Total number of printed pages: **UG/4th Sem/UFET 403**

2024

Fluid Mechanics

Full Marks : 100

Time : Three hours

The figures in the margin indicate full marks for the questions.

*Answer **any five** questions.*

1.	a)	Define fluid. What do you mean by real and ideal fluids?	2 +3=5
	b)	Define mass density and specific weight.	2
	c)	State Newton's law of viscosity.	3
	d)	Define compressibility.	2
	e)	What is surface tension?	2
	f)	What are the types of pressure gauges?	3
	g)	Draw the U tube manometer for negative pressure.	3
2.	a)	What do you mean by viscous flow?	2
	b)	Calculate the density,specific weight and weight of one litre of petrol of specific gravity = 0.7	5
	c)	A plate having an area of 0.6 m^2 is sliding down the inclined plate at 30° to the horizontal with a velocity of 0.36 m/s. There is a cushion of fluid 1.8 mm thick between the plane and the plate. Find the viscosity of the fluid if the weight of the plate is 280 N.	6
	d)	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 dynamic viscosity of the oil (ii) The kinematic viscosity of oil if the specific gravity of oil is 0.95	7
3.	a)	What is the difference between laminar and turbulent flow?	4
	b)	What is the physical significance of Reynold's number?	2
	c)	Write the assumptions of Bernoulli's Theorem.	4
	d)	State Bernnoulli's Theorem. Derive the expression for Bernoulli's equation from Euler's equation.	2+8=10

4.	a)	Water flows in a circular pipe. At one section the diameter is 0.3 m the static pressure is 260 kPa gauge, the velocity is 3 m/s and the elevation is 10 m above ground level. The elevation at a section downstream is 0 m and the pipe diameter is 0.15 m. Find the gauge pressure at the downstream section. Frictional effect may be neglected. Assume density of water to be 999 kg/m^3	6
	b)	The water is flowing through a tapering pipe having diameters 300 mm and 150 mm at a sections 1 and 2 respectively. The discharge through the pipe is 40 litres/sec. The section 1 is 10 m above datum and section 2 is 6 m above datum. Find the intensity of pressure at section 2 if that at section 1 is 400 kN/m^2.	7
	c)	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 Darcy's formula and Chezy's formula for which C= 60. Take kinematic viscosity of water is 0.01 stoke.	7
5.	a)	A fluid of viscosity 8 poise and specific gravity 1.2 is flowing through a circular pipe of diameter 100 mm. The maximum shear stress at the pipe wall is 210 N/m^2. Find: i. The pressure gradient ii. The average velocity, and iii. Reynolds number of flow.	7
	b)	A fluid of density 1200 kg/m^3 and viscosity 0.5 poise is flowing at a rate of 5 m^3/min in a circular pipe of cross-section of 1 m^2. Is the flow laminar or turbulent? Can you predict the maximum velocity of the fluid in the pipe?	6
	c)	Water is to be supplied to the inhabitants of a college campus through a supply main. The following data is given: Distance of the reservoir from the campus = 3000 m Number of inhabitants = 4000 Consumption of water per day of each inhabitant = 180 litres Loss of head due to friction = 18 m Co-efficient of friction for the pipe, f = 0.007 If half of the daily supply is pumped in 8 hours, determine the size of the supply main.	7
6.			
	a)	Explain the concept of boundary layer development over a flat plate?	6
	b)	Explain the following boundary layer thicknesses (a) Displacement thickness (b) Momentum thickness (c) Energy thickness	6

	c)	The velocity distribution in the boundary layer is given by : $\frac{u}{U} = \frac{y}{\delta}$, where u is the velocity at a distance y from the plate and $u = U \; at \; y = \delta$, δ being boundary layer thickness. Find: i) The displacement thickness, ii) The momentum thickness, iii) The energy thickness, and iv) The value of $\frac{\delta^*}{\theta}$	8