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

B.E. / B. TECH. DEGREE EXAMINATION, MAY 2023

Third Semester

CH18302 – FLUID MECHANICS

(Chemical Engineering)

(Regulation 2018 / Regulation 2018A)

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

CO1 Understanding of basic fluid properties, like density viscosity and surface tension. Classification of fluids based on their properties.
CO2 Analyzing the fluid flow problems using different laws like Euler's law, Bernoulli law etc.
CO3 Computing the pressure drops during the flow of fluids through different physical systems like pipes, valves, fixed and fluidized beds etc.
CO4 Several machineries used to transport the fluid and their performance including the flow measurements.
CO 5 Studying the fluid flow during the turbulent conditions using the analogies.

PART- A(10x2=20Marks)
(Answer all Questions)

		CO	RBT LEVEL
1.	Illustrate the effect of temperature and pressure on viscosity of fluids.	**1**	**2**
2.	Calculate the density of one litre of a liquid which weighs 7N.	**1**	**2**
3.	Outline the differential type micromanometer containing 'M' cross sectional area of reservoir and 'a' cross sectional area of the manometric fluid tube.	**2**	**2**
4.	Relate gauge pressure, absolute pressure and vacuum pressure.	**2**	**2**
5.	Compare superficial velocity and interstitial velocity.	**3**	**2**
6.	Illustrate the driving force for pipe flow and open channel flow.	**3**	**2**
7.	Show the advantages and disadvantages of orifice meter over venturi meter.	**4**	**2**
8.	Illustrate the significance of NPSH during the selection of pump.	**4**	**2**
9.	Sketch the velocity profile during the development of turbulent flow regime.	**5**	**2**
10.	State 'Buckingham's π - theorem.	**5**	**2**

PART- B(5x 14=70Marks)

			Marks	CO	RBT LEVEL
11. (a)	**(i)**	With a neat sketch and suitable examples explain the rheological behaviour of fluids.	**(10)**	**1**	**3**

	(ii)	Two horizontal plates are placed 1.57 cm apart, the space between them filled with oil of viscosity 17 poises. Calculate the shear stress in oil if the upper plate is moved with the velocity of 3.5 m/sec.	**(4)**	**1**	**3**
		(OR)			
(b)	**(i)**	If the velocity distribution over a plate is given by u = (3/5) y – y2, in which 'u' is the velocity in metre per second, at a distance y metre above the plate, determine the shear stress at y = 0, y = 0.15 and y = 0.25 m. Take dynamic viscosity of fluid to be 10 Poise.	**(7)**	**1**	**3**
	(ii)	Classify the different types of fluid flow and discuss in detail.	**(7)**		
12. (a)	**(i)**	Using Pascal's law prove that the pressure at a point is same in all the directions	**(7)**	**2**	**3**
	(ii)	Derive an expression of Hydrostatic equilibrium application in a centrifugal field	**(7)**	**2**	**3**
		(OR)			
(b)	**(i)**	The U tube manometer is used to measure the pressure of water in a pipe line, which is in excess of atmospheric pressure. The right limb of manometer contains mercury and is open to atmosphere. The contact between water and mercury is in the left limb. Determine the pressure in the main line, if the difference in level of mercury in the limbs of U – tube is 10 cm and the free surface of mercury is in level with the centre of the pipe. If the pressure of water in pipe line is reduced to 9810 N/m^2, Calculate the difference in the level of mercury.	**(7)**	**2**	**3**
	(ii)	An open tank contains water up to a height of 2.7 m and above it an oil of specific gravity 0.92 for a depth of 2.2 m. and another liquid of specific gravity 0.85 for a depth of 1.7 m. Determine the pressure intensity at the interface of the three liquids.	**(7)**	**2**	**3**
13. (a)		A sugar syrup having sp. gravity of 1.04 is flowing through a 55 mm i.d. Pipe at a flow rate of 66.67 cm^3/sec. The viscosity of the syrup is 0.15 $N.s/m^2$. Calculate the frictional loss over the length of 10 m.	**(14)**	**3**	**3**
		(OR)			
(b)	**(i)**	Derive the expression for head loss due to sudden enlargement.	**(7)**	**3**	**3**

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	(ii)	Derive the expression for head loss due to sudden contraction.	**(7)**	**3**	**3**
14. (a)		Explain the working principles, advantages and application of any two constant area meters with a neat diagram. Derive the volumetric flow rate expression for the both flow measurement devices.	**(14)**	**4**	**3**
		(OR)			
(b)		A horizontal venturimeter with inlet and throat diameter 30 cm and 15 cm respectively is used to measure the flow of water. The reading of the differential manometer connected to the inlet and throat is 20 cm of mercury. Determine the rate of flow. $C_d = 0.98$.	**(14)**	**4**	**3**
15. (a)	**(i)**	The thrust 'F' of a screw propeller is dependent upon the diameter 'd', speed of advance 'v', fluid density 'ρ', revolutions per second 'n' and coefficient of dynamic viscosity 'μ'. Using Buckingham-Pi theorem show that it can be expressed by the equation $F = \rho d^2 v^2 \varphi \left[\left\{\frac{\mu}{(\rho v d)}\right\}, (nd)/v\right]$	**(10)**	**5**	**3**
	(ii)	Discuss about the principle of dimensional homogeneity.	**(4)**	**5**	**3**
		(OR)			
(b)		A pipe of diameter 1.5 m, is required to transport an oil of sp.gr. 0.90 and viscosity 3 x 10^{-2} poise at the rate of 3000 litter/s. Tests were conducted on a 15 cm diameter pipe using water at 20°C. Find the velocity and rate of flow in the model. Viscosity of water at 20°C = 0.01 poise.	**(14)**	**5**	**3**

PART- C(1x 10=10Marks)
(Q.No.16 is compulsory)

			Marks	CO	RBT LEVEL
16.		The right limb of a simple U tube manometer containing mercury is open to atmosphere while the left limb is connected to a pipe in which a fluid of specific gravity 0.9 is flowing. The centre of the pipe is 12cm below the level of mercury in the right limb. Find the pressure of the fluid in the pipe if the difference of the mercury level in the two limbs is 20cm.	**(10)**	**2**	**5**