



Name : .....

Roll No. : .....

Invigilator's Signature : .....

**CS/M.Tech (CT)/SEM-1/M(CT)-103/2009-10**  
**2009**  
**ADVANCED THERMO DYNAMICS**

Time Allotted : 3 Hours

Full Marks : 70

*The figures in the margin indicate full marks.*

*Candidates are required to give their answers in their own words  
as far as practicable.*

Answer Question No. 1 which is compulsory  
and any *four* from the rest.

1. Answer the following : 5 × 1 = 5

A. Choose the correct alternatives for the following :

i) Gellation always results

- |                     |                      |
|---------------------|----------------------|
| a) $\Delta S = +ve$ | b) $\Delta S = -ve$  |
| c) $\Delta G = +ve$ | d) $\Delta G = -ve.$ |

ii) Chemical potenital is

- a) extensive property
- b) intensive property
- c) dependent only on enthalpy
- d) none of these.



iii) Chemical potential of a substance in different phases in a system of equilibrium will be

- a) equal                      b) not equal
- c) could not predict d) none of these.

iv) Addition of high surface tension component always goes in

- a) bulk                      b) surface
- c) interface              d) none of these.

v) Decomposition of limestone is characterized by

- a) partial pressure of  $\text{CO}_2$
- b) partial pressure of atmosphere
- c) purity of limestone
- d) none of these.

B. Write short notes on the following :

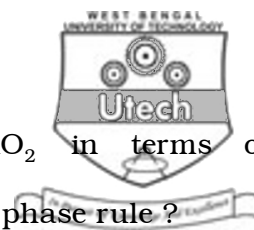
$2 \times 2 \frac{1}{2}$

vi) Grain growth

vii) Crystal imperfection.



2. What is surface excess and surface chemical potential ?  
Show that surface chemical potential of any constituent of a system is equal to its chemical potential in the bulk phase at equilibrium. 5 + 10
  
3. What is spinodal decomposition ? Discuss the thermodynamics of spinodal decomposition with relevant liquid immiscibility Gibbs free energy diagram. 3 + 12
  
4. a) What is the third law of thermodynamics ? Explain it.  
 b) What do you mean by thermodynamic probability ?  
 c) 20 litres Nitrogen at 100 atm and 200°C expands adiabatically against a constant external pressure at 1 atm till equilibrium is attained. Calculate  $\Delta S$  for the change.  $[C_p = 7.0 \text{ cal/mole} \cdot \text{K}]$ . 2 + 3 + 4 + 6
  
5. Deduce Gibbs adsorption isotherm. How does surface energy change with composition ? Discuss with specific example in ceramic system. 6 + 9
  
6. Discuss the thermodynamic background of Sol-Gel transition in ceramic system. Explain why Gel structure converts to glassy structure on heat treatment. 10 + 5



7. a) Draw the phase diagram of  $\text{SiO}_2$  in terms of temperature *vs* pressure. What is the phase rule?
- b) State and discuss the Clapeyron-Clausius equation.
- c) The densities of ' $\alpha$ ' and ' $\beta$ '-sulphur are 2.00 and 1.95 gms/cc respectively at their transition temperature,  $96^\circ\text{C}$ . The transition temperature changes by  $0.036^\circ$  for every atmosphere rise in pressure. Find out heat of transition. 4 + 2 + 4 + 5
8. a) State and discuss the lever rule.
- b) Discuss the pressure-temperature variation in binary system.
- c) Depict the binary system of  $\text{Al}_2\text{O}_3\text{-SiO}_2$ . 4 + 5 + 6
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