Q. Code:645862

Reg. No. | | | | | | | | | | | | | |

B.E. / B.TECH. DEGREE EXAMINATIONS, MAY 2024

Fourth Semester

ME22401 – FLUID MECHANICS

(MECHANICAL ENGINEERING)

(Regulation 2022)

TIME: 3 HOURS **MAX. MARKS: 100**

COURSE OUTCOMES	STATEMENT	RBT LEVEL
CO 1	Students will be able to Calculate the various properties of the fluids using fundamental relationships and calculate the hydrostatic forces on the submerged objects.	**3**
CO 2	Students will be able to Calculate and draw the velocity and acceleration field vectors by knowing the potential and/or stream functions and apply the Reynolds Transport theorem	**3**
CO 3	Students will be able to Calculate the forces acting on the various surfaces and pressure drop in the flow.	**3**
CO 4	Students will be able to Calculate the flow parameters in a compressible fluid flow.	**3**
CO 5	Students will be able to perform dimensional analysis and model analysis.	**3**

PART- A (20 x 2 = 40 Marks)

(Answer all Questions)

		CO	RBT LEVEL
1.	Calculate the relative density of diesel weighing 7 N?	**1**	**3**
2.	Draw the shear-stress-velocity gradient profile for non-Newtonian fluids.	**1**	**3**
3.	What is the average velocity and discharge for an oil of viscosity 0.02 Ns/m^2 flowing between two stationary parallel plates 1m wide maintained 10 mm apart if the velocity midway between the plates is 2 m/s.	**1**	**3**
4.	At a certain point in flowing castor oil, the shear stress is 2 N/m^2 and velocity gradient is 0.25/sec. The mass density of the oil is 800 kg/m^3. Find the kinematic viscosity of oil in stokes.	**1**	**3**
5.	Differentiate Eulerian and Lagrangian flow methods.	**2**	**3**
6.	What do you mean by stream line and path line in a fluid flow?	**2**	**3**
7.	What is the function of vorticity?	**2**	**3**
8.	Differentiate control and differential control volume.	**2**	**3**

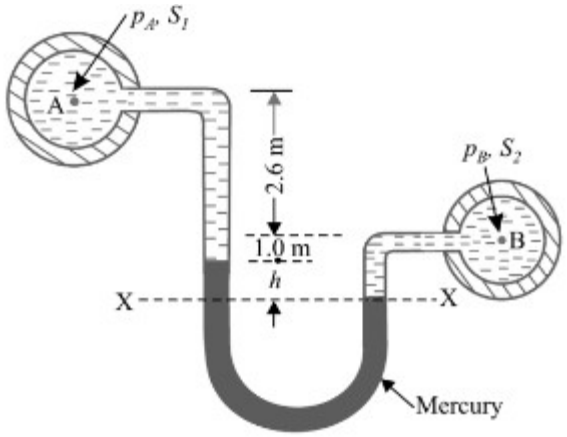
9.	What are the losses experienced by fluid when it is passing through a pipe?	**3**	**3**
10.	How does surface roughness affect the pressure drop in a pipe if the flow is turbulent.	**3**	**3**
11.	Write down the expression for loss of head due to entrance and exit of pipe.	**3**	**3**
12.	What do you mean by flow through parallel pipes?	**3**	**3**
13.	Classify the flow regimes in terms of Mach number.	**4**	**3**
14.	How velocity of the flow varies in convergent and divergent ducts for subsonic and supersonic conditions.	**4**	**3**
15.	What is the Fanno line of compressible flow?	**4**	**3**
16.	What is normal shock in compressible flow?	**4**	**3**
17.	Give examples for dimensionally homogeneous and non-homogeneous equations.	**5**	**3**
18.	Distinguish between Rayleigh's method and Buckingham's π-theorem.	**5**	**3**
19.	Explain the significance of Reynolds number.	**5**	**3**
20.	Distinguish between Undistorted and distorted models.	**5**	**3**

PART- B (5 x 10 = 50 Marks)

		Marks	CO	RBT LEVEL
21. (a)	Two large fixed parallel planes are 12 mm apart. The space between the surfaces is filled with oil of viscosity 0.972 N.s/m^2 . A flat thin plate 0.25 m2 area moves through the oil at a velocity of 0.3 m/s. Calculate the drag force. (i)when the plate is equidistant from both the planes and (ii)when the thin plate is at a distance of 4 mm from one of the plane surfaces.	**(10)**	**1**	**3**

(OR)

(b)	The figure 1.0 shows a U-tube differential manometer connecting two pressure pipes at A and B. The pipe A contains a liquid of specific gravity of 1.6 under a pressure of 110 kN/m^2 . The pipe B contains oil of specific gravity 0.8 under a pressure of 200 kN/m^2.find the difference of pressure measured by mercury as fluid filling U tube.	**(10)**	**1**	**3**



22. (a)	A 300 mm diameter conveying water branches into two pipes of diameter 200 mm and 100 mm respectively. if the average velocities in the 300 mm diameter pipe and 200 mm pipe are 2.5 m/s and 1.6 m/s respectively. Determine the velocity in the 100 mm diameter pipe.	**(10)**	**2**	**3**

(OR)

(b)	The stream function for a two-dimensional flow is given by $\psi = 2xy$. Calculate the velocity at the point P (2,3). Find the value of velocity potential.	**(10)**	**2**	**3**
23. (a)	Find the head lost due to friction in a pipe diameter 280 mm and length 50 m through which water is flowing at a velocity of 3m/s using (i) Darcy Weishbach formula (ii) Chezy's formula. Take C = 60 and v for water = 0.01 stoke.	**(10)**	**3**	**3**

(OR)

(b)	At a sudden enlargement of water main from 25 cm to 50 cm diameter, the hydraulic gradient rises by 12 mm. Calculate the rate of flow through pipe.	**(10)**	**3**	**3**

24. (a)	Derive an expression for velocity of the sound wave in a compressible fluid in terms of change of pressure and change of density.	**(10)**	**4**	**3**
	(OR)			
(b)	A convergent nozzle has an exit area of 500 mm^2.Air enters the nozzle with a stagnation pressure of 1000 kPa and a stagnation temperature of 360 K. Determine the mass rate of flow for back pressures of 800 kPa,528 kPa, and 300 kPa,assuming isentropic flow.	**(10)**	**4**	**3**
25. (a)	The resisting force (R) of a supersonic plane during flight can be considered as dependent upon the length of the air craft 'l', velocity 'V', air viscosity 'μ', air density 'ρ' and bulk modulus of air is 'K'. Express the functional relationship between these variables and the resisting force.	**(10)**	**5**	**3**
	(OR)			
(b)	A Ship 300m long moves in sea water, whose density is 1030 kg/m^3, A1:100 model of ship is to be tested in a wind tunnel. The velocity of air in the wind tunnel around the model is 30m/s and the resistance of model is 60N. Determine the velocity of ship in sea water and also the resistance of the ship in sea water. The density of air is given as 1.24 kg/m^3 .Take the kinematic viscosity of sea -water and air as 0.012 stokes and 0.018 respectively.	**(10)**	**5**	**3**

PART- C (1 x 10 = 10 Marks)

(Q.No.26 is compulsory)

		Marks	CO	RBT LEVEL
26.	The ratio of length of a submarine and its model is 30:1. The speed of submarine (prototype) is 10 m/s. The model is to be tested in a wind tunnel. Find the speed of air in wind tunnel. Also determine the ratio of the drag (resistance) between the model and prototype. Take the value of kinematic viscosities of sea water and air as 0.012 stokes and 0.016 stokes respectively. The density of sea water and air is given as 1030 kg/m^3 and 1.24 kg/m^3 respectively.	**(10)**	**5**	**4**

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