Total No. of Questions—**8**] [Total No. of Printed Pages—**4**

Seat No.	

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S.E. (Chemical) (Second Semester) EXAMINATION, 2019

CHEMICAL ENGINEERING THERMODYNAMICS—I

(2015 PATTERN)

Time : Two Hours **Maximum Marks : 50**

N.B. **:—** (*i*) Solve Q. No. **1** *or* Q. No. **2**, Q. No. **3** *or* Q. No. **4**, Q. No. **5** *or* Q. No. **6**, Q. No. **7** *or* Q. No. **8**.

(*ii*) Neat diagram must be drawn wherever necessary.

(*iii*) Figures to the right indicate full marks.

(*iv*) Use of logarithmic tables, slide rule, Mollier charts, electronic pocket calculator and steam table is allowed.

(*v*) Assume suitable data, if necessary.

1. (*a*) Two kilograms of CO_2 gas is contained in a piston cylinder assembly at a pressure of 6.5 bar and a temperature of 300 K. The piston has a mass of 5000 Kg and a surface area of 1 m^2. The atmospheric pressure is 1.01325 bar. The latch holding the piston is suddenly removed and the gas is allowed to expand. The expansion is arrested when the volume is double the original volume. Determine the work appearing in the surroundings. [8]

(*b*) Distinguish between Extensive properties, Intensive properties. [4]

P.T.O.

Or

2. (*a*) A mass of 500g of gaseous ammonia is contained in a 30000 cm^3 vessel immersed in a constant-temperature bath at 65ºC. Calculate pressure of gas by each of the following : (Tc = 405.7 K, Pc = 112.8 bar)

(*a*) The ideal gas equation

(*b*) Redlich Kwong equation. [8]

(*b*) Explain P-T diagram for a pure substance showing all region. [4]

3. (*a*) A 40 kg steel casting (Cp = 0.5 kJ/kg.K) at a temperature of 450ºC is quenched in 150 kg of oil (Cp = 2.5 kJ/kg K) at 25 ºC. If there are no heat losses, what is the change in entropy of :

(*i*) The casting

(*ii*) The oil

(*iii*) Both consider together. [8]

(*b*) Explain Standard heat of reaction and Standard heat of formation. [4]

Or

4. (*a*) Obtain an expression for determination of standard heat of reaction of temperature T if standard heat of reaction is given at temperature T_1. Use the following heat capacity equation $Cp = \alpha + \beta T + \gamma T^2$. [8]

(*b*) Prove that entropy is state function. [4]

5. (*a*) Prove the Maxwell's relation. [9]

(*b*) Write a note on Availability. [4]

Or

6. Prove that : [13]

(*a*) $dH=CpdT+[V-T(dV/dT)_p]dV$

(*b*) $dS=CpdT - (dV/dT)_p dP$

7. (*a*) Explain vapour compression cycle. [6]

(*b*) A house has a winter heating requirement of 30 kJ/s and summer cooling requirement of 60 kJ/s. Consider a heat pump installation to maintain the house temperature at 20ºC in winter and 25ºC in summer. This requires circulation of the refrigerant through interior exchanger coils at 30ºC in winter and 5ºC in summer. Underground coils provide heat source in winter and the heat sink in summer. For a year round ground temperature of 15ºC,

the heat tansfer characteristics of the coil necessitate refrigerant temperature of 10ºC in winter and 25ºC in summer. What are the minimum power requirements for winter heating and summer cooling ? [7]

Or

8. (*a*) Explain Claude process of liquefaction with neat diagram. [6]

(*b*) A heat pump is used to maintain the temperature inside a building at 295 K by pumping heat from the outside air at 275 K. The unit has an overall efficiency of 25%. The pump is driven electrically and the electric power is generated by the combustion of certain fuel gas. The heat of combustion of the fuel is 890.09 kJ/mol. It is estimated that only 33% of the heat of combustion of the fuel is converted into electricity. Determine the amount of fuel burned for delivering 1000 MJ of heat to the building. [7]

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