# V.P. & R.P.T.P. Science College

**Vallabh Vidyanagar-388120**

**B.Sc. (Semester - 4) Subject: Physics Course: US04CPHY01**

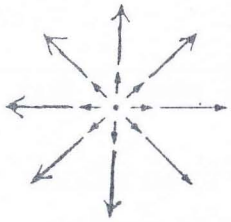
**Title of the paper: Electromagnetic Theory and Spectroscopy**

**INTERNAL TEST**

**Date: 06-03-2019, Wednesday** **Time: 3 pm to 5 pm**

**Total Marks: 50**

**Q-1 MCQs:** **[8 Marks]**

**1** 

**Vector point function in given Figure has _____divergence.**

(a) Positive
(b) Negative
(c) Zero
(d) None of these

**2 Joule / Coulomb is the unit of**

(a) Electric Force (b) Electric Flux (c) Electric potential (d) Potential energy

**3 A charged particle traveling with a velocity $\vec{v}$ in a magnetic field $\vec{B}$ experiences a force $\vec{F}$ that must be:**

(a) parallel to $\vec{v}$ (b) perpendicular to only $\vec{v}$ (c) perpendicular to $\vec{v}$ and $\vec{B}$ (d) perpendicular to $\vec{v} \times \vec{B}$

**4 Which of the following relationship is incorrect in magnetostatics?**

(a) $\vec{\nabla} \bullet \vec{B} = 0$ (b) $\vec{\nabla} \bullet \vec{j} = 0$ (c) $\vec{\nabla} \times \vec{B} = 0$ (d) $\vec{\nabla} \cdot \vec{A} = 0$

**5 If L = 3 and S = 1, there are _____ possible number of ways in which L and S can be combined.**

(a) 2 (b) 3 (c) 4 (d) 5

**6 In a continuous spectrum, intensity of a spectral maximum at wavelength [$\lambda_m$] when temperature of the sample is [T]. If temperature of the sample is double, $\lambda_m$ will be equal to**

(a) $\lambda_m$ (b) $\lambda_m/2$ (c) $2 \times \lambda_m$ (d) $\lambda_m^2$

**7 Minimum interplanar spacing required for Bragg's diffraction is:**

(a) $\lambda/4$ (b) $\lambda/2$ (c) $\lambda$ (d) $2\lambda$

**8 The wavelength of X-rays varies between _____ cm to _____cm.**

(a) $6\times10^{-12}$ to $35\times10^{-12}$
(b) $6\times10^{-13}$ to $35\times10^{-13}$
(c) $6\times10^{-14}$ to $35\times10^{-14}$
(d) $6\times10^{-15}$ to $35\times10^{-15}$

| Q-2 | Short Questions [Attempt any FIVE] | [5 ×2 Marks = 10 marks] |
|---|---|---|
| 1 | State and explain Coulomb's law. | |
| 2 | Explain: curl of $\vec{E}$. | |
| 3 | Derive cyclotron formula. | |
| 4 | Discuss the boundary conditions in magnetostatics. | |
| 5 | Write allowed combination of ( $n, l, j$ ) for L – shell. | |
| 6 | Compare normal and anomalous Zeeman effect. | |
| 7 | State and explain Duane-Hunt law. | |
| 8 | Compare optical spectrum and X-ray spectrum (Any four points). | |

**Long Questions:**

| | | |
|---|---|---|
| Q-3 (a) | Explain the concept of electric field lines and electric flux. Derive and discuss Gauss's law. | 5 |
| Q-3 (b) | Using Gauss's law prove that electric field ($\vec{E}$) due to an infinite thin plane which carries uniform surface charge $\sigma$ is $\frac{\sigma}{2\epsilon_0}\hat{n}$. | 3 |
| | **OR** | |
| Q-3 (a) | Write a note on electric potential. | 5 |
| Q-3 (b) | Find the electric potential inside and outside a spherical shell of radius R, which carries a uniform surface charge ($\sigma$). Set the reference point at infinity. | 3 |

| | | |
|---|---|---|
| Q-4 (a) | State and explain (i) Biot-Savart law and (ii) Ampere's law. | 5 |
| Q-4 (b) | Using Ampere's law, find the magnetic field a distance s from a long straight wire carrying a steady current I. | 3 |
| | **OR** | |
| Q-4 | Explain: (a) $\vec{\nabla} \cdot \vec{B}$ and (b) $\vec{\nabla} \times \vec{B}$. | 8 |

| | | |
|---|---|---|
| Q-5 | Write a note on Vector Atom Model. | 8 |
| | **OR** | |
| Q-5 | Write a note on Zeeman effect. | 8 |

| | | |
|---|---|---|
| Q-6 | Discuss different techniques to produce X-rays and enlist merits and demerits of these methods. | 8 |
| | **OR** | |
| Q-6 | State and derive Moseley's law. Discuss the applications of Moseley's law. | 8 |

==========