BIRLA INSTITUTE OF TECHNOLOGY, MESRA, RANCHI
(MID SEMESTER EXAMINATION)

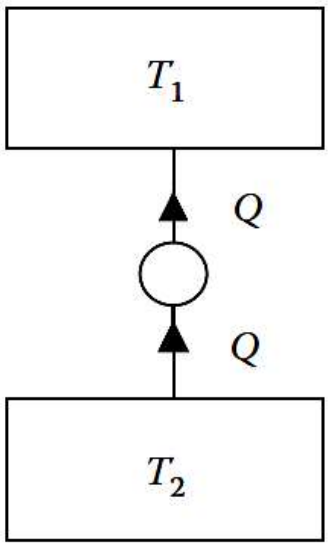
CLASS: IMSC — **SEMESTER:** III
BRANCH: PHYSICS — **SESSION:** MO/2022

SUBJECT: PH201 THERMAL PHYSICS

TIME: 2 HOURS — **FULL MARKS:** 25

INSTRUCTIONS:
1. The total marks of the questions are 25.
2. Candidates attempt for all 25 marks.
3. Before attempting the question paper, be sure that you have got the correct question paper.
4. The missing data, if any, may be assumed suitably.
5. Tables/Data hand book/Graph paper etc. to be supplied to the candidates in the examination hall.

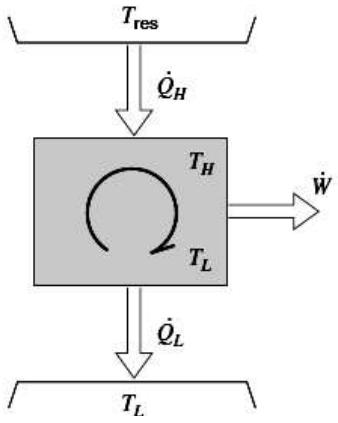
				CO	BL
Q1	(a)	Write the equation of internal energy for non-adiabatic work considering old sign convention.	[2]	CO_1	6
Q1	(b)	If the gas is compressed or expanded by motion of the piston, any change in internal energy results from the piston's motion is due to work W. Write the signs of W (work) and Q (heat) during compression and expansion of the gas by the motion of the system using old sign convention.	[3]	CO_2	6
Q2	(a)	One mole of ideal monatomic gas is confined in a cylinder by a piston and is maintained at a constant temperature T_0 by thermal contact with a heat reservoir. The gas slowly expands from V_1 to V_2 while being held at the same temperature T_0. Why does the internal energy of the gas not change?	[2]	CO_1	5
Q2	(b)	A monatomic ideal gas undergoes an adiabatic expansion from volume V_i to V_f. Obtain an expression for the ratio of the initial to the final temperature of the gas.	[3]	CO_2	5
Q3	(a)	Refer to the figure below and,	[2]	CO_1	5



prove utilizing the concept of principle of increasing entropy that the process violates the second law.

PTO

Q3 (b) A Carnot heat engine, shown in figure below, receives energy from a reservoir at Tres through a heat exchanger where the heat transferred is proportional to the temperature difference as $\dot{Q}_H = K(T_{res} - T_H)$ It rejects heat at a given low temperature T_L. To design the heat engine for maximum work output, show that the high temperature, T_H, in the cycle should be selected as $T_H = \sqrt{T_{res} T_L}$ [3] CO_2 5



Q4 (a) Explain pictorially the principle of thermodynamic square and write the differential of Helmholtz function. [2] CO_1 1

Q4 (b) The Helmholtz function of one mole of a certain gas is defined as [3] CO_2 6

$$f = f(V,T) = -\frac{a}{V} - RT\ln(V-b) + j(T)$$

Where a and b are constants j is a function of T only. Deduce the expression for the number of microstates

Q5 (a) Explain the three dimensional representation of PVT surfaces. [2] CO_1 2

Q5 (b) Why PT representation is favored over PV representation in the study of thermodynamics. [3] CO_2 2

:::::: 27/09/2022 M ::::::