

B.E. METALLURGICAL ENGINEERING, SECOND YEAR, SECOND SEMESTER EXAM 2025

THERMODYNAMICS OF MATERIALS

TIME : THREE HOURS

FULL MARKS: 100

Answer QUESTION 1 and any FOUR from the rest

Assume any missing data

Q1 Answer the following questions

1x20=20

Q. NO	QUESTIONS	MARKS
1(A)	The essence of second law is directly related to heat exchanger design for calculating a) Flow rate of hot fluid b) Log-mean temperature difference c) Outlet temperature of cold fluid d) Passes in heat Exchanger	
1(B)	The second law predicts a) In an isolated system free energy remains constant b) In an isolated system the total entropy will always increase or remains constant. c) In an isolated system work done is always zero d) In an isolated system total entropy Should be equal to Gibbs free energy.	
1(C)	In a heat exchanger a) Gibbs free energy change is infinity b) entropy change is always positive c) Entropy change is always negative d) Work done is always positive	
1(D)	If free energy change Of formation of sulfur dioxide is -300 kJ/mol , the free energy change of the reaction $S + O_2 = SO_2$ a) 300 b) -300 c) -150 d) 150	
1(E)	A Carnot engine is characterized by its ability a) to Extract heat from low temperature reservoir b) To achieve maximum efficiency between two given heat reservoirs. c) To coordinate between four reversible and irreversible processes. d) To extract heat from adiabatic sink	
1(F)	A Reversible Process Is characterized by a) Infinitesimal change of entropy only b) Infinitesimal change of External conditions only c) Thermodynamic non-equilibrium with its surrounding d) Involving dissipative effects like heat loss	

[Turn over

1(G)	A chemical reaction is spontaneous at all temperatures when a) ΔS and ΔG are both positive b) ΔS is positive and ΔG is negative c) ΔS and ΔG are both negative d) ΔS is positive and ΔG is zero	
1(H)	When $\Delta G=0$ a) The reacting system is spontaneous b) The reacting system is in equilibrium c) The reacting system is reversible d) The reacting system is endothermic	
1(I)	For a reaction if $\Delta S=200\text{J/Kmol.K}$, and $\Delta H=500\text{kJ/kmol}$, then the reaction is Spontaneous when a) $T<25$ b) $T>25$ c) $T=25$ d) $T=0$	
1(J)	Which statement is true for heat engines a) All heat energy can be converted to work b) All heat energy cannot be converted to work c) Work can be converted to heat energy completely d) None of the above statement is correct	
1(K)	Which of the following is true for adiabatic process? a) There is no heat generation b) There is sudden heat transfer c) Work done is due to net heat content of the system d) Work done is due to the change in its internal energy of gas system	
1(L)	If a cylinder containing a gas at high pressure explodes the gas undergoes a) Rise in temperature b) No change in temperature c) Reversible adiabatic process d) Irreversible adiabatic process	
1(M)	Which of the following thermodynamic law/ Equation gives the concept of enthalpy a) zeroth law of thermodynamics b) 2 nd law of thermodynamics c) Maxwell equation in thermodynamics d) First law of thermodynamics	
1(N)	Which of the following Machines follows the Carnot theorem a) Sewing machine b) Gas turbine engine c) Gas compressor d) Heat engines	

1(O)	The enthalpy and internal energy are the function of temperature for a) All gasses b) Steam c) Water d) Ideal gasses	
1(P)	In which of the following systems mass transfer occurs across the system boundary a) Isolated system b) Closed system c) Reversible system d) Open system	
1(Q)	If temperature and pressure of a system decreases the available energy of the system a) Is oscillating b) Remains constant c) Increases d) Decreases	
1(R)	The Clausius-Clapeyron equation is used to predict a) Total entropy of the vapor liquid system b) Work done in a vapor liquid system c) Enthalpy of a vapor liquid system d) Vapor pressure at different temperatures of a vapour liquid system	
1(S)	The four main thermodynamic potentials are a) U, T, H, A b) U, H, S, A c) U, H, E, A d) U, H, A, G	
1(T)	Which of the following statement is incorrect about Ellingham diagram a) The diagram helps to Determine Spontaneity of a reduction reaction b) It helps to choose The most effective reducing agent c) It helps in selecting appropriate temperature and pressure for reduction of metal oxides d) It determines the proper stoichiometry for metal oxide Reduction	
Q2	(a) What is the importance of Maxwell relations (b) Using appropriate Maxwell relations and thermodynamic identities show that change of internal energy U may be expressed as $\Delta U = \int C_p dT + \int \left[T \left(\frac{\partial P}{\partial T} \right)_V - P \right] dV$ Modify the equation using equation of state for ideal gas.	5 15

