SARDAR PATEL UNIVERSITY

B.Sc. (Fourth Semester) Examination April-2022

Code No.: **US04CPHY21**   Paper Title: **Electromagnetic Theory and Spectroscopy**

Date : 12-04-2022, Tuesday
Time: 03:00 pm to 05:00 pm   Total Marks: 70

Q-1   Answer the following multiple choice questions: (All questions are compulsory)   [10]

1. Forces for which their line integral is independent of the path of integration, such forces are called _____ forces.
    (a) gravitational   (b) conservative   (c) electromagnetic   (d) non-conservative

2. For electrostatics $\vec{\nabla} \times \vec{E} =$_____.
    (a) 0   (b) 1   (c) 2   (d) ∞

3. Electric field is the negative gradient of _____.
    (a) force   (b) charge   (c) flux   (d) electric potential

4. Magnetic dipole term is always _____.
    (a) 1   (b) 0   (c) ½   (d) 1/3

5. The resultant force on a current-loop placed in a uniform magnetic field is _____.
    (a) 1N   (b) 3N   (c) 2N   (d) 0N

6. Air starts absorbing light at _____ Å wavelength.
    (a) 3600   (b) 1900   (c) 1250   (d) 1800

7. 1 eV = ... cm^{-1}.
    (a) 6608   (b) 8660   (c) 8066   (d) 6806

8. _____ coupling is prominent in atoms of light elements.
    (a) L-S   (b) j-j   (c) L-j   (d) S-j

9. The kinetic energy is converted into _____ energy in X-ray production.
    (a) heat   (b) electric   (c) radiation   (d) chemical

10. X-ray spectra are attributed to the transition of _____ electrons of an atom.
    (a) outermost   (b) surface   (c) innermost   (d) none of these

Q-2   Answer the blanks/ true or false given below: (All questions are compulsory)   [08]

1. SI unit of electric flux is _____ .

2. "$\nabla^2 V = 0$ is called Poisson's equation " – True or False ?

3. _____ law is used to decide magnetic field intensity. (*Ampere, Biot-Savart*)

4. " Substance that gets magnetized in the opposite direction of the applied magnetic field is called diamagnetic " – True or False ?

5. Effect of electric field on atomic spectra is called _____ effect.

6. In 1925 Uhlenbach and Goudsmit put forward the famous hypothesis of _____ .

7. In the M-group of X-rays there are _____ series.

8. "Moseley's Law gives relationship between frequency and atomic mass" – True or False ?

① (P.T.O)

Q-3 **Answer the following questions in short. (Any ten)** **[20]**

1) Derive Poisson and Laplace equations.

2) Find the volume of a sphere with radius R using Spherical Polar Coordinate system.

3) Obtain the equation of work done to move a charge Q from point a to point b.

4) Steady current I flows through a linear wire of infinite length. Find the magnetic field intensity at a distance s from the wire.

5) Obtain Ampere's law with magnetic vector potential **A**.

6) Explain the generation of magnetic dipole and briefly clarify what is ferromagnetic substance?

7) Explain in short j-j coupling.

8) Give any four characteristics of Line Spectrum.

9) Give brief explanation of orbital magnetic quantum number m_l. If for a given atom orbital quantum number $l = 2$, find the possible values of m_l.

10) State any four characteristics of X-ray.

11) Give four points of comparison of X-ray and light spectra.

12) Give four usefulness of Moseley's law.
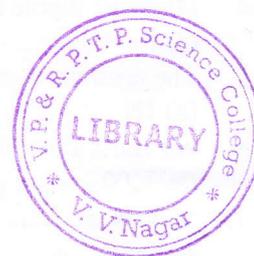
Q-4 **Answer the following long questions in detail: (Any four)**

(1) Give explanation of electric flux. Based on it obtain Gauss law in differential as well as integral form with necessary equations. **[08]**

(2) Prove that the energy associated with discrete point charge distribution is given by the equation: $W = \frac{1}{2}\sum_{i=1}^{n} q_i V(\mathbf{r}_i)$. With its help obtain the energy equation for continuous charge distribution. **[08]**

(3) Discuss the divergence and curl of magnetic field **B** using Biot-Savart law and and derive Ampere's Law. **[08]**

(4) (i) Prove that work done by magnetic field is zero. **[04]**

(ii) Discuss the points of comparison of electrostatics and magnetostatics. **[04]**

(5) Discuss in detail different types and sub-types of spectra. **[08]**

(6) Explain with equations and diagram, the classical interpretation of normal Zeeman effect. **[08]**

(7) Discuss various aspects of continuous spectra for X-rays and derive Daune Hunt law. **[08]**

(8) Discuss different methods to produce X-rays with their limitations. **[08]**