Name: **Enrolment No:**	

UPES

End Semester Examination, May 2025

Course: Engineering Thermodynamics

Semester : 2nd

Program: B.Tech Biomedical Engineering/Biotechnology/Food Technology

Duration : 3 Hours

Course Code: MECH1013 **Max. Marks: 100**

Instructions: Attempt all the questions

S. No.	Section A Short answer questions/ MCQ/T&F (20Qx1.5M= 30 Marks)	Marks	COs
Q1	The purpose of catalysts is to reduce the activation energy of for product formation. Is this statement true or false?	**1.5**	**CO4**
Q2	Define homogeneous catalysis.	**1.5**	**CO4**
Q3	The fugacity is equal to the pressure in case of ideal gases. Is this statement true or false?	**1.5**	**CO2**
Q4	Which of the following is true for molecularity and order of a reaction? a. molecularity and order of a reaction can be fractional values b. molecularity and order of a reaction are both related to collisions among molecules c. molecularity and order of a reaction can both be zero d. molecularity and order of a reaction can both have a value of one	**1.5**	**CO3**
Q5	Molecularity of a complex reaction is always governed by the slow reaction. Is this statement true or false?	**1.5**	**CO3**
Q6	Define a thermodynamic system and surrounding.	**1.5**	**CO1**

Q7	All spontaneous thermodynamic processes are characterized by negative Gibb's free energy. Is this statement true or false?	**1.5**	**CO1**
Q8	Increasing the reactant surface area results in an increase in the rate of reaction. Is this statement true or false?	**1.5**	**CO3**
Q9	Collision theory of chemical reaction is based on classical hard sphere model. Is this statement true or false?	**1.5**	**CO3**
Q10	Catalysts increase the rate of reaction without taking part in the reaction. Is this statement true or false?	**1.5**	**CO4**
Q11	Refrigeration process works on the principle of heat engine. Is this statement true or false?	**1.5**	**CO1**
Q12	Proteins are not responsible for providing structural integrity to cell membrane. Is this statement true or false?	**1.5**	**CO2**
Q13	Give the mathematical relationship highlighting Fick's second law of diffusion.	**1.5**	**CO2**
Q14	The sodium-glucose transporter is an antiport. Is this statement true or false?	**1.5**	**CO2**
Q15	Secondary active transport require energy from electrochemical gradient. Is this statement true or false?	**1.5**	**CO2**
Q16	A successful chemical reaction is determined by the orientation of reactants. Is this statement true or false?	**1.5**	**CO3**
Q17	Biochemical reactions can be accurately described by the classical theory. Is this statement true or false?	**1.5**	**CO3**
Q18	On which principle is the 1st law of thermodynamics based?	**1.5**	**CO1**
Q19	Passive transport occurs against the concentration gradient. Is this statement true or false?	**1.5**	**CO2**
Q20	Isochoric processes are characterized by a constant pressure. Is this statement true or false?	**1.5**	**CO1**
Section B (4Qx5M=20 Marks)			
Q 1	Explain the various gas laws and derive an expression of the ideal gas behavior.	**5**	**CO1**
Q2	Discuss why transition state theory is more efficient than collision theory for explaining reaction kinetics.	**5**	**CO3**

Q3	Describe homogeneous and heterogeneous catalysis with suitable examples.	**5**	**CO4**
Q4	(a) What is the change in internal energy of 5 moles of monoatomic $Ar_{(g)}$ if its temperature is increased by 40°C? (b) If the gas is heated to 200 J, how much work is being done on the system? If temperature now increases to 70°C, what is the entropy of the system?	**2.5+2.5=5**	**CO1**
Section C **(2Qx15M=30 Marks)**			
Q 1	Discuss how the human body obeys all the laws of thermodynamics.	**15**	**CO1**
Q2	(a) Define fugacity. Estimate the fugacity coefficient if N_2 gas exhibits fugacity of 97.03 atm at temperature and pressure of 0°C and 100 atm respectively. (b) Estimate the Gibb's free energy change involved during the active transport of Na^+ ions across the cell membrane, provided the outside and inside concentrations are 150 mM and 10 mM respectively. Assume the membrane potential to be 60 mV.	**5+10=15**	**CO2**
Section D **(2Qx10M=20 Marks)**			
Q 1	Discuss the various types of passive transport involved in biological membranes. Describe the governing mechanism of passive transport.	**10**	**CO2**
Q2	For the reaction $2NO(g) + O_2(g) \longrightarrow 2NO_2(g)$, calculate the following: 1. Express the rate of reaction in terms of the reactants and product using both mass action law and differential forms. 2. At a particular instant if [NO] is decreasing at 0.5 mol/L/s, what is the rate of formation of NO_2 at that instant?	**5+5=10**	**CO3**