Name: **Enrolment No:**	UPES UNIVERSITY OF TOMORROW

UPES

End Semester Examination, May 2023

Course: Storage and Transportation of Oil and Gas **Semester: VI**
Program: B.Tech Applied Petroleum Engineering+Upstream **Time : 03 hrs.**
Course Code: CHCE 3036P **Max. Marks: 100**

Instructions:
All Questions are Mandatory.

SECTION A
(5Qx4M=20Marks)

S. No.		Marks	CO
Q 1	List out the objectives of above ground storage tanks?	**4M**	**CO1**
Q 2	Differentiate between normal venting and emergency venting?	**4M**	**CO2**
Q 3	Explain the effect of compressibility factor on flow velocity of different types of fluids through a cylindrical pipe having (i) uniform diameter and (ii) non-uniform diameter?	**4M**	**CO3**
Q 4	List out the regulations and standards that govern oil and gas transportation?	**4M**	**CO3**
Q 5	Identify the advantages and disadvantages of pipelines as a mode of transportation?	**4M**	**CO4**

SECTION B
(4Qx10M= 40 Marks)

Q 6	(a) Discuss the main types of oil and gas storage facilities, and classify their advantages and disadvantages? (b) Illustrate the safety considerations that need to be taken into account when designing and operating oil and gas storage facilities?	**5M +5M**	**CO2**
Q 7	A gas pipeline, NPS 22 with 0.800 in. wall thickness, transports natural gas (specific gravity = 0.6) at a flow rate of 280 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 1200 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 = 1.00. What is the erosional velocity for this pipeline based on the above data and a compressibility factor Z = 0.85? Also, calculate the change in compressibility factor at inlet and outlet pressures and its effect on velocities?	**10M**	**CO3**
Q 8	A natural gas pipeline, NPS 25 with 0.500 in. wall thickness, transports 275 MMSCFD. The specific gravity of gas is 0.6 and viscosity is	**10M**	**CO4**

	0.0000075 lb/ft-s. Calculate the friction factor using the Colebrook equation. Assume absolute pipe roughness = 600 μ in. The base temperature and base pressure are 60°F and 14.7 psia, respectively.		
Q 9	The Nord Stream 2 pipeline is a controversial project that will transport natural gas from Russia to Germany, bypassing traditional transit countries such as Ukraine. What are the geopolitical implications of this project, and what are some of the economic and environmental risks associated with the pipeline's construction and operation?	**10M**	**CO4**
	SECTION-C **(2Qx20M=40 Marks)**		
Q 10	a) The Groningen gas field in the Netherlands is one of the largest natural gas fields in the world and has been in production since the 1960s. However, concerns about seismic activity and subsidence have led to a gradual reduction in production levels in recent years. What are the key challenges associated with decommissioning and repurposing large-scale storage facilities like the Groningen gas field, and what are some potential solutions to these challenges? b) The Fukushima nuclear disaster in 2011 resulted in the shutdown of several nuclear power plants in Japan, leading to a significant increase in demand for natural gas as a replacement fuel source. What were the key challenges associated with storing and transporting the increased volumes of natural gas, and how were these challenges addressed?	**10M** **+** **10M**	**CO2**
Q 11	A gas pipeline, NPS 19 with 0.270 in. wall thickness, 55 mi long, transports natural gas (specific gravity = 0.6 and viscosity = 0.000008 lb/ft-s) at a flow rate of 123 MMSCFD at an inlet temperature of 60°F. Assuming isothermal flow, calculate the inlet pressure required if the required delivery pressure at the pipeline terminus is 870 psig. The base pressure and base temperature are 14.7 psig and 60° F, respectively. Use the Colebrook equation with pipe roughness of 0.00055 in. Case A—Consider no elevation changes along the pipeline length. Case B—Consider elevation changes as follows: inlet elevation of 100 ft and elevation at delivery point of 450 ft, with elevation at the midpoint of 250 ft. (OR) A 150 mi long natural gas pipeline consists of several injections and deliveries as shown in below figure. The pipeline is NPS 20, has 0.500 in. wall thickness, and has an inlet volume of 250 MMSCFD. At points B (milepost 20) and C (milepost 80), 50 MMSCFD and 70 MMSCFD, respectively, are delivered. At D (milepost 100), gas enters the pipeline at 60 MMSCFD. All streams of gas may be assumed to have a specific gravity of 0.65 and a viscosity of 8.0×10^{-6} lb/ft-s. The pipe is internally coated (to reduce friction), resulting in an absolute roughness of 150 μ in. Assume a constant gas flow temperature of 60°F and base pressure	**20M**	**CO4**

	and base temperature of 14.7 psia and 60°F, respectively. Use a constant compressibility factor of 0.85 throughout. Neglect elevation differences along the pipeline. a) Using the AGA equation, calculate the pressures along the pipeline at points A, B, C, and D for a minimum delivery pressure of 300 psig at the terminus E. Assume a drag factor = 0.96. b) What diameter pipe will be required for section DE if the required delivery pressure at E is increased to 500 psig? The inlet pressure at A remains the same as calculated above.