

JAYPEE UNIVERSITY OF INFORMATION TECHNOLOGY, WAKNAGHAT

TEST -3 EXAMINATION- 2025

B.Tech -- III<sup>rd</sup> Semester (BT)

COURSE CODE (CREDITS):25B11BT311(4)

MAX. MARKS: 35

COURSE NAME: Thermodynamics and Chemical Processes

COURSE INSTRUCTORS: Dr. Poonam Sharma

MAX. TIME: 2 Hours

*Note: (a) All questions are compulsory.*

*(b) The candidate is allowed to make Suitable numeric assumptions wherever required for solving problems. Calculators are allowed.*

| Q.No  | Question   | CO   | Marks |
|-------|--|------|-------|
| Q1(a) | Explain how first law of thermodynamics leads to the concept of internal energy.   | CO-1 | 2     |
| (b)   | Efficiency of heat engine cannot be more than 100%, but coefficient of performance for refrigerator can be much higher than 100%. Explain  | CO-2 | 2     |
| Q2(a) | How maximum possible yield of biomass differs from maximum possible yield of product?  | CO-4 | 2     |
| (b)   | To ensure turbulent conditions and minimum mixing time during agitation with a turbine impeller, the Reynolds number must be at least $10^4$ . A stirred laboratory-scale fermenter with a turbine impeller 5 cm in diameter is operated at 800 rpm. If the density of broth being stirred is close to that of water, what is the viscosity of the suspension?   | CO-5 | 4     |
| Q3(a) | (a) A furnace wall is constructed of firebrick 15-cm thick. The temperature inside the wall is $700^\circ\text{C}$ the temperature outside is $80^\circ\text{C}$ . If the thermal conductivity of the brick under these conditions is $0.3 \text{ W m}^{-1} \text{ K}^{-1}$ , what is the rate of heat loss through $1.5 \text{ m}^2$ of wall surface?<br>(b) The $1.5 \text{ m}^2$ area in part (a) is insulated with 4-cm thick asbestos with thermal conductivity $0.1 \text{ W m}^{-1} \text{ K}^{-1}$ . What is the rate of heat loss?  | CO-6 | 4     |
| (b)   | Coupling of reactions is important concept of biology. Justify.  | CO-2 | 3     |
| Q4(a) | Explain the viscosity gradient with the help of Couette flow.  | CO-5 | 3     |
| (b)   | The chemical reaction equation for conversion of ethanol is:<br>$\text{C}_2\text{H}_6\text{O} + \text{O}_2 \rightarrow \text{C}_2\text{H}_4\text{O}_2 + \text{H}_2\text{O}$<br>Acetic acid is produced from ethanol during growth of <i>Acetobacter aceti</i> , which has the composition $\text{CH}_{1.8}\text{O}_{0.5}\text{N}_{0.2}$ . Biomass yield from substrate is $0.14 \text{ g g}^{-1}$ ; product yield from substrate is $0.92 \text{ g g}^{-1}$ . Ammonia is used as nitrogen source. How does growth in this culture affect oxygen demand and ammonia requirement for acetic acid production? | CO-4 | 5     |
| Q5(a) | Elaborate the classification of fluids according to their rheological behaviour  | CO-5 | 5     |
| ((b)  | Describe the Double tube and shell heat exchanger with the help of diagram   | CO-6 | 5     |