Roll No.												

PRESIDENCY UNIVERSITY

BENGALURU

Mid - Term Examinations – October 2025

Date: 07-10-2025 **Time:** 02.00pm to 03.30pm

School: SOE	**Program:** B. Tech-PET	
Course Code: PET2020	**Course Name:** Process Pipeline Design	
Semester: V	**Max Marks**: 50	**Weightage**:25%

CO - Levels	CO1	CO2	CO3	CO4	CO5
Marks	26	24	-	-	-

Instructions:

(i) Read all questions carefully and answer accordingly.

(ii) Do not write anything on the question paper other than roll number.

Part A

Answer ALL the Questions. Each question carries 2marks. **5Q x 2M=10M**

1	Outline the difference any two pairs from the following, giving one key point for each: a. steady vs unsteady, b. uniform vs non-uniform, c. laminar vs turbulent, d. compressible vs incompressible, e. rotational vs irrotational, 1D vs 2D vs 3D.	**2 Marks**	**L1**	**CO1**
2	List the condition on **p, q, and r** required for a flow with velocity components **u** = **px**, **v** = **qy, w** = **rz** to be incompressible	**2 Marks**	**L1**	**CO1**
3	Describe the Darcy–Weisbach equation and the relation between Darcy's friction factor and Fanning's friction factor.	**2 Marks**	**L1**	**CO1**
4	During pump operation, cavitation is observed. The engineer checks NPSH values. Which action best applies the concept of NPSH to prevent cavitation? Select the correct option. a) Increase pipe roughness to raise the suction head. b) Lower the fluid vapor pressure by cooling the liquid c) Increase discharge pressure to reduce suction head losses d) Reduce the impeller diameter to increase the suction velocity	**2 Marks**	**L1**	**CO2**

5	A petroleum pipeline requires increased throughput capacity, while the static head remains moderate. Two identical centrifugal pumps are available. Select which arrangement provides a higher flow rate? a) Pumps in series – heads add, flow remains constant b) Pumps in parallel – flow rates add, head remains constant c) Pumps in series – flow doubles, head constant d) Pumps in parallel – eliminates cavitation risk at all conditions	**2 Marks**	**L1**	**CO2**

Part B

Answer the Questions. **Total Marks 40M**

6.	**a.**	The velocity field is given as: V = (3x, -2y, 0.5z) and the density field as: $\rho(x,y,z,t) = 2 + 0.2t + 0.1x - 0.05y + 0.02z$ At the point (x,y,z) = (2, -2, 1) and t = 1.0 Explain whether the continuity equation is satisfied at the given point and defend your reasoning with proper calculations.	**10 Marks**	**L2**	**CO1**
	b.	Explain the derivation of Dupuit's equation for the equivalent diameter of a pipeline system consisting of pipes in series, and show that: $L / d^5 = (L_1 / d_1^5) + (L_2 / d_2^5) + (L_3 / d_3^5)$	**10 Marks**	**L2**	**CO1**
		Or			
7.	**a.**	Water at 25°C (ρ = 998 kg/m^3, $\mu = 0.89\times10^{-3}$ Pa·s) flows through three pipes in series carrying a steady discharge of Q = 0.015 m^3/s. Assume representative values: $f_D = 0.018$ The system consists of: 1) Pipe 1: L_1 = 80 m, d_1 = 0.12 m 2) Pipe 2: L_2 = 120 m, d_2 = 0.08 m 3) Pipe 3: L_3 = 60 m, d_3 = 0.18 m 1. Compute the velocity in each pipe 2. Estimate the head loss in each pipe using the Darcy–Weisbach equation. 3. Estimate the total head loss for the series system.	**10 Marks**	**L2**	**CO1**
	b.	A gas mixture contains H_2, N_2, and CH_4 with amounts of 30 mol, 50 mol, and 20 mol, respectively. The total pressure of the mixture is 12.0 bar (at constant T). Using Dalton's law, estimate the partial pressure of each gas.	**10 Marks**	**L2**	**CO1**

8.	**a.**	Calculate the specific speed of a five-stage double suction centrifugal pump, 12 in. diameter impeller, that, when operated at 3560 RPM, generates a head of 2200 ft at a capacity of 3000 gal/min at the BEP on the head capacity curve. If the NPSH required is 15 ft, calculate the suction specific speed.	**10 Marks**	**L3**	**CO2**
	b.	Differentiate between centrifugal pumps and reciprocating (positive displacement) pumps, highlight how their features differ,	**10 Marks**	**L3**	**CO2**

		and recommend which pump is best suited for (a) transporting crude oil through a pipeline and (b) injecting liquids into a gathering system			
Or					
9.	**a.**	A centrifugal pump delivers 3000 gal/min of water against a head of 2200 ft with an efficiency of 80%. Calculate the brake horsepower (BHP) required.	**10 Marks**	**L3**	**CO2**
	b.	A pump delivers 500 m^3/hr of crude oil (specific gravity = 0.85) against a head of 120 m with an efficiency of 75%. Using the SI unit equation, determine the power in kW required to operate the pump.	**10 Marks**	**L3**	**CO2**