Name: **Enrolment No:**	

UPES

End Semester Examination, May 2023

Course : THERMAL PHYSICS **Semester : II**

Program : BSc PHYSICS (H) **Time : 03 hrs.**

Course Code: PHYS1029 **Max. Marks: 100**

Instructions:

- **All questions are compulsory (Q9 and Q11 have an internal choice).**
- **Use of scientific calculator is allowed.**

SECTION A
(5Qx4M=20Marks)

S. No.		Marks	CO
Q 1	A motor car tyre has a pressure of 3 atmospheres at a temperature of 38 ^{o}C. If the tyre suddenly bursts, find the resulting temperature (given γ = 1.4).	**4**	**CO1**
Q 2	Calculate the maximum possible efficiency of a heat engine working between 40 ^{o}C and 300 ^{o}C.	**4**	**CO1**
Q 3	(a) A heat engine can develop efficiency equal to 100% if the temperature of the sink is: 1. Less than that of the source. 2. Equal to that of the source. 3. 0 K. 4. 0 ^{o}C. (b) If a system A is in thermal equilibrium separately with B and C, then B and C are also in thermal equilibrium with each other. This is the statement of: 1. Zeroth law of thermodynamics. 2. First law of thermodynamics. 3. Second law of thermodynamics. 4. Third law of thermodynamics.	**2+2**	**CO1**
Q 4	(a) Which statement(s) is (are) true about the 2nd order phase transition: 1. Variable T & P. 2. No transference of heat.	**2+2**	**CO2**

	3. Change in S & V. (b) Which paramagnetic substance is used in the Adiabatic Demagnetization setup: 1. Gadolinium Sulphate. 2. Platinum. 3. Aluminum.		
Q 5	(a) For a throttling process what can be said about the enthalpy of the system: 1. No change. 2. Increases. 3. Decreases. (b) Which among the following is the expression of the Clausius inequality: 1. $\int \delta H/T \leq 0$. 2. $\int \delta H/T \geq 0$. 3. $\int \delta H/T \neq 0$.	**2+2**	**CO2**
	SECTION B **(4Qx10M= 40 Marks)**		
Q 6	Explain "Carnot's Theorem" taking example of two engines that are working between same source and same sink.	**10**	**CO1**
Q 7	(a) What is Magneto-caloric effect. (b) Explain the construction and working of the setup to achieve low temperatures making use of the concept of Adiabatic Demagnetization.	**10** **(3+7)**	**CO2**
Q 8	Explain "Production of Cooling in Adiabatic Expansion" using Maxwell's thermodynamical relations and show that: $$dT = -\frac{TP\beta}{mc_v}dV$$ where β is the coefficient of increase of pressure at constant volume and c_v is the specific heat per gram.	**10**	**CO3**

Q 9	Explain the construction and working of the Andrews experiment to study the behavior of real gases. **OR** On a PV diagram depict and explain the 5 isothermals from Andrews experiment at 13.1 ^oC, 21.5 ^oC, 31.1 ^oC, 35.5 ^oC and 48.1 ^oC. On the same plot depict the "border curve" and the "critical point".	**10**	**CO4**
SECTION-C **(2Qx20M=40 Marks)**			
Q 10	(a) Explain the porous-plug experiment for the production of low temperature. (b) Obtain an expression of the Joule Thomson coefficient and hence show that there is no fall in temperature with pressure for a perfect gas.	**20** **(10+10)**	**CO3**
Q 11	(a) Starting with Van der Waal's equation obtain the values of T_c, P_c & V_c and hence show that value of the critical coefficient of a gas is 8/3. (b) Calculate the Van der Waal's constants for a gas, given that T_c = 150 K, P_c = 40 Atm and R = 82.07 cm^3 Atm K^{-1} . **OR** (a) Obtain the reduced equation of state and explain the law of corresponding states. (b) Find the mean free path, frequency of collision and molecular diameter of a gas, given the viscosity of gas $\eta = 170 \times 10^{-7}$ N m^{-2} per unit velocity gradient, average velocity c = 5 x 10^2 ms^{-1}, density ρ = 1.25 kg m^{-3} and number of molecules per m^3 = 2.705 x 10^{25}.	**20** **(10+10)**	**CO4**