D **520B3** **Total pages: 2**

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SAINTGITS COLLEGE OF ENGINEERING (AUTONOMOUS)

(AFFILIATED TO APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY, THIRUVANANTHAPURAM)

FOURTH SEMESTER B.TECH DEGREE EXAMINATION(R,S), MAY 2024

Food Technology

(2020 SCHEME)

Course Code : 20FTT 206

Course Name : Food Engineering Thermodynamics and Reaction Kinetics

Max. Marks : 100 **Duration:3 Hours**

Scientific calculator and statistical table is allowed in the examination hall.

PART A

(Answer all questions. Each question carries 3 marks)

1. Define the First Law of Thermodynamics and explain its limitations.
2. Describe a reversible process and give an example.
3. Explain the change in entropy equation when two substances are mixed adiabatically together at different temperatures.
4. Define entropy with an appropriate example.
5. Define Helmholtz free energy with its equation.
6. Describe the significance of specific heat capacity in food engineering.
7. Analyse the factors affecting rate of reaction.
8. Define transition state theory.
9. Explain the concept of ideality in chemical reactors.
10. Describe the methods used for monitoring and controlling pH levels in bioreactors during cell culture processes.

PART B

(Answer one full question from each module, each question carries 14 marks)

MODULE I

11. Prove that Q=W, for cyclic process and dU=dQ-dW, for non flow process of first law of thermodynamics. 14

OR

12. 1 kmol carbon dioxide occupies volume of 0.65 m^3 at 303K. Calculate the pressure given by a) ideal gas equation b) Van der Waals equation. Take the Van der Waal's constants as a = 0.415 Nm^4/mol^2; b = 4.6 x 10^{-5} m^3/mol. 14

MODULE II

13. Hydrocarbon oil is to be cooled from 425 K to 340 K at a rate of 5000 kg/h in a parallel flow heat exchanger. Cooling water at a rate of 10,000 kg/h at 295 K is available. The mean specific heats of the oil and water are respectively 2.5 kJ/kg K and 4.2 kJ/kg K. Determine the total change in entropy. Is the process reversible? 14

OR

14. Explain the Carnot cycle and discuss about the pressure-volume (P-V) diagram and also the efficiency of the reversed Carnot cycle. 14

MODULE III

15. Evaluate the equation that expresses Joule thomson coefficients and Gibbs-Helmholtz equation in terms of measurable properties. 14

OR

16. Prove that fugacity is a measure of pressure of real gases. 14

MODULE IV

17. Explain the significance of each term in the Arrhenius equation and how they contribute to the overall temperature dependence of reaction rates. 14

OR

18. Derive integral method of analysis of rate data. 14

MODULE V

19. Analyze the working principles of continuous stirred tank reactors (CSTRs) and laminar flow reactors regarding their operational efficiency and scalability in industrial applications. 14

OR

20. Derive the Michaelis Menten equation and plot the graph to identify V_{max} and K_m. 14

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