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MSCPHY-12 (M.Sc. PHYSICS)

Second Year Examination-2015

PHY-552

Electromagnetic Theory and Spectroscopy

Time : 3 Hours **Maximum Marks :** 60

Note : This paper is of sixty (60) marks divided into three (03) sections A, B, and C. Attempt the questions contained in these sections according to the detailed instructions given therein.

Section - A

(Long Answer Type Questions)

Note : Section 'A' contains four (04) long-answer-type questions of fifteen (15) marks each. Learners are required to answer any two (02) questions only. (2×15=30)

1. What is Lienard-Wiechert potentials. Using Lienard-Wiechert potential obtain expressions for fields of an accelerated changed particle.
2. Explain Zeeman effect for two electron system for the different states of $^3D_3$, $^1D_2$ and $^1P_1$.
3. Find the vibrational energy of a diatomic molecule when the potential energy is given by $U = \frac{1}{2}k(r - r_e)^2$ where k is constant.

4. Explain the formation of electronic spectra and intennity distribution of electronic spectrum.

Section - B

(Short Answer Type Questions)

Note : Section 'B' contains eight (08) short-answer-type questions of five (05) marks each. Learners are required to answer any four (04) questions only. (4×5=20)

1. Calculate the divergence of magnetic vector potential $\overline{A}$.
2. Obtain the magnetic field induction $\vec{B}$ inside long solenoid using Biot-Savart law.
3. Using Maxwell's relations

$$\text{curl } \vec{E} = -\frac{\partial \vec{B}}{\partial t} \text{ and } \vec{H} = \vec{J} + \frac{\partial \vec{D}}{\partial t}$$

show that

$$\text{div } \vec{B} = 0 \text{ and div } \vec{D} = \rho$$

4. Derive an expression for magnetic moment of an electron.
5. Illustrate with the help of diagrams the splilting of D_2 levels of sodium when
   (i) a weak magnetic field
   (ii) when a strong magnetic field is applied.
6. Obtain an expression for rotational energy levels of a diatomic molecule taking it as a regid rotator. Discuss its spectrum and relevant selection rules.
7. Discuss classical and quantum theory of Raman effect.
8. Explain pure rolational Raman spectra and discuss stokes and Anti stokes lines.

Section - C

(Objective Type Questions)

Note : Section 'C' contains ten (10) objective-type questions of one (01) mark each. All the questions of this section are compulsory. (10×1=10)

1. The differential form of Gauss's law in CGS system -

   (a) $\vec{\nabla}.\vec{E} = \frac{\rho}{\epsilon_0}$ (b) $\epsilon_0 \, \text{div}\vec{E} = \rho$

   (c) $\vec{\nabla}.\vec{E} = u\pi p$ (d) $\text{div}\vec{E} = 4\pi\sigma$

2. The electric field inside a spherical shell of uniform surface change density is -

   (a) Zero

   (b) Non zero constant

   (c) Directly proportional to distance from centre

   (d) Inversly proportional to distance from centre

3. Magnetic vector potential $\vec{A}$ is related to electrostatic potential V through the relation -

   (a) $\text{div}\vec{A} + \epsilon_0 \, \mu_0 \frac{\partial v}{\partial t} = 0$ (b) $\text{div}\vec{A} - \epsilon_0 \, \mu_0 \frac{\partial v}{\partial t} = 0$

   (c) $\text{curl}\vec{A} + \epsilon_0 \, \mu_0 \frac{\partial v}{\partial t} = 0$ (d) $\text{curl}\vec{A} - \epsilon_0 \, \mu_0 \frac{\partial A}{\partial t} = 0$

4. The Maxwell's equation which remains unchanged when a medium changes is -

   (a) $\vec{\nabla}.\vec{B} = 0$ (b) $\vec{\nabla}.\vec{B} = P/\epsilon_0$

   (c) $\vec{\nabla}.\vec{B} = \mu_0 J + \mu_0 \epsilon_0 \frac{\partial E}{\partial t}$ (d) None of these

5. The power radiated by an electric charge is proportional to the frequency by -

   (a) w (b) w^2

   (c) w^3 (d) w^4

6. In MKS unit Bohr magneton is given by -

   (a) $\frac{em}{4\lambda}$ (b) eh/uπm

7. Multiplicity of the state $^2D_{3/2}$ is given by -

   (a) 1 (b) 2

   (c) 3 (d) 4

8. The normal Zeeman effect is :

   (a) observed only in atoms with an even number of electron

   (b) observed only in atoms with an odd number of electrons

   (c) A confirmation of space quantization

   (d) Not a confirmation of space quantization

9. The Lande of factor for the level $^3D_3$ is :

   (a) 2/3 (b) 3/2

   (c) 3/4 (d) 4/3

10. In Rawan spactra Q branch is :

   (a) Absent

   (b) Present

   (c) Presence and appearance depends on the state of polarisation of the molecule

   (d) None of these