

Name:

Enrolment No:



**UPES**

**End Semester Examination, May 2024**

**Course:** Natural Gas Conditioning and Processing

**Program:** B.Tech. (APEG)

**Course Code:** CHCE3047

**Semester** : VI

**Time** : 3 Hrs.

**Max. Marks** : 100

**Instructions:**

1. All questions are compulsory.
2. Assume any missing data, if any

<b>SECTION - A</b> <b>(5Qx4M= 20 Marks)</b>			
<b>S. No.</b>		<b>Marks</b>	<b>CO</b>
<b>Q1</b>	Enumerate the primary reasons for removal of water from natural gas.	<b>4</b>	<b>CO1</b>
<b>Q2</b>	Mention the hydrate number of all the hydrate forming molecules.	<b>4</b>	<b>CO1</b>
<b>Q3</b>	List all the chemical reactions that takes place in carbonate process.	<b>4</b>	<b>CO1</b>
<b>Q4</b>	Elaborate on the process variables that must be considered for designing adsorption dehydration plant?	<b>4</b>	<b>CO2</b>
<b>Q5</b>	Discuss why membrane separation process is to be preferred over other NGL production processes?	<b>4</b>	<b>CO2</b>
<b>SECTION - B</b> <b>(4Qx10M= 40 Marks)</b>			
<b>Q6</b>	a) Discuss dew point and dewpoint depression. b) Detail the Hammerschmidt's equation and its importance.	<b>5+5</b>	<b>CO2</b>
<b>Q7</b>	a) Classify the chemical reactions involved in sponge iron process and Alkanolamine process. b) Compare the different Claus process configuration with reference to H <sub>2</sub> S mole % in acid gas.	<b>10</b>	<b>CO2</b>
<b>Q8</b>	Sketch and explain the internal refrigeration process used for NGL recovery.	<b>10</b>	<b>CO3</b>
<b>Q9</b>	Examine LO-CAT sulfur recovery process. Write the chemical reactions involved in the process.	<b>10</b>	<b>CO3</b>
<b>SECTION - C</b> <b>(2Qx20M= 40 Marks)</b>			
<b>Q10</b>	A glycol dehydrator plant is to be designed for handling 14 MMscfd of the sour gas (N <sub>2</sub> = 8.5%, H <sub>2</sub> S = 5.4%, CO <sub>2</sub> = 0.5%, C <sub>1</sub> = 77.6%, C <sub>2</sub> = 5.8%, C <sub>3</sub>	<b>20</b>	<b>CO4</b>

	<p>= 1.9%, n-C<sub>4</sub> = 0.1%, i-C<sub>4</sub> = 0.1%, i-C<sub>5</sub> = 0.1%). The glycol circulation rate is 4 gal TEG/lb water, lean glycol concentration is 99 %, glycol specific gravity is 1.0, inlet gas pressure and temperature are 1000 psi and 120<sup>0</sup>F respectively, and the absorption tower uses bubble-cap trays. For an exit water content of 10 lb/MMscf gas, determines the followings:</p> <p>a) Specific gravity of natural gas  b) Water content of inlet gas  c) Dew point depression  d) Water removal rate in lbm/hr</p>		
<b>Q11</b>	<p>a) Analyze the adsorption sweetening process with the help of a process flow diagram.</p> <p>b) Explore the following terms with reference to the designing of adsorption dehydration process.</p> <p style="padding-left: 40px;">I. Water Loading</p> <p style="padding-left: 40px;">II. Zone Length</p>	<b>10+10</b>	<b>CO4</b>

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Figure 1: The McKetta-Wehe correlation for water content of natural gases

