M.Sc. PH-07

Electromagnetic theory and Spectroscopy

Section – A (Very Short Answer Type Questions)

1. For a given surface S, what is the meaning of term $\oint \vec{E}.\vec{ds} = 0$.
2. Which theorem represents the statement of the conservation of Electromagnetic energy?
3. Power radiated by an electric dipole is proportional to fourth power of frequency. Is this statement correct?
4. How the spin magnetic moment $\left(\vec{\mu}_s\right)$ of electron is related to the spin angular momentum $\left(\vec{S}\right)$?
5. Write the Lande g factor for the level $^3D_3$.
6. What is the reason for hyperfine splitting of the spectral lines of an atom?
7. What is the Stark effect?
8. What is kinetic energy of an electron in atom?
9. Write the expression for the rotational energy of a diatomic molecule.
10. In which region the typical wavelengths emitted by diatomic molecules in purely vibrational and purely rotational transitions will fall?
11. Write the electric field intensity $\vec{E}$ due to an infinite uniformly charged plane sheet at a point distant r from the sheet.
12. The field of magnetic vector $\vec{B}$ is always solenoidal. Is this statement correct?
13. Write the formula for the power radiated by a non-relativistically accelerated charge particle.
14. What is the magnitude of the orbital magnetic dipole for a current i in a loop of area A.
15. Which of the interactions cause the non-conservation of orbital angular momentum of the electrons in an atom?
16. The normal Zeeman effect is a confirmation of space quantization. Is this statement correct?
17. Write the selection rule for the R-branch in rotational structure of electric bands.
18. Pure rotational spectrum of a diatonic molecule consists of many equally spaced lines. Yes or no?

19. Whether Q-branch in Raman spectra is present or absent?
20. Infrared spectrum (IR spectra) of diatonic molecules is known as Rotational spectrum or Rotational-vibrational spectrum.

Section B (Short Answer Type Questions)

1. If $\nabla^2 V = 0$, why does it not follow that V is identically zero?
2. What do you mean by magnetic vector potential?
3. Define power gain and radiation efficiency of an antenna.
4. What will be the number of permitted transitions from $^2P_{3/2}$ to $^2S_{1/2}$ due to a weak magnetic field? (Assuming that the L-S coupling scheme is valid.)
5. The linear Stark effect is possible in a hydrogen atom but not in a Sodium atom. Explain why?
6. What do you mean by Lande factor?
7. Define the rotational fine structure of electronic spectra.
8. What are stokes and anti-stokes lines?
9. What are the principles of IR spectroscopy?
10. What will be the characteristics of Raman effect in a crystal?
11. What are the fundamental postulates of magnetostatic fields in free space?
12. Write down the Maxwell's equations for electrodynamics.
13. What do you mean by Retarded potentials?
14. What will be the value of L, S and J quantum numbers corresponding to the ground state electronic configuration of Boron Z=5 ?
15. What do you mean by Paschen back effect?
16. Three values of rotational energies of molecules are given below in different units P : 12 cm^1, Q = 10^{-24} J and R = 10^5 MHz. Arrange them in the increasing order.
17. What is the vibrational isotope effect?
18. What are the chief characteristics of pure rotational Raman spectra?
19. State the Frank Condon principle.
20. Define the vibrational Raman spectra.

Section – C (Long Answer Type Questions)

1. Deduce an expression for energy density of an electrostatic field.
2. Obtain an expression for the average power radiated by an oscillating electric dipole and hence find an expression for the radiation resistance.
3. Describe the theory of Zeeman effect in detail.
4. Describe the experimental arrangements for studying Raman spectra in Liquids. Distinguish between Raman spectra and IR spectra.
5. Sate and prove Poynting theorem.
6. Using Lienard - wiechert potentials, obtain expression for field of an accelerated charge.
7. Give the theory of vibrational and rotational structure of electronic spectra.
8. Give the quantum theory of Raman effect. How rotational energy changes in molecules can be studied using Raman effect.