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

CLASS: IMSC **SEMESTER : III**
BRANCH: CHEMISTRY & MATHS & COMP. **SESSION : MO/2022**

SUBJECT: PH111 PHYSICS-II

TIME: 3:00 Hours **FULL MARKS: 50**

INSTRUCTIONS:
1. The question paper contains 5 questions each of 10 marks and total 50 marks.
2. Attempt all questions.
3. The missing data, if any, may be assumed suitably.
***4*. Before attempting the question paper, be sure that you have got the correct question paper.**
5. Tables/Data hand book/Graph paper etc. to be supplied to the candidates in the examination hall.

		Marks	CO	BL
Q.1(a)	The Gibbs function of one mole of a certain gas is defined as $$f = f(V,T) = -\frac{a}{V} - RTln(V-b) + j(T) \quad (1)$$ where a and b are constants j is a function of T only. Besides, $$df = -PdV - SdT. \quad (2)$$ *P*, *V*, *S*, and *T* have their usual meanings. Utilizing Eq. (1) and Eq. (2), Obtain the expression for the number of microstates.	[2]	CO1	3
Q.1(b)	A Maxwell–Boltzmann distribution implies that a given molecule (mass *m*) will have a speed between v and $v + dv$ with probability equal to $f(v)dv$ where $$f(v) \propto v^2 e^{-mv^2/2k_BT},$$ and proportionality constant is used because normalization constant has been omitted. For this distribution, calculate the mean distribution $\langle v \rangle$ and the mean inverse speed $\langle 1/v \rangle$. Show that $$\langle v \rangle \langle 1/v \rangle = \frac{4}{\pi}$$	[3]	CO1	5
Q.2(a)	Compare the energy of a particle in a box considering the classical and quantum mechanical concepts.	[2]	CO2	3
Q.2(b)	Assume u and ϕ to be real quantities, calculate the probability current density *j*(*x*) for the wave function $$\Psi(x) = u(x)e^{i\phi(x)}$$	[3]	CO2	4
Q.3(a)	Differentiate between three- and four-level lasers with examples.	[2]	CO3	2
Q.3(b)	Stimulated emission does occur and its probability for a transition between two states is equal to the probability for absorption. Prove such probabilities utilizing Einstein's coefficients.	[3]	CO3	2
Q.4(a)	During calculation of the polarization of a dielectric from the polarizability of the atoms, we have to use the local electric field, which is different from the average internal electric field and from the external electric field. Explain all three fields.	[2]	CO4	4
Q.4(b)	Qualitatively describe the frequency dependence of the dielectric function for a material with both electronic and ionic polarization.	[3]	CO4	4
Q.5(a)	What is the difference between diamagnetism and paramagnetism? What are the basic physical causes for these phenomena? How do diamagnetic/ paramagnetic materials react when placed into an inhomogeneous magnetic field?	[2]	CO5	2
Q.5(b)	Explain the characteristics of Ferromagnetism, Anti-Ferro-Magnetism and Ferrimagnetism. Discuss about the Bloch wall in the Ferromagnetic domains	[3]	CO5	1

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