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Question Paper Code:R4C02

B.E./B.Tech. DEGREE EXAMINATION, APRIL / MAY 2025

Fourth Semester

Biotechnology

R21UBT402 APPLIED THERMODYNAMICS FOR BIOTECHNOLOGISTS

(Regulations R2021)

Duration: Three hours

Maximum: 100 Marks

Answer ALL Questions

PART A - (10 x 2 = 20 Marks)

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| 1. Define state function. | CO1- U |
| 2. Differentiate open and closed system. | CO3- App |
| 3. Give the expression for Total property and partial molar property. | CO1-U |
| 4. Identify the application of chemical potential in thermodynamics. | CO1-U |
| 5. State Gibb's phase rule. | CO2-U |
| 6. Define bubble point. | CO2-U |
| 7. Predict the effect of pressure on equilibrium conversion of a gas-phase chemical reaction. | CO3-App |
| 8. Is the Gibbs free energy change of a chemical reaction related to the work done by the system? Justify your answer. | CO3-App |
| 9. Calculate the degree of reduction of carbon in glucose. | CO3-App |
| 10. Hydrogen reacts with oxygen to form water. Sketch the elemental balances for the above reaction. | CO3-App |

PART – B (5 x 16= 80 Marks)

11. (a) Derive the relationship between enthalpy, internal energy. Also, derive an expression for the Mathematical statement of first law of thermodynamics for non-flow process. CO3-App (16)
- Or
- (b) Predict the Maxwell's relation from the fundamental property relations of enthalpy, Helm-Holtz free energy and Gibbs free energy. CO3-App (16)
12. (a) The partial molar properties of the components are related to one another. Justify the above statement with corresponding derivations. CO3-App (16)
- Or
- (b) Derive an expression for finding the chemical potential of a solution, explaining the effect of temperature and pressure on the same. CO3-App (16)
13. (a) A solution contains the mixture of toluene and benzene which doesn't behave like a normal binary mixture. Predict the special feature of this mixture and sketch the V-L equilibrium also explain in detail about the properties of this mixture. CO4-App (16)
- Or
- (b) Predict the phase diagrams for binary solutions considering constant pressure equilibria and constant temperature equilibria. CO4-App (16)
14. (a) Explain in detail about equilibrium constants and the methods for evaluation of the same. CO2-U (16)
- Or
- (b) Consider any chemical reaction that is in equilibrium, explain in detail about the factors that affect equilibrium conversion. CO2-U (16)
15. (a) Illustrate with an example to find the stoichiometric coefficient for calculation of the anabolic reaction for autotrophic growth. CO4-App (16)
- Or
- (b) Sketch the microbial growth curve, discuss in detail about the phases and the thermodynamics involved in growth of a microorganism. CO4-App (16)