

BIRLA INSTITUTE OF TECHNOLOGY, MESRA, RANCHI
(END SEMESTER EXAMINATION MO/2022)

CLASS: IMSC
BRANCH: CHEMISTRY

SEMESTER : III
SESSION : MO/2022

SUBJECT: CH215 PHYSICAL CHEMISTRY III

TIME: 03 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. Tables/Data handbook/Graph paper etc., if applicable, will be supplied to the candidates

Q.1(a)	If the mass of an electron is 10^{-27} kg and the uncertainty in position is equal to 10^{-11} m then find the uncertainty in velocity.	[2]	CO1	Understand
Q.1(b)	What are normalized, orthogonal and orthonormal wave functions?	[3]	CO1	Remember
Q.1(c)	Derive the expression for the energy of the particle in a one-dimensional box. Justify the quantization of energy and existence of zero point energy.	[5]	CO1	Remember
Q.2(a)	What is the significance of Ψ and Ψ^2 ?	[2]	CO1	Understand
Q.2(b)	Verify that the wave function $\Psi(x) = x e^{-ax^2}$ is an eigenfunction of the operator $d^2/dx^2 - 4a^2x^2$. What is the corresponding eigenvalue?	[3]	CO2	Understand
Q.2(c)	What are radial probability distribution curve? Draw and discuss them for 2s and 3p orbitals.	[5]	CO1	Remember
Q.3(a)	What is the difference between bonding and anti-bonding molecular orbitals?	[2]	CO3	Remember
Q.3(b)	Set up the Schrodinger wave equation for a simple harmonic oscillator.	[3]	CO2	Remember
Q.3(c)	Write down the expressions and associated energies of bonding and anti-bonding molecular orbitals.	[5]	CO3	Remember
Q.4(a)	What is mutual exclusion principle in Raman spectroscopy?	[2]	CO4	Remember
Q.4(b)	Derive the energy expression for fundamental, 1st overtone and 2nd overtone vibration for an anharmonic oscillator.	[3]	CO4	Remember
Q.4(c)	Explain the origin of Stokes, anti-Stokes lines and Rayleigh scattering in Raman spectroscopy applying classical electrodynamics theory.	[5]	CO4	Remember
Q.5(a)	How the mass number of nuclide govern the NMR spectroscopy?	[2]	CO5	Remember
Q.5(b)	Why does ^1H NMR is much more sensitive than ^{13}C NMR spectrum?	[3]	CO5	Understand
Q.5(c)	What is TMS? Explain its role in NMR spectroscopy.	[5]	CO5	Remember

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