17P409 (Pages: 2) Name……….…………….

Reg. No…………………..

FOURTH SEMESTER M.Sc. DEGREE EXAMINATION, APRIL 2019

(CUCSS - PG)

(Physics)

CC15P PHY4 C12 / CC17P PHY4 C12 –

ATOMIC AND MOLECULAR SPECTROSCOPY

(Regular/Improvement/Supplementary)

(2015 Admission onwards)

Time: Three Hours Maximum: 36 Weightage

SECTION A

Answer ***all*** questions. Each question carries 1 weightage.

1. Explain the concept of space quantisation.
2. The magnetic moment μ of an atom never points in the z direction. Explain.
3. Distinguish between Zeeman effect and Paschen Back effect
4. What is centrifugal distortion. Describe the effect of centrifugal distortion on the moment of inertia and energy of diatomic molecule.
5. Alternate lines of P and R branches of acetylene are less intense. Why?
6. Which is more intense in Raman lines - stokes lines or antistokes line? Why?
7. Very intense light sources are needed for the observation of non linear Raman effects. Why?
8. Define depolarization ratio. Why it is important in Raman spectroscopy?
9. Distinguish between dissociation energies De and Do.
10. What is predissociation? How can we account for it?
11. Discuss the principle behind Mossbauer Spectroscopy
12. Explain the factors responsible for hyperfine structure in ESR spectra.

(12 x 1 = 12 Weightage)

SECTION-B

Answer any ***two*** questions. Each question carries 6 weightage.

13. Outline the theory of Paschen Back effect and discuss the Paschen Back pattern for a ^2P-^2S transition
14. Discuss in detail the rotational fine structure of electronic vibrational transitions
15. Discuss rotational Raman spectrum of linear molecule and symmetric top molecules
16. Explain different relaxation processes for nuclei and briefly explain chemical shift in NMR spectra.

(2 x 6 = 12 Weightage)

SECTION C

Answer any ***four*** questions. Each question carries 3 weightage.

17. Find the Zeeman structure of a spectral line which results from the transition $^4F_{3/2}$ to $^4D_{5/2}$ transition.
18. For CO molecule the internuclear distance is r=1.28cm^{-1}. Calculate the reduced mass, moment of inertia, frequency at J=2 and J=4
19. Two consecutive lines of the rotational spectrum of a diatomic molecule are observed at 84.544cm^{-1} and 101.355cm^{-1}. Calculate the values of rotational constant B, distortion constant D and rotational quantum number J of these transitions.
20. Light of wavelength 1.5 micrometre incident on a material with a characteristic Raman Frequency of 20X10^{12} Hz results in a stokes line. What is the shift in wavelength of the stokes line?
21. The vibrational structure of the absorption spectrum of O_2 becomes continuum at 56876 cm^{-1}. If the upper electronic state dissociates into one ground state atom and one excited atom with excitation energy 15,875cm^{-1}, estimate the dissociation energy of O_2 in cm^{-1} and in kJ/mol.
22. Electron spin resonance is observed for atomic hydrogen with an instrument operating at 9.5 GHz. If the g value for the electron in hydrogen atom is 2.0026, what is the magnetic field applied? Bohr magneton μ_B = 9.274x 10^{-24} JT^{-1}.

(4 x 3 = 12 Weightage)

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