UNIVERSITY OF PETROLEUM AND ENERGY STUDIES
End Semester Examination, December 2023

Program Name : B.Tech APE Gas   **Semester : V**
Course Name : Natural Gas Conditioning and Processing   **Time : 3 hrs**
Course Code : CHCE 3047   **Max. Marks: 100**
Nos. of page(s) : 05

Section A
(4x15=60 Marks)

S. No.		Marks	CO
Q 1	Gas flow rate Q_g=98 MMSCFD at 0.67 specific gravity is saturated with water at 1000 psig and 100^oF dehydrate to 7 lb/MMSCF. Use Tri ethylene glycol. 98.5% TEG Concentration. The number of valve trays is 5. $\rho C(T_2-T_1)$=1200, Q_h=20000 Btu/hr, Estimate the following: a) Amount of water to be removed. b) Glycol to water circulation rate c) Glycol circulation rate d) Reboiler heat load	15M	CO1
Q 2	Discuss the following: a) Merits and demerits of absorptive acid gas removal b) Comparison of CO_2 and H_2S removal processes. c) Preferred polymer used for acid gas removal d) Parameters affecting membrane performance	15M	CO2
Q 3	For an Alkanol Amine process to remove sulfur from natural gas, discuss the following: a) Types of solvents used and their applicability. b) Solution concentrations and reactions in the alkanol amine process c) Process description with a neat sketch.	15M	CO3
Q 4	Design an Iron Sponge Unit: Gas flow rate=2 MMSCFD, Specific Gravity= 0.6, H_2S=19 ppm, T=100^oF, Z=0.85, Vg, max=10 ft/s, rate of deposition=15 grains /min-ft^2, minimum gas velocity=2 ft/s. a) Minimum vessel diameter for gas velocity b) Minimum vessel diameter for deposition c) Maximum diameter	15M	CO4
	Section B **(2x20=40 Marks)**		
Q 5	a) Illustrate the regeneration and cooling calculations involved in solid bed dehydration and estimate the water removed per cycle, the diameter of the adsorber bed, water loading, and	20M	CO3[10] CO4[10]

	zone length for a gas flow rate of 25 MMsfcd of a 0.67 gravity gas at 500 psia and 100°F for a tow tower plant. Assume an 8 hr cycle with 15 ft long bed. Z=0.87 b) With a neat sketch describe the Holmes Stretford process, its operating conditions, solution concentrations, and reactions.		
Q 6	Given: Gas volume = 120,000 std m^3/h, Gas gravity=0.67 (air=1.0), Pressure=7000 kPa, Gas temperature=38°C, CO_2 inlet= 4.03%, CO_2 outlet=2%, H_2S inlet=0.0016%, H_2S outlet=4 ppm, Max. Ambient temp. =38°C. Use 35 weight % DEA. DEA density 1045 kg/m^3, c=0.35 lb/lb, Acid gas loading =0.50 mol/mol. Heat of reaction for CO_2 is 1,395,000 Joules/kg and for H_2S is 1,300,000 Joules/kg. pump efficiency=65 %. Design an amine processing unit.	**20M**	**CO4**

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Water Content of Hydrocarbon Gas

Lb water m l on cu ft of wet gas at 60 F and 14 7 psia

Correction for Gas Gravity

C_G

Gas Gravity

Molecular Weight

Correction for Salinity

$C_s = \dfrac{H_2O \; From \; Brine}{H_2O \; From \; Water}$

Total Solids in Brine, %

14 7 psia

HYDRATE FORMATION LINE

Warning: Dashed lines are meta-stable equilibrium. Actual equilibrium is lower water content. Angle is a function of composition.

Position of this line is a function of gas composition.

14 7 psia

Water contents of natural gases with corrections for salinity and relative density After McKetta and Wehe. Hydrocarbon Processing. August. 1958

Curves for required dew point depression

Number of valve trays or ft. of packing required (y-axis)

Glycol to water circulation rate, gal TEG/lb H_2O (x-axis)

95°F
85°F
75°F
65°F
55°F