Name:

Enrolment No:

UNIVERSITY OF PETROLEUM AND ENERGY STUDIES

End Semester Examination, December 2022

Course: Thermodynamics and kinematics of materials **Semester : 3rd**
Program: B. Tech Advanced Materials and Nanotechnology **Time : 03 hrs.**
Course Code: MECH 2047 **Max. Marks : 100**

Instructions: Section-A Attempt all questions
Section-B Attempt all questions, in Q9 answer any one
Section-C Attempt all questions, in Q11 answer any one
Make suitable assumptions whenever necessary

SECTION A
(5Qx4M=20Marks)

S. No.		Marks	CO
Q 1	Explain briefly zeroth law of thermodynamics.	**4**	**CO1**
Q 2	Calculate the enthalpy of formation of ethane from the following data: (i) $C(s)+O_2(g)=CO_2$; $\Delta_f H^o=-393.5kJ$ (ii) $H_2(g)+1/2O_2(g)=H_2O(l)$; $\Delta_f H^o=-285.8kJ$ (iii) $C_2H_6(g)+7/2O_2(g)=2CO_2(g)+3H_2O(l)$; $\Delta_f H^o=-1560kJ$	**4**	**CO1**
Q 3	Write Gibbs Helmholtz equation giving meanings of the symbols used.	**4**	**CO1**
Q 4	Define electrode potential, oxidation potential and reduction potential. Why is it not possible to determine the absolute value of electrode potential?	**4**	**CO1**
Q 5	A reversible change has quasi-static characteristics, but a quasi-static process may not be reversible one. Justify.	**4**	**CO1**

SECTION B
(4Qx10M= 40 Marks)

S. No.		Marks	CO
Q 6	One kg of gaseous CO_2 contained in a closed system undergoes a reversible process at constant pressure. During this process 42kJ of internal energy is decreased. Determine the work done during the process. Take Cp=840 J/kg °C and Cv=600 J/kg °C.	**10**	**CO2**
Q 7	State Henry's law correlating the pressure of a gas and its solubility in a solvent and mention two applications for the law. What helps in existence of aquatic life?	**10**	**CO3**

Q 8	At what partial pressure, oxygen will have a solubility of 0.05g/L in water at 293K? Henry's constant (K_H) for O_2 in water at 293K is 34.86kbar. Assume the density of the solution to be same as that of the solvent.	**10**	**CO2**
Q 9	A refrigerator transfers heat from a low temperature medium (the refrigerated space) to a high temperature one (the room space). Is this a violation of the second law of thermodynamics? Explain. **OR** State and explain first law of thermodynamics. What are the limitations first law of thermodynamics	**10**	**CO1**
SECTION-C (2Qx20M=40 Marks)			
Q 10	What do you understand by the terms ideal gas and real gas? Comment on the statement that all gases behave ideally at low pressures and high temperature.	**20**	**CO3**
Q 11	A resistor of 30 ohms is maintained at a constant temperature of 27 ^oC while a current of 10 amperes is allowed to flow for 1sec. Determine the entropy change of the resistor and the universe. If the resistor initially at 27 ^oC is now insulated and the same current is passed for the same time, determine the entropy change of the resistor and the universe. The specfici heat of the resistor is 0.9Kj/Kg K and the mass of the resistor is 10g. **OR** A copper block of mass 1kg at 500K is immersed in lake at 300K till it reaches thermal equilibrium with water. Find the total (i) Total heat transferred to the lake, (ii) Change in entropy of the lake, (iii) Change in entropy of Copper (Cp of Copper=0.386 kJ/kgK, Cp of Water=4.187kJ/kg-K).	**20**	**CO4**