

**PHY-552**  
**Electromagnetic Theory and**  
**Spectroscopy**

M.Sc. PHYSICS (MSCPHY-12/13/16/17)

2<sup>nd</sup> Year, Examination-2019

**Time: 3 Hours**

**Max. Marks: 80**

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**Note:-** This paper is of Eighty (80) marks divided into two (02) Section A and B. Attempt the question contained in these sections according to the detailed instructions given therein.

**Section-A**

**(Long Answer Type Question)**

**Note:-** Section - A contains five (05) long answer-type questions of fifteen (15) marks each. Learners are required to answer any three (03) questions only. **(3×15=45)**

1. Discuss the law of conservation of energy for the electromagnetic field. How will you define momentum of Electromagnetic wave?
2. A spherical rubber balloon carries a  $Q$  that is uniformly distributed over its surface. How does  $E$  vary for points a) inside b) on the surface and c) outside the balloon, as the balloon is grown up?
3. Define Lien and Wiechert potentials. Derive the expression for electric and magnetic field.
4. Derive the expression for Lande's splitting  $g$ -factor and explain it with help the Zeeman effect of sodium doublet components  $D_1$  and  $D_2$ .
5. Discuss the main features of rotational bond spectrum of a diatomic molecule. The transition  $J = 3$  to  $J = 4$  in Hcl is associated with radiation of  $83.03 \text{ cm}^{-1}$ , using rigid - rotator approximation, calculate the moment of inertia and intermolecular distance of Hcl.

## Section-B

### (Short Answer Type Questions)

**Note:-** Section-B contains eight (08) short answer type questions of seven (07) marks each. Learners are required to answer any five (05) questions only. **(5×7=35)**

1. Draw a schematic diagram to represent the energy levels of a diatomic molecule regarded as an anharmonic oscillator and show the allowed transitions and expected spectrum.
2. Write down the Maxwell's equation in differential form with their explanation. Discuss the idea of displacement current.
3. Discuss the principal features of electronic spectrum of a diatomic molecule.
4. Determine the possible terms of a one electron atom corresponding  $n = 3$  and compute the angle between  $\vec{L}$  and  $\vec{S}$  vectors for a term  $^2D_{5/2}$ .

5. Calculate the potential due to a charge sphere.
6. Explain Amperes circuital law and determine the magnetic field inside solenoid using this law.
7. Discuss stark effect in weak field and strong field in hydrogen.
8. 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.