Name: **Enrolment No:**	

UPES

End Semester Examination, December 2023

Course: Chemical Eng I (Thermodynamics & Measuring A. Inst.) – HSFS2001 **Semester: III**

Programme: BTech (FSE)

Time: 03 hrs. **Max. Marks: 100**

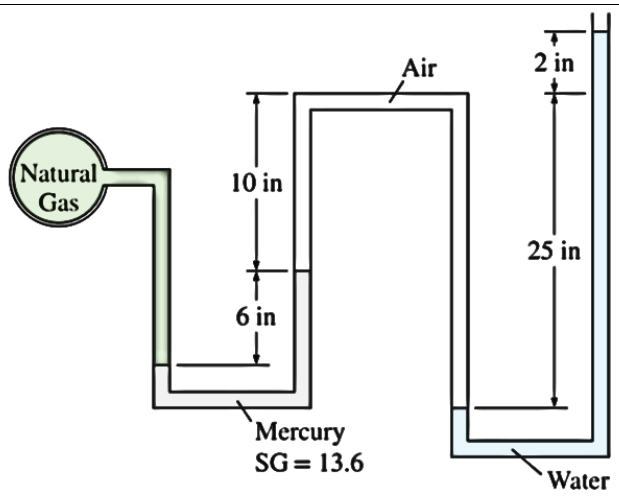
Instructions:

(i) All Questions in Section A are compulsory. Section B has 4 Questions with Qusetion 9 having an internal choice. Section C has 2 questions Question 10 having an internal choice.

(ii) Answer all the questions sequentially.

SECTION A
(5Qx4M=20Marks)

S. No.		Marks	CO
Q 1	1. What is specific gravity? How is it related to density? 2. Bimetal thermostats is made up of two metallic strips with different _____ a) Melting point temperature b) Coefficient of thermal expansion c) Cross sectional areas d) Density	**4**	**CO1**
Q2	True and False: (a) Is it true that, according to the 1st Law of Thermodynamics, there are no limitations on the direction of energy conversion? (b) Dip Stick and Float type level measurement devices provide a direct measurement of level. (c) In an open system, energy can move across the system boundaries as heat and work, but the transfer of mass is not permitted. (d) The Joule Thomson coefficient serves as an indicator of the temperature change with pressure in a constant enthalpy process.	**4**	**CO1**
Q3	The pressure in a natural gas pipeline is measured by the manometer shown in the figure below with one of the arms open to the atmosphere where the local atmospheric pressure is 14.2 psia. Determine the absolute pressure in the pipeline.	**4**	**CO3**

			
Q4	What is the importance of temperature measurement in chemical industry? Discuss various methods used for temperature measurement in light of their strength and limitations.	**4**	**CO2**
Q5	How does electromagnetic radiation impact the behavior and properties of molecules, and what specific changes or interactions can occur at the molecular level in response to exposure to electromagnetic radiation?	**4**	**CO2**
SECTION B (4Qx10M= 40 Marks)			
Q6	For the following reaction given by equation aA + bB $\rightarrow$ cC + dD i) Write the generic rate equation. ii) Units of rate equation. iii) State the Le Chatelier's principle. iv) What effect order of reaction has on overall rate of reaction?	**10**	**CO2**
Q7	Explain the working of a mass spectroscope with the help of a diagram.	**10**	**CO4**
Q8	Elaborate on the underlying principle governing the operation of a strain gauge. Clarify the connection between the resistance in a metal and the exerted force. Describe the instrument employed for gauging the alteration in resistance and explain its working.	**10**	**CO4**
Q9	Write Bernoulli's equation and derive the expression for velocity of fluid flowing out from the bottom of water tank filled to a height of *h* meters. Explain all the assumptions made in the derivation. **OR** A rigid tank contains a hot fluid that is cooled while being stirred by a paddle wheel. Initially, the internal energy of the fluid is 800 kJ. During the cooling process, the fluid loses 500 kJ of heat, and the paddle wheel does 100 kJ of work on the fluid. Determine the final internal energy of the fluid. Neglect the energy stored in the paddle wheel. Clearly explain all the assumptions made in solving the problem.	**10**	**CO3**
SECTION-C (2Qx20M=40 Marks)			

<table>
<tr>
<td>Q10</td>
<td>
i) Define polymers and elucidate the molecular structure of polymers using diagrams. Evaluate and comment on the relative strength of different polymer structures.
ii) What is the method for calculating the molecular weight of a polymer, and what factors contribute to this calculation?
iii) Calculate the molecular weight for a polymer based on the given data: Number of monomer units and mass of monomer units (in kilograms). The data is as follows:
<table>
<tr><td>Number of monomer units</td><td>Mass of monomer units(Kg)</td></tr>
<tr><td>1</td><td>60</td></tr>
<tr><td>3</td><td>40</td></tr>
<tr><td>4</td><td>70</td></tr>
<tr><td>2</td><td>50</td></tr>
<tr><td>1</td><td>80</td></tr>
</table>
OR
What factors dictate the type of bonding that may exist between various chemical species? Describe the characteristics of metallic crystals. Define Atomic packing factor (APF) and calculate the atomic packing factor for a body centered cubic structure.
</td>
<td>20</td>
<td>CO5</td>
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<td>Q11</td>
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Knowing kinetics of a chemical reaction is crucial for design of a chemical reactor.
i) What are the various methods used for the determination of rate equations?
ii) Using the initial rate and chemical data given in the table below. Determine a) rate equation and b) the rate constant.
$CH_3COCH_3(aq) + I_2(aq) \xrightarrow{H^+} CH_3COCH_2I(aq) + H^+(aq) + I^-(aq)$
<table>
<tr><td rowspan="2">Initial rate (mol dm^{-3} s^{-1})</td><td colspan="3">Initial concentration (mol dm^{-3})</td></tr>
<tr><td>$[I_2(aq)]$</td><td>$[CH_3COCH_3(aq)]$</td><td>$[H^+(aq)]$</td></tr>
<tr><td>3.5×10^{-5}</td><td>2.5×10^{-4}</td><td>2.0×10^{-1}</td><td>5.0×10^{-3}</td></tr>
<tr><td>3.5×10^{-5}</td><td>1.5×10^{-4}</td><td>2.0×10^{-1}</td><td>5.0×10^{-3}</td></tr>
<tr><td>1.4×10^{-4}</td><td>2.5×10^{-4}</td><td>4.0×10^{-1}</td><td>1.0×10^{-2}</td></tr>
<tr><td>7.0×10^{-5}</td><td>2.5×10^{-4}</td><td>4.0×10^{-1}</td><td>5.0×10^{-3}</td></tr>
</table>
</td>
<td>20</td>
<td>CO5</td>
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