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

CLASS: IMSc/MSC/PRE-PHD **SEMESTER: IX/III/I**
BRANCH: CHEMISTRY **SESSION: MO/2023**

SUBJECT: CH503 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)	Discuss with suitable example, the effect of isotopic substitution on rotational spectroscopy. Prove that the angular momentum of a molecule is quantized.	[5]	1	2
Q.1(b)	Elaborate the classical theory of Raman spectroscopy. Explain clearly the concept of polarizability ellipsoid.	[5]	1	2
Q.2(a)	Explain the mutual exclusion principle with respect to IR and Raman spectra of carbon dioxide molecule?	[5]	1	2
Q.2(b)	The equilibrium vibrational frequency of I_2 molecule is 215 cm^{-1} and anharmonicity constant is 0.003. At 300K, what would be the intensity of hot band (v=1 → v=2 transition) with respect to fundamental band (v=0 → v=1)?	[5]	1	3
Q.3(a)	What is Frank-Condon principle? With clear schematics, discuss its role in predicting intensity of spectral lines of vibrational-electronic spectra.	[5]	1	1
Q.3(b)	Discuss the limitations of Beer-Lambert's law. With suitable example, explain how selecting the right λ_{max} can make 'Absorbance' analyte specific?	[5]	1	2
Q.4(a)	Explain the differences among the UPS, XPS and AES techniques.	[5]	2	2
Q.4(b)	Explain the UPS spectrum of argon.	[5]	2	1
Q.5(a)	Explain the relaxation processes observed in NMR spectroscopy.	[5]	3	1
Q.5(b)	Compare and contrast the symmetry of IF_6^- anion and IF_6^+ cation by resonance with ^{129}I in Mossbauer spectroscopy.	[5]	3	2

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