**VEER SURENDRA SAI UNIVERSITY OF TECHNOLOGY, BURLA**
**DEPARTMENT OF METALLURGICAL AND MATERIALS ENGINEERING**
**SESSION 2015 - 16 (Supplementary June ~ July 2016)**

**Total Pages—5** **B.Tech-3(M&M)**
**MTK**
**Set-$Q_2$**

*Full Marks* : 70

*Time* : 3 hours

Answering of Q. No. 1 is compulsory. Answer any five questions from the rest.

All parts of a question should be answered at one place

*The figures in the right-hand margin indicate marks*

1. Answer any *ten* questions : 2 × 10

(*a*) Differentiate between reversible and irreversible process.

(*b*) What is the relation between internal energy, heat and work ?

(*c*) Does the heat capacity at constant pressure vary with temperature ? Explain.

(*d*) Differentiate between Activation Energy and Internal Energy.

(*e*) What do you mean by degree of reduction of iron ore ?

(*f*) Differentiate between adiabatic and closed system.

( *Turn Over* )

(*g*) What do you mean by Chemical potential of a substance ?

(*h*) What is Hess's law of constant heat summation ?

(*i*) Outline importance of kinetics in process metallurgy.

(*j*) What is the basic principle of DTA ?

(*k*) What do you mean by regular solution ?

(*l*) What do you mean by fugacity ?

(*m*) Differentiate between homogeneous and heterogeneous system.

2. Write short notes on any *three* of the following : 10

(*a*) Johson-Mehl equation

(*b*) Transformation formula

(*c*) Partial molal quantities

(*d*) Ellingham-Richardson diagram.

(*e*) Solid Electrolyte.



( *Continued* )

3. (*a*) What do you mean by fugacity ? Derive quantitative definition of fugacity $f = P.e^{\frac{A}{RT}}$ from P-V isotherm. 2 + 4

(*b*) Calculate the standard emf of a Denial Cell which is working at 25 °C with standard free energy change of the cell reaction $\Delta G^\circ$ is –413.75 kJ/mol at STP. 4

4. (*a*) In an isothermal process enthalpy of an ideal gas is independent of pressure, justify from Maxwell's relation. 6

(*b*) Calculate the standard entropy of solid copper at 1063 °C from the following data : 4

$S^\circ_{300}, <Cu> = 8.0$ cal/deg/mole

$C_p, <Cu> = 5.41 + 1.50 \times 10^{-3}$ T cal/deg/mole

5. (*a*) Discuss the important characteristics of an ideal solution in terms of molal thermodynamic potential and entropy. 5

(*b*) Find the enthalpy change for the reaction $<CaO> + (CO_2) = <CaCO_3>$ at 600 °C from the following data : 5

The values of $\Delta H^{\circ}F$ at 298 K for <CaO>, ($CO_2$) and <$CaCO_3$> (in kJ/mole) are –634.3, –393.5 and –1206.7 respectively.

$C_p$ <$CaCO_3$> $= 104.516 + (21.924 \times 10^{-3} T) -$

$(25.945 \times 10^{5} T^{-2})$ J/gm.mol.K

$C_p$ ($CO_2$) $= 44.141 + (9.037 \times 10^{-3} T) -$

$(8.535 \times 10^{5} T^{-2})$ J/gm.mol.K

$C_p$ <CaO> $= 49.622 + (4.519 \times 10^{-3} T) -$

$(6.945 \times 10^{5} T^{-2})$ J/gm.mol.K

6. (*a*) Deduce equation for the combined statement of 1st and 2nd law of thermodynamics. 5

(*b*) State Henry law. Raoult's law appears to be a special case of Henry's law for pairs of closely related substance, justify. 5

7. Derive following thermodynamic relations (any *two*) : $2 \times 5$

(*a*) $S = C_p \ln V + C_v \ln P + \text{constant}$

(*b*) $C_p - C_v = R$

(*c*) $(\delta T/\delta P)_S = (\delta V/\delta S)_P$

8. (*a*) What is an ideal solution ? Derive necessary equation for free energy change in the formation of an ideal solution. 5

(*b*) What are the important steps involve in the iron ore reduction by carbon monoxide. Give comments on pore steps in the above reduction. 5

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