

TM144390B

Reg. No:.....

Name:.....

M. Sc. DEGREE (C.S.S.) EXAMINATION, MARCH 2017

(Supplementary – 2014 Admission)

SEMESTER IV - PHYSICS

PHY4AMP - ATOMIC AND MOLECULAR PHYSICS

Time: Three Hours

Maximum Weight: 30

PART A

I. Answer any six questions. Each question carries a weight of 1

1. State Hund's rules.
2. Describe Paschen-Back effect.
3. What are the term symbols for the following equivalent electrons (i) s^2 (ii) p^2 ?
4. Explain working principle of a microwave oven.
5. Describe hot bands in infrared spectra.
6. Write down the selection rules for Raman spectra of symmetric top molecules.
7. State and explain mutual exclusion principle.
8. Describe Fortrat Parabolae
9. Write down four applications of ESR spectroscopy.
10. Explain isomer shift in Mossbauer spectroscopy.

(6x1=6)

PART B

II. Answer any four questions. Each question carries weight of 2

11. Describe normal and anomalous Zeeman Effect.
12. The Fundamental and first overtone transition of $^{14}\text{N}^{16}\text{O}$ are centered at 1876.06 cm^{-1} and 3724.20 cm^{-1} . Evaluate the equilibrium vibration frequency, the anharmonicity constant, zero point energy and force constant of the molecule. Mass of $^{14}\text{N}=23.25\times 10^{-27}\text{ kg}$, Mass of $^{16}\text{O}=26.56\times 10^{-27}\text{ kg}$.
13. Explain the term polarizability. Why anti-Stokes lines are less intense than Stokes lines? (1 Weight each).
14. The vibrational structure of the absorption spectrum of O_2 becomes a continuum at $56,876\text{ cm}^{-1}$. If the upper electronic state dissociates into one ground state atom and one excited state atom with excitation energy $15,875\text{ cm}^{-1}$, estimate the dissociation energy of the ground state of O_2 in cm^{-1} and in kJmol^{-1} .
15. Why ESR spectrum is usually recorded in derivative mode? Draw hyperfine structure of Tritium (1 Weight each).
16. A particular NMR instrument operates at 30.256 MHz what magnetic fields are required to bring ^1H nuclei and ^{13}C nuclei to resonance at this frequency?

(4x2=8)

PART C

III. Answer all questions. Each question carries weight of 4

17. (a) With necessary theory explain Stark effect and draw Stark pattern of Hydrogen atom.

OR

Explain L-S coupling and j-j coupling schemes (Weight 3). A state is denoted as ${}^4D_{5/2}$ what are its values of L S and J. What is the minimum number of electrons, which give rise to this? (Weight 1)

18. Explain the rotational levels and spectra of a non-rigid rotator.

OR

With the help of a neat diagram describe the principle and working of an FTIR spectrometer.

19. Describe Raman spectra of CO_2 molecule.

OR

Explain Franck-Condon principle. How is the intensity distribution in the molecular spectra explained on the basis of this principle?

20. Derive Bloch equations and arrive at steady state solutions.

OR

Give the principle of ESR spectroscopy (Weight 1). Briefly describe magnetic hyperfine and quadrupole interactions in Mossbauer spectroscopy (Weight 3).

(4x4=16)