in a pipe of diameter D and length due to viscous flow depends on the velocity V, viscosity μ and density ρ. Using Bukingham's pi – theorem, obtain an expression for Δp. [7M]

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UNIT-IV

7 a) Derive the expression for the force exerted by a jet of water on a fixed plate in the direction of the jet. [7M]

b) A jet of water of diameter 50 mm strikes a fixed plate in such a way that the angle between the plate and the jet is 30^{o}. The force exerted in the direction of the jet is 1471.5 N. Determine the rate flow of water. [7M]

OR

8 a) What is meant by turbine? Explain about their classification. [7M]

b) Explain with neat sketch about Pelton wheel and derive the expression for work done by the pelton wheel. [7M]

UNIT-V

9 a) By means of neat sketch explain the governing mechanism of Francis Turbine. [7M]

b) Define the terms specific speed of a turbine, unit power and unit rate of flow of a turbine. Derive the expressions for specific speed and unit speed. [7M]

OR

10 a) Define centrifugal pump and explain the working of a single-stage centrifugal pump with neat sketch. [7M]

b) The diameter of an impeller of a centrifugal pump at inlet and outlet are 20 cm and 40 cm respectively. Determine the minimum speed for starting the pump if it works against a head of 25 m. [7M]

Code No: R2021032 **R20** SET - 2

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UNIT-I

1 a) Define viscosity and derive the expression for viscosity. [7M]

b) The space between two square flat parallel plates is filled with oil. Each side of the plate is 720 mm. The thickness of the oil film is 15 mm. The upper plate, which moves at 3 m/s requires a force of 120 N to maintain the speed. Determine (i) The dynamics viscosity of the oil (ii) The kinematics viscosity. [7M]

OR

2 a) What are different types of manometer? Explain in detail about differential manometer with neat sketch. [7M]

b) In measuring the unit energy of a mineral oil of specific gravity 0.85 by the bubble method, a tube having an internal diameter of 1.5 mm is immersed to depth of 12.5 mm in oil. Air is forced through the tube forming a bubble at the lower end. What magnitude of the unit surface energy will be indicated by a maximum bubble pressure intensity of 150 N/sq.m. [7M]

UNIT-II

3 a) Explain about velocity potential function and stream function. [7M]

b) A fluid flow field is given by $V= x^2yi+y^2zj-(2xyz+yz^2)$ k Prove that it is a case of possible steady incompressible fluid flow. Calculate the velocity and acceleration at the point (2,1,3). [7M]

OR

4 a) Define the equation of continuity. Obtain an expression for continuity equation for a three-dimensional flow. [7M]

b) Water is flowing through a pipe having diameters 800 mm and 600 mm at the bottom and upper end respectively. The intensity of pressure at the bottom end is $350kN/m^2$ and the pressure at the upper end is $100kN/m^2$. Determine the difference in datum head if the rate of flow through the pipe is 60 litres/s. [7M]

UNIT-III

5 a) Derive the expression for displacement thickness and momentum thickness in the boundary layer. [7M]

b) Find the displacement thickness, momentum thickness and energy thickness for the velocity distribution in the boundary layer given by $(u/v) = (y/\delta)$, where u is the velocity at a distance y from the plate and u=U at $y= \delta$, where δ= boundary layer thickness. Also calculate the value of δ^*/θ. [7M]

OR

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6 a) Explain about dimensional homogeneity with two examples. [7M]

b) What are different methods of dimensional analysis? Explain any one in detail. [7M]

UNIT-IV

7 a) Derive the expression for the force exerted by a jet of water on a moving plate. [7M]

b) A nozzle of 50 mm diameter delivers a stream of water at 20 m/s perpendicular to a plate that movers away from the jet at 5 m/s. Find (i) the force on the plate (ii) the work done and (iii) efficiency of jet. [7M]

OR

8 a) Differentiate between impulse turbine and reaction turbine. [7M]

b) A Pelton wheel is to be designed for the following specifications: Shaft power=11,772 kW, Head=380 m, Speed=750 rpm, Overall efficiency=86%, jet diameter is not to exceed one sixth of the wheel diameter. Determine (i) the wheel diameter(ii) The number of jets required (iii) Diameter of the jet. Take Cv=0.985, Speed ratio=0.45. [7M]

UNIT-V

9 a) Explain about different characteristics curves of hydraulic turbine with neat sketch. [7M]

b) Explain about hydraulic lift with neat sketch. [7M]

OR

10 a) Derive the expression for specific speed of the centrifugal pump [7M]

b) Explain about various parts of Reciprocating pump and their working principle with neat sketch. [7M]

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UNIT-I

1 a) Explain the phenomena of Surface Tension. Derive the expression for pressure inside the liquid droplet and soap bubble. [7M]

b) In measuring the unit energy of a mineral oil of specific gravity 0.85 by the bubble method, a tube having an internal diameter of 1.5 mm is immersed to depth of 12.5 mm in oil. Air is forced through the tube forming a bubble at the lower end. What magnitude of the unit surface energy will be indicated by a maximum bubble pressure intensity of 150 N/sq.m. [7M]

OR

2 a) State and derive the expression for Pascal's law. [7M]

b) In a pipeline water is flowing. A Manometer is used to measure the pressure drop for flow through the pipe. The difference in level was found to be 20 cm. If the manometric fluid in CCl4, find the pressure drop in S.L units (density of CCl4 = 1.596 g/cubic cm). If the manometric fluid is changed to mercury (p= 13.6 gm/cubic cm) what will be the difference in level? [7M]

UNIT-II

3 a) Write the equation of continuity for 1D flow? [7M]

b) A fluid flow field is given by V= $x^2yi+y^2zj-(2xyz+yz^2)$ k Prove that it is a case of possible steady incompressible fluid flow. Calculate the velocity and acceleration at the point (1,1,2). [7M]

OR

4 a) Derive Bernoulli's equation of motion along with their assumption. [7M]

b) In a pipe of 90 mm diameter is flowing with a mean velocity of 3m/s and at a gauge pressure of 250 kN/sq.m. Determine the total head, if the pipe is 86 metres above the datum line. Neglect friction. [7M]

UNIT-III

5 a) Write basic concepts of velocity profiles with neat sketch. [7M]

b) Find the displacement thickness, momentum thickness and energy thickness for the velocity distribution in the boundary layer given by $(u/v) = (y/\delta)$, where u is the velocity at a distance y from the plate and u=U at y= δ, where δ= boundary layer thickness. Also calculate the value of δ^*/θ. [7M]

OR

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6	a)	How the separation of Boundary layer occurs in stream and why it in required.	[7M]
	b)	What are different types of forces acting on moving fluid? Explain about various types of dimensional numbers.	[7M]

UNIT-IV

7	a)	Write the work of Kaplan turbine with neat sketch.	[7M]
	b)	A nozzle of 60 mm diameter delivers a stream of water at 30 m/s perpendicular to a plate that movers away from the jet at 8 m/s. Find (i) the force on the plate (ii) the work done and (iii) efficiency of jet.	[7M]

OR

8	a)	Draw velocity diagrams for different flows.	[7M]
	b)	Differentiate between impulse turbine and reaction turbine.	[7M]

UNIT-V

9	a)	By means of neat sketch explain the governing mechanism of Kaplan Turbine.	[7M]
	b)	Explain the terms: i) Hydraulic ram ii) Hydraulic lift iii) Hydraulic coupling	[7M]

OR

10	a)	Define centrifugal pump and explain the working of a multi-stage centrifugal pump with neat sketch.	[7M]
	b)	The diameter of an impeller of a centrifugal pump at inlet and outlet are 30 cm and 50 cm respectively. Determine the minimum speed for starting the pump if it works against a head of 20 m.	[7M]

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UNIT-I

1 a) Explain about compressibility and bulk modulus. [7M]

b) The space between two square flat parallel plates is filled with oil. Each side of the plate is 700 mm. The thickness of the oil film is 20mm. The upper plate, which moves at 4m/s requires a force of 110N to maintain the speed. Determine (i) The dynamics viscosity of the oil (ii) Thekinematics viscosity. [7M]

OR

2 a) State and derive the expression for Hydrostatic law. [7M]

b) In measuring the unit energy of a mineral oil of specific gravity 0.7 by the bubble method, a tube having an internal diameter of 1.2 mm is immersed to depth of 10mm in oil. Air is forced through the tube forming a bubble at the lower end. What magnitude of the unit surface energy will be indicated by a maximum bubble pressure intensity of 120 N/sq.m. [7M]

UNIT-II

3 a) Explain about velocity potential function and stream function. [7M]

b) A fluid flow field is given by $V= x^2yi+y^2zj-(2xyz+yz^2)$ k Prove that it is a case of possible steady incompressible fluid flow. Calculate the velocity and acceleration at the point (2,1,2). [7M]

OR

4 a) Derive Euler's equation of motion along with their assumption. [7M]

b) In a pipe of 80 mm diameter is flowing with a mean velocity of 3 m/s and at a gauge pressure of 300 kN/sq.m. Determine the total head, if the pipe is 10 metres above the datum line. Neglect friction. [7M]

UNIT-III

5 a) Derive the expression for displacement thickness and momentum thickness in the boundary layer. [7M]

b) Find the displacement thickness, momentum thickness and energy thickness for the velocity distribution in the boundary layer given by $(u/v) = 2(y/\delta) – (y/\delta)^2$ [7M]

OR

6 a) What are different methods of dimensional analysis? Explain in detail about Buckingham's Pi- theorem method. [7M]

b) The pressure difference Δp in a pipe of diameter D and length due to viscous flow depends on the velocity V, viscosity μ and density ρ. Using Bukingham's pi – theorem, obtain an expression for Δp. [7M]

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UNIT-IV

7	a)	Derive the expression for the force exerted by a jet of water on a inclined plate.	[7M]
	b)	A nozzle of 60 mm diameter delivers a stream of water at 25 m/s perpendicular to a plate that movers away from the jet at 4 m/s. Find (i) the force on the plate (ii) the work done and (iii) efficiency of jet.	[7M]

OR

8	a)	Write difference between pelton & Kaplan turbine.	[7M]
	b)	Explain with neat sketch about Francis wheel and derive the expression for work done by the Francis wheel.	[7M]

UNIT-V

9	a)	What are parameters need to consider for selection of type of turbine.	[7M]
	b)	What is the need of amplifiers, sensors and oscillators in hydraulic turbines.	[7M]

OR

10	a)	How the performance of hydraulic turbine can be calculated?	[7M]
	b)	The diameter of an impeller of a centrifugal pump at inlet and outlet are 30 cm and 50 cm respectively. Determine the minimum speed for starting the pump if it works against a head of 22 m.	[7M]