Roll No.											

PRESIDENCY UNIVERSITY

BENGALURU

End - Term Examinations – December 2025

Date: 10- 12- 2025 **Time:** 1.00pm to 04.00pm

School: SOE	**Program:** B. Tech-PET	
Course Code: PET2020	**Course Name:** Process Pipeline Design	
Semester: V	**Max Marks:** 100	**Weightage:**50%

CO - Levels	**CO1**	**CO2**	**CO3**	**CO4**	**CO5**
Marks	**10**	**6**	**34**	**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. 10Q x 2M=20M

1.	Identify which pump configuration (series or parallel) is suitable when: (a) High head is required → _________ (b) Higher flowrate is required → _________	**2 Marks**	**L1**	**CO2**
2.	State which expression correctly relates compressor flow rate to speed change: (a) $Q_2/Q_1 = N_2/N_1$ (b) $Q_2/Q_1 = (N_2/N_1)^2$ (c) $Q_2/Q_1 = (D_2/D_1)^2$ (d) $Q_2/Q_1 = D_2/D_1$	**2 Marks**	**L1**	**CO2**
3.	Define ‘Pipeline Sizing’ in process pipeline design.	**2 Marks**	**L1**	**CO3**
4.	Describe briefly the purpose of the Schedule Number (SCH) system.	**2 Marks**	**L1**	**CO3**
5.	Define CAPEX and state one example of a capital expenditure used in pipeline projects.	**2 Marks**	**L1**	**CO4**

6.	Recognize the correct mathematical expression that represents the Net Present Value (NPV): (a) $PW = \dfrac{F}{(1+i)^n}$ (b) $FV = P(1+i)^n$ (c) $PW = \dfrac{(1+i)^n - 1}{i(1+i)^n}$ (d) $PV = F(1+i)^n$	**2 Marks**	**L1**	**CO4**
7.	Order the following project stages correctly: 1. Feasibility Study 2. Construction 3. Concept Selection 4. Commissioning Correct sequence is: (a) 1–2–3–4 (b) 3–1–2–4 (c) 2–1–3–4 (d) 1–3–2–4	**2 Marks**	**L1**	**CO4**
8.	Name the parameter that determines whether a pipeline route is technically and economically feasible: (a) CAPEX analysis (b) Feasibility study (c) Stress analysis (d) Corrosion modeling	**2 Marks**	**L1**	**CO5**
9.	Tabulate which option correctly lists three examples of capital expenditures: (a) Rent, utilities, salaries (b) Pipeline material, compressor station, SCADA system (c) Fuel, office supplies, repairs (d) Income tax, training cost, and insurance.	**2 Marks**	**L1**	**CO5**
10.	Identify the correct statement about the NPSH (Net Positive Suction Head) of a pump: (a) NPSH decreases as flow rate increases (b) NPSH remains constant for all flows (c) NPSH increases as pump flow rate increases (d) NPSH is not related to cavitation.	**2 Marks**	**L1**	**CO2**

Part B

Answer the Questions. **Total Marks 80M**

11.	**a.**	A five-stage double suction centrifugal pump with a 12-inch diameter impeller operates at 3560 RPM, delivering a head of 2200 ft at a capacity of 3000 gal/min at the BEP. The NPSH required is 25 ft. Using the given data, estimate the pump's specific speed and the suction specific speed.	**10 Marks**	**L2**	**CO1**
	b.	Describe the widely used types of pipeline coating systems, highlighting their material composition and methods of application.	**10 Marks**	**L2**	**CO3**
Or					
12.	**a.**	A natural-gas mixture consists of CH_4 (0.80), C_2H_6 (0.15), and C_3H_8 (0.05). The critical properties of each component are given, and the gas mixture is at T = 300 K and P = 100 bar. Compute the pseudo-critical temperature (Tpc) and pseudo-critical pressure (Ppc) of the mixture using Kay's rule.	**10 Marks**	**L2**	**CO1**
	b.	Explain the various stages involved in the pipe fabrication process, highlighting the purpose and importance of each stage.	**10 Marks**	**L2**	**CO3**

13.	**a.**	Demonstrate your understanding of the pipeline construction process by explaining each phase — from route selection to site restoration — highlighting the purpose and key engineering activities involved in every stage.	**20 Marks**	**L3**	**CO3**
Or					
14.	**a.**	(i) Determine the minimum required wall thickness (t_m) for a pipe designed to withstand the given operating conditions using the appropriate Barlow-based schedule formula. The pipe details are as follows: • Design Pressure (P): 2.5 MPa (≈ 362.5 psi) • Outside Diameter (D_0): 8 in • Allowable Stress (S_e): 17,500 psi • Coefficient (y): 0.4 • Corrosion/Extra Allowance (A): 0.03 in (ii) Water is conveyed through a 4-inch galvanized-iron pipeline forming part of an industrial process-water distribution system. The pipeline segment under consideration includes: • a 175 m horizontal straight run, • two 45° elbows, • one fully open gate valve, and • a sudden contraction where the pipe discharges into a smaller manifold.	**10+10 Marks**	**L3**	**CO3**

		The pumping station delivers water to this pipeline at a steady flow rate of 55 m^3/h under standard operating conditions. The pipe diameter remains constant along the entire length of the segment. Using the Hazen–William's equation, compute the frictional head loss (in meters of water column) for this pipeline section. Assume that the minor losses from fittings and the contraction are negligible for the purpose of this calculation.			

15.	**a.**	A 20-mile-long pipeline has an outside diameter of 16 inches and a wall thickness of 0.375 inches. The cost of pipe material is $780 per ton. (a) Calculate the pipe material cost (PMC) in dollars. (b) Examine how increasing the wall thickness from 0.375 in. to 0.5 in. affects the material cost.	**20 Marks** **(10+10)**	**L4**	**CO4**
		Or			
16.	**a.**	(i) Analyze the differences between Capital Expenditure (CapEx) and Operating Expenditure (OpEx) in pipeline projects. (ii)A chemical plant must convey a liquid at a volumetric flow rate of 0.45 m^3/min. The liquid properties are: • density = 880 kg/m^3 and dynamic viscosity = 4.2 cP. (a) Convert the volumetric flow to a mass flow rate in lb/hr and convert the given density to lb/ft^3. (b) Then calculate the economic diameter de in inches using the same correlation and constant A = 1.7 $d_e = 1.7\, m^{0.45}\, \mu^{0.27} / \rho^{0.31}$ (Use μ = 4.2 cP in the formula after conversion; show all unit-conversion steps clearly.)	**20 Marks** **(10+10)**	**L4**	**CO4**

17.	**a.**	(i) Describe the primary steps in feasibility studies. (ii) Classify how each step contributes to predicting the overall likelihood of project success.	**20 Marks**	**L2**	**CO5**
		Or			
18.	**a.**	(i)Explain the concept of economic diameter using the given empirical formula and estimate how changes in viscosity or mass flow rate influence the diameter. (ii)Compare the economic and environmental benefits of using Compressed Natural Gas (CNG) over conventional fossil fuels such as diesel and petrol.	**20 Marks**	**L2**	**CO5**