Name: **Enrolment No:**	UPES

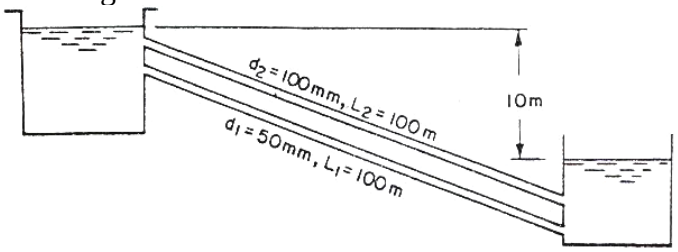
UNIVERSITY OF PETROLEUM AND ENERGY STUDIES
End Semester Examination, December 2022

Program Name: B. Tech (APE Gas) **Semester: VII**
Course name: Pipeline Transportation of Oil and Gas **Time: 3:00 hrs.**
Course Code: CHGS3007P **Max. Marks: 100**
Note: Assume suitable data wherever necessary

Section – A
Attempt all the questions. All questions carry equal marks

S. No.		Marks	CO
Q1	Discuss the pre-construction surveys required for a pipeline project and the land acquisition procedure	**12**	**CO3**
Q2	A gas pipeline, NPS 20 with 0.500 in. wall thickness, transports natural gas (specific gravity = 0.6) at a flow rate of 250 MMSCFD at an inlet temperature of 60°F. Assuming isothermal flow, calculate the velocity of gas at the inlet and outlet of the pipe if the inlet pressure is 1000 psig and the outlet pressure is 850 psig. The base pressure and base temperature are 14.7 psia and 60°F, respectively. Assume compressibility factor Z = 1.0. What is the erosional velocity for this pipeline based on the above data and a compressibility factor Z = 0.90?	**12**	**CO2**
Q3	What is cathodic protection and explain impressed current C.P system and sacrificial anode system for protecting a pipeline?	**12**	**CO5**
Q4	Describe the different modes of transportation of oil and gas.	**12**	**CO1**
Q5	Water flows through a 20 in. pipe at 5700 gal/min. Calculate the friction factor using the Colebrook-White equation. Assume 0.375 in. pipe wall thickness and an absolute roughness of 0.002 in. Use a specific gravity of 1.00 and a viscosity of 1.0 cSt. What is the head loss due to friction in 2500ft of pipe?	**12**	**CO2**

Section – B
Answer all questions

Q6	Following figure shows two reservoirs with a difference elevation connected by two parallel pipes. a) Determine the flow rate in each pipe (f=0.015) b) Also, if the two pipes are replaced with one pipe of the same length, determine the diameter which give the same flow. 	**20**	**CO3**

Q7	(i) Discuss the variation of pump efficiency with flow rate for centrifugal pump. (ii) The head (H) and efficiency (E) versus flow rate (Q) data for a centrifugal pump with a 10 in. impeller is as shown below. Q, gal/min: 0, 800, 1600, 2400, 3000 H, ft: 3185, 3100, 2900, 2350, 1800 E, %: 0.0, 55.7, 78.0, 79.3, 72.0 The pump is driven by a constant-speed electric motor at a speed of 3560 RPM. a) Determine the performance of this pump with an 11 in. impeller, using Affinity Laws. b) If the pump drive were changed to a variable frequency drive (VFD) motor with a speed range of 3000 to 4000 RPM, calculate the new H-Q curve for the maximum speed of 4000 RPM with the original 10 in. impeller.	**7+13**	**CO4**

Equations for gas pipeline and liquid pipeline:

- Velocity of gas at section 1: $u = 0.002122\left(\frac{Q_b}{D^2}\right)\left(\frac{P_b}{T_b}\right)\left(\frac{Z_1T_1}{P_1}\right)$, (USCS units)
- Velocity of gas at any point in the pipeline: $u = 0.002122\left(\frac{Q_b}{D^2}\right)\left(\frac{P_b}{T_b}\right)\left(\frac{ZT}{P}\right)$, (USCS units)
- Velocity of gas at section 1: $u = 14.7349\left(\frac{Q_b}{D^2}\right)\left(\frac{P_b}{T_b}\right)\left(\frac{Z_1T_1}{P_1}\right)$, (SI units)
- Velocity of gas at any point in the pipeline: $u = 14.7349\left(\frac{Q_b}{D^2}\right)\left(\frac{P_b}{T_b}\right)\left(\frac{ZT}{P}\right)$, (SI units)
- Erosional velocity: $u_{max} = \sqrt{\frac{ZRT}{29GP}}$ (USCS units)
- Colebrook-White equation for turbulent flow: $\frac{1}{\sqrt{f}} = -2\,log_{10}\left(\frac{e}{3.7D} + \frac{2.51}{Re\sqrt{f}}\right)$