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

CLASS: IMSC | **SEMESTER: III**
BRANCH: MATHS AND CHEMISTRY | **SESSION: MO/2022**

SUBJECT: PH111 PHYSICS-II

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.

Q1	(a)	Write the equations of internal energy for the adiabatic and non-adiabatic work for the thermodynamic processes.	[2]	CO_1	4
Q1	(b)	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?	[3]	CO_2	4
Q2	(a)	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.	[2]	CO_1	5
Q2	(b)	Referring to Q2 (a) state whether internal energy is changed or unchanged during the process of compression and expansion of the gas by the motion of the system.	[3]	CO_2	4
Q3	(a)	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.	[2]	CO_1	4
Q3	(b)	Write the expression for volume expansivity (β) and volume compressibility (κ). If they are related by an expression, $C_P - C_V - VT\beta^2/\kappa$ Show that the relationships that connect the specific heats at constant volume and constant pressure are consistent for n mole of an ideal gas. P, V, and T are thermodynamic variables.	[3]	CO_2	2
Q4	(a)	The quantum mechanics is concerned with the wave function Ψ which itself has no physical meaning. However, the square of its absolute magnitude $\lvert\Psi\rvert^2$ evaluated at a particular place and at a particular time is proportional to the probability of finding the body at that time (probability density/distribution function). What would be the expectation value for its momentum when the wave function Ψ is normalized and not normalized?	[2]	CO_1	5
Q4	(b)	If the speed distribution function $f(v)$ of a body between v and $v + dv$ is given by $f(v)dv \propto v^2 e^{-mv^2/2\kappa_B T} dv$ Calculate the expectation value of square of the speed.	[3]	CO_2	5
Q5	(a)	What do you mean by ultraviolet catastrophe and how this catastrophe problem was solved by the Planck's work?	[2]	CO_1	5
Q5	(b)	Under what approximations Planck's work reduces to Rayleigh-Jeans radiation density.	[3]	CO_2	5

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