Roll No. .....

42026

M. Sc. Physics 4th Semester Examination – May, 2019

ATOMIC AND MOLECULAR PHYSICS-II

Paper : PHY(S)-406

Time : Three Hours] *[Maximum Marks : 80*

Before answering the questions, candidates should ensure that they have been supplied the correct and complete question paper. No complaint in this regard, will be entertained after examination.

Note : Attempt ***five*** questions in all, selecting ***one*** question from each unit. Question No. **1** is ***compulsory***. All questions carry equal marks.

UNIT – I

1. Write short notes on : 4 × 4 = 16

(i) Quadrupole splitting

(ii) Resonance condition in ESR

(iii) Ligand Hyperfine structure

(iv) Laser applications in holography

UNIT – II

2. Explain spin-spin relaxation mechanisms and discuss necessary conditions. How spin-spin relaxation time measurements are determined ? Differentiate between spin-spin relaxation time and spin-lattice relaxation time measurements. 16

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3. (a) Analyse nuclear magnetic resonance from the classical as well as quantum mechanical point of view. 6

(b) Explain the phenomenon of photon anti-bunching, a purely quantum-mechanical effect described by the intensity correlation function of the emitted light. 5

(c) Discuss computation of the spectrum of spontaneous emission of an atom irradiated by a continuous monochromatic field, which is given in steady state by the Fourier transform of the first-order correlation function of the field. 5

UNIT – III

4. Explain origin of EPR signal and deduce the sensitivity of an EPR signal by Maxwell-Boltzmann distribution. Describe the concept of field modulation. 16

5. List and describe spectral parameters of an ESR spectra. Underline basic principle of an ESR spectrometer and explain its operation. 16

UNIT – IV

6. Describe Einstein's theory of radiation and derive the Einstein coefficients. For an atom placed in an EM field, show that the probability of absorption is equal to that for the stimulated emission. 16

7. (a) Describe Amplification & Population Inversion a Laser. What is a laser resonator ?

   (b) The 629.9 nm line of neon has an Einstein coefficient of $1.7 \times 10^7 s^{-1}$. Find the temperature at which the Natural and Doppler line widths will be the same in a low pressure lamp.

UNIT – V

8 How laser pumping in a gas laser is achieved Describe the characteristics and functioning of nitrogen laser pumped dye Laser. Discuss any two applications of Dye lasers.

9. How are gas lasers different from solid state lasers ? Describe essential characteristics of a gas laser and present a detailed account of the principle and working of (i) Nitrogen laser (ii) CO_2 laser.