

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

CLASS: M.SC./IMSC.
BRANCH: PHYSICS

SEMESTER : II/VIII
SESSION : SP/2023

SUBJECT: PH409 ATOMIC AND MOLECULAR SPECTROSCOPY

TIME: 3 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.
-

		CO	BL
Q.1(a)	Describe the addition of angular momenta for many-electron atoms.	[5]	1 2
Q.1(b)	Explain the vector model of atom.	[5]	1 2
Q.2(a)	Why is the intensity of Stokes lines generally greater than the anti-Stokes lines? Derive the expression for the induced dipole moment in vibrational Raman spectroscopy using the classical theory.	[5]	2 2
Q.2(b)	Solve: For hydrogen molecule, the spacing between the S-branch lines in the Raman spectrum is 243 cm^{-1} . Calculate the bond length of hydrogen. Given the Planck constant, $h = 6.626 \times 10^{-34} \text{ J.s}$, and the speed of light, $c = 2.998 \times 10^8 \text{ m/s}$. Assume the mass of hydrogen to be $1.673 \times 10^{-27} \text{ kg}$.	[5]	2 3
Q.3(a)	Provide a table for the different spectroscopic techniques used for various regions of the electromagnetic spectrum.	[5]	3 1
Q.3(b)	Provide a sketch of the basic elements of a spectrometer, labelling the parts. Why is the sample usually kept close to the detector and not to the source?	[5]	3 2
Q.4(a)	Describe the $180^\circ - \tau - 90^\circ$ process for deducing spin-lattice relaxation rate.	[5]	4 2
Q.4(b)	Explain the working principle of chemical shift in NMR spectroscopy.	[5]	4 2
Q.5(a)	What is the electrospray ionization method?	[5]	5 2
Q.5(b)	Explain how the charge-to-mass ratio can be obtained from a Dempster's mass spectrometer.	[5]	5 2

.....26/04/2023.....E