Name:

Enrolment No:

UNIVERSITY OF PETROLEUM AND ENERGY STUDIES

Supplementary Examination, May 2022

Programme Name: B. Tech. APE (Gas) Semester : IV

Course Name : Natural Gas Engineering Time : 03 hrs

Course Code : CHCE 3001 Max. Marks : 100

Nos. of page(s) : 4

Instructions:

- ✓ Draw diagrams wherever necessary
- ✓ Attempt questions in sequence
- ✓ Appendix with all the tables and graphs are attached at the end of the question paper

SECTION A (5 X 4= 20 Marks)

Answer all questions

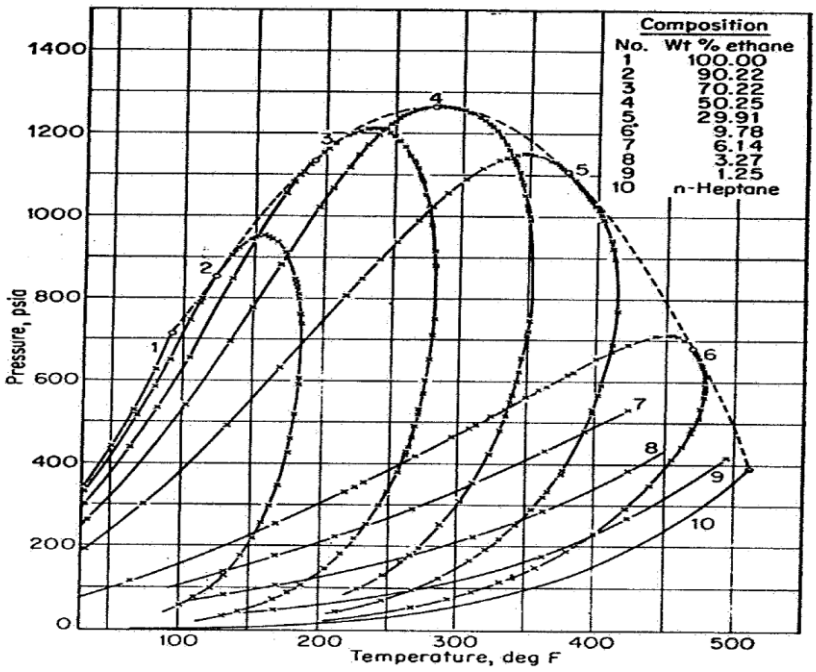
S. No.		Marks	CO
1.	Explain biogenic and thermogenic mechanisms?	4M	CO1
2.	The following is a list of the compositional analysis of different hydrocarbon systems. The compositions are expressed in the terms of mol%. Classify hydrocarbon systems.	4M	CO2
3.	Describe the working principle of an axial flow compressor.	4M	CO3
4.	Compare orifice types including their effect on gas flow measurement.	4M	CO4
5.	Articulate the functions of a well-designed separator.	4M	CO5

Component	System #1	System #2	System #3	System #4
C_1	68.00	25.07	60.00	12.15
C_2	9.68	11.67	8.15	3.10
C_3	5.34	9.36	4.85	2. 51
C_4	3.48	6.00	3.12	2.61
C_5	1.78	3.98	1.41	2.78
C_6	1.73	3.26	2.47	4.85
C_{7+}	9.99	40.66	20.00	72.00

SECTION B (4 x 10=40 Marks)

Answer all questions

6.	a) Solve for compressibility for the given gas composition at 200 psia and 80°F. N_2-1%, C_1-89%, C_2-5% and C_{3+} =5%. Assume the C3+ fraction to be equivalent to n-C_5.	(5+5) 10M	CO1 & CO2

	b)Illustrate the P-T diagram of ethane and heptane system  		
7.	A gas is being compressed from 150 psia and 200°F to 2000 psia. Determine its compression parameters at the suction end. The gas has the following composition expressed as mole fraction. C_1=0.9134, C_2=0.0456, C_3=0.0175, i-C_4=0.0043, n-C_4=0.0044, i-C_5=0.0148.	10M	CO3
8.	A 4-in diameter orifice meter is installed in a pipe with an inside diameter of 12.09 in. The differential pressure is measured at 30 in of water and the static pressure upstream is 600 psig. Gas gravity= 0.6, gas flowing temperature= 70°F. The base temperature and the base pressure are 60°F and 14.7 psia, respectively. Assuming flange taps, calculate the flow rate in standard ft^3/h. The barometric pressure is 14.5 psia.	10M	CO4
9.	Illustrate the working of a vertical separator with a neat diagram, its advantages and disadvantages.	10M	CO5
SECTION C (2 x 20=40 Marks)			
10.	Solve the adiabatic horsepower required to compress 1 MMcfd of a 0.6 grvaity natural gas from 100 psia and 80°F to 1600 psia. Intercoolers cool the gas to 80°F. What is the heat load on the intercoolers and what is the final gas temperature. Use: a) The enthalpy –entropy diagram	20M	CO3

	b) Analytical expressions.		
11.	Meter equipped with flange taps , with static pressure from downstream tap: D1= line size=8.071 in. actual ID D2=orifice size=1 in Flowing temperature=65^{o}F Ambient temperature=70^{o}F Base pressure=14.65 psia Base temperature= 50^{o}F Specific gravity=0.570 Total heating value=999.1 Btu/cu ft Mole fraction of nitrogen content=0.011 Mole fraction of carbon dioxide content=0 Average differential head=50 in water Average downstream gauge pressure=370 psig Solve for the orifice flow constant and the quantity rate of flow for 1 hour at base conditions	20M	CO4
	(Or)		
	a)A metering system is required to measure approximately 8.5 MMSCFD of 0.62 gravity gas at a line pressure of 250 psig The meter run is to be made of 8 in pipe (7.981 in ID). Determine the size of the orifice plate to give a differential of about 50 inches. Flowing temperature averages about 80°F. Use flange taps. b)A 2 in [5.1 cm] orifice plate is used in 3.438 in [8.7 cm] ID pipeline. The differential pressure is 30 in of water. The static pressure upstream is 80 psia and the specific gravity is 0.65. The flowing temperature of gas is 80°F . Flange taps are used. Assume *Ftb* = *Fpb* = 1. Calculate the gas flow rate through the pipe.	(10+10) 20M	CO4