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DCV-003-1013002

Seat No. _____

B. Sc. (Sem. III (CBCS) Examination

August - 2022

Physics - 301

Faculty Code : 003

Subject Code : 1013002

Time : $2\frac{1}{2}$ Hours] [Total Marks : **70**

Instructions : (1) Answer any five out of ten questions.
(2) Symbols have their usual meanings.
(3) Figures to the right indicate marks.

1 (a) Answer the following objective questions : **4**

(1) Gauss's theorem converts surface integral into _____.

(2) Define vector triple product.

(3) Scalar triple product gives volume. True or False?

(4) If $\vec{r} = x\hat{i} + y\hat{j} + z\hat{k}$, then $\nabla \cdot \vec{r}$ = _____.

(b) Answer in brief : **2**

Find the curl of $\vec{A} = 3x^2\hat{i} + 3yz\hat{j} + 2z^2\hat{k}$.

(c) Answer in brief : **3**

Explain curl of a vector and its physical significance.

(d) Answer in detail : **5**

State and prove the fundamental theorem of curl.

2 (a) Answer the following objective questions : **4**

(1) Curl of a gradient is always _____.

(2) $\vec{A}\cdot\left(\vec{B}\times\vec{C}\right) = -\vec{B}\cdot\left(\vec{C}\times\vec{A}\right)$. True or False?

(3) $\vec{A}\times\left(\vec{B}\times\vec{C}\right) = -\left(\vec{B}\times\vec{C}\right)\times\vec{A}$. True or False?

(4) Divergence of a curl is always _____.

(b) Answer in brief : **2**

Find the gradient of $f = 3x^2 - y^2 + 5z^4$.

(c) Answer in brief : **3**

Explain divergence of a vector and its physical significance.

(d) Answer in detail : **5**

State and prove the fundamental theorem of divergence.

3 (a) Answer the following objective questions : **4**

(1) State Coulomb's law.

(2) Define electrostatics.

(3) $\nabla\cdot\vec{E}$ = _____.

(4) Give the relation between electric field and potential.

(b) Answer in brief : **2**

The potential due to an isolated point charge at a point 20 cm from the charge is 400 volt. Calculate the magnitude of the charge.

(c) Answer in brief : **3**

Discuss the properties of field lines.

(d) Answer in detail : **5**

Explain curl of an electric field.

4 (a) Answer the following objective questions : 4

(1) State Gauss law.

(2) Define equipotential surface.

(3) $\nabla \times \vec{E}$ = _____.

(4) Write Laplace's equation.

(b) Answer in brief : 2

A uniformly charged sphere has a total charge of $300\,\mu C$ and a radius of 8 cm. Find the electric intensity at a point 16 cm away from the center of the sphere.

(c) Answer in brief : 3

Explain work done to move a charge.

(d) Answer in brief : 5

Explain electric potential.

5 (a) Answer the following objective questions : 4

(1) Write the equation of continuity.

(2) Magnetic Lorentz force $\vec{F} = q\left(\vec{v} \times \vec{B}\right)$. True or False?

(3) State Ampere's circuital law.

(4) Magnetic field lines form closed loops. True or False?

(b) Answer in brief : 2

Find the magnetic field at the centre of a circular coil of radius 5 cm while carrying a current of 10A.

(c) Answer in brief : 3

Explain magnetic vector potential and derive an expression for it.

(d) Answer in detail : 5

Explain cycloid motion.

6 (a) Answer the following objective questions : 4

(1) $\nabla \cdot \vec{B}$ = _____.

(2) $\vec{B} = \nabla \times \vec{A}$, where $\vec{A}$ is known as _____.

(3) The magnetic field produced by a current carrying conductor is given by Biot and Savart law. True or False?

(4) The magnetic field at the centre of a circular current carrying coil is $B = \frac{\mu_0 I}{2\pi r}$. True or False?

(b) Answer in brief : 2

Find the magnetic field at a distance of 5 cm from an infinitely long straight conductor carrying a current of 2A.

(c) Answer in brief : 3

Derive the expression for the magnetic field at the centre of a current carrying square loop of side a.

(d) Answer in detail : 5

Obtain an expression for the magnetic field due to a long straight current carrying conductor.

7 (a) Answer the following objective questions : 4

(1) Define polarization.

(2) Define dielectric material.

(3) For vaccum, the relative permittivity ε_r = _____.

(4) Define linear dielectrics.

(b) Answer in brief : **2**

When neutral dielecrtric is polarized, charge moves a bit, but the total remains zero. This fact should be reflected in the bound charges σ_b and ρ_b. Using the equations derived for σ_b and ρ_b prove that the total bound charge vanishes.

(c) Answer in brief : **3**

Explain electric displacement.

(d) Answer in detail : **5**

Explain torque and force experienced by the dipole in an electric field.

8 (a) Answer the following objective questions : **4**

(1) Define magnetization.

(2) Define macroscopic magnetic field.

(3) What is diamagnetic material?

(4) What is paramagnetic material?

(b) Answer in brief : **2**

Suppose the field inside a large piece of magnetic material is $\vec{B}_0$, so that $\vec{H}_0 = \frac{1}{\mu_0}\vec{B}_0 - \vec{M}_0$. Do the same for a thin wafer-shaped cavity perpendicular to $\vec{M}$.

(c) Answer in brief : **3**

Explain bound current in detail.

(d) Answer in detail : **5**

Explain deceptive parallel and boundary condition in magnetic field inside the matter.

9 (a) Answer the following objective questions : **4**

(1) Define faithful amplification.

(2) Define operating point of transistor.

(3) Write the minimum values of V_{BE} for silicon and germanium transistors which are required for faithful amplification.

(4) Write the general formula for stability factor.

(b) Answer in brief : **2**

A silicon transistor with $\beta = 60$ is biased by base resistor method. Determine the operating point. What is the stability factor?

Given : $V_{CC} = 9V, R_B = 530\,k\Omega, R_C = 2\,k\Omega$.

(c) Answer in brief : **3**

Explain how would you identify the leads of a transistor and describe the method of testing a transistor.

(d) Answer in detail : **5**

Explain voltage divider biasing method with neat circuit diagram.

10 (a) Answer the following objective questions : **4**

(1) What is phase reversal?

(2) Give classification of transistor amplifiers based on coupling methods.

(3) Define frequency response of an amplifier.

(4) What is the function of emitter bypass capacitor in single stage amplifier circuit?

(b) Answer in brief : **2**

For a transistor amplifier having $R_{in} = 1\,k\Omega, R_C = 2\,k\Omega$, $R_L = 1\,k\Omega$ and $\beta = 80$, find the voltage gain.

(c) Answer in brief : **3**

Explain voltage gain for a transistor amplifier and derive its formula.

(d) Answer in detail : **5**

Explain the single stage transistor amplifier circuit and explain the functions of all its components.
