BUDDHA SERIES

(Unit Wise Solved Question & Answers)

Course – B.ScMaths 2nd year 3rd Semester

College – Buddha Degree College

(DDU Code-859)

Department: Science

Course code: PHY 201

Course title: Electromagnetic Theory and Optics

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Unit-1

1. **Which of the following is the unit of electric charge?** A) N B) V C) C D) J **Answer: C**
2. **Electric charge is quantized. This means:** A) It is always positive B) It exists in small, discrete amounts C) It can have any value D) It cannot be conserved **Answer: B**
3. **Electric field due to a point charge q at a distance r is given by:** A) $\frac{q}{4\pi\epsilon_0 r^2}$ B) $\frac{q}{r^2}$ C) $\frac{1}{4\pi\epsilon_0}\frac{q}{r^2}$ D) $\frac{1}{\epsilon_0}\frac{q}{r^2}$**Answer: C**
4. **Volume charge density ρ has units:** A) C B) C/m² C) C/m³ D) C/m **Answer: C**
5. **The general expression of electric field from volume charge density is obtained using:** A) Gauss's Law B) Biot-Savart Law C) Coulomb's Law D) Integral form of field from charge distribution **Answer: D**

6. **Divergence of electric field is:** A) Zero B) $\frac{\rho}{\epsilon_0}$ C) $\rho\epsilon_0$ D) $\frac{1}{\epsilon_0}\vec{J}$**Answer: B**

7. **Curl of electrostatic field is:** A) Zero B) $\vec{B}$ C) ρ D) $\mu_0\vec{J}$**Answer: A**

8. **Electric potential V in terms of volume charge density ρ is given by Poisson's equation:** A) $\nabla \cdot \vec{E} = \rho$ B) $\nabla^2 V = -\frac{\rho}{\epsilon_0}$ C) $\nabla \times \vec{E} = 0$ D) $\nabla^2 V = \rho\epsilon_0$**Answer: B**

9. **Gauss's Law in integral form is:** A) $\oint \vec{E} \cdot d\vec{A} = q_{enc}$ B) $\oint \vec{E} \cdot d\vec{A} = \frac{q_{enc}}{\epsilon_0}$ C) $\nabla \cdot \vec{E} = q_{enc}$ D) $\nabla \cdot \vec{E} = \mu_0\vec{J}$**Answer: B**

10. **Electric field inside a conductor in electrostatic equilibrium is:** A) Maximum B) Non-zero C) Zero D) Infinite **Answer: C**

11. **An electric dipole consists of:** A) A single charge B) Two charges of same sign C) Two equal and opposite charges D) Neutral particles **Answer: C**

12. **Electric field due to a dipole on its axial line varies as:** A) $\frac{1}{r}$ B) $\frac{1}{r^2}$ C) $\frac{1}{r^3}$ D) $\frac{1}{r^4}$**Answer: C**

13. **Polarization $\vec{P}$ is defined as:** A) Charge per volume B) Dipole moment per unit volume C) Electric field per unit charge D) Current per unit area **Answer: B**

14. **Electric displacement field $\vec{D}$ is given by:** A) $\vec{D} = \epsilon_0\vec{E}$ B) $\vec{D} = \vec{P} + \vec{E}$ C) $\vec{D} = \epsilon_0\vec{E} + \vec{P}$ D) $\vec{D} = \epsilon\vec{E}$**Answer: C**

15. **Electric susceptibility χ_e relates polarization and electric field as:** A) $\vec{P} = \epsilon_0\chi_e\vec{E}$ B) $\vec{P} = \chi_e\vec{D}$ C) $\vec{P} = \chi_e\vec{B}$ D) $\vec{P} = \chi_e\vec{H}$**Answer: A**

16. **Current density $\vec{J}$ has units:** A) C B) A C) A/m² D) V/m **Answer: C**

17. **Magnetic force between two current elements is given by:** A) Coulomb's Law B) Lorentz Force C) Biot-Savart Law D) Ampere's Law **Answer: C**

18. **Biot-Savart Law gives the magnetic field $\vec{B}$ as proportional to:** A) I B) $\frac{I}{r^2}$ C) $\frac{I}{r}$ D) $\frac{I}{r^3}$**Answer: B**

19. **Divergence of magnetic field is:** A) $\mu_0\vec{J}$ B) $\nabla \cdot \vec{B} = 0$ C) $\nabla \cdot \vec{B} = \rho$ D) $\nabla \cdot \vec{B} = \epsilon_0\vec{E}$**Answer: B**

20. **Curl of magnetic field is:** A) $\nabla \times \vec{B} = 0$ B) $\nabla \times \vec{B} = \mu_0\vec{J}$ C) $\nabla \cdot \vec{B} = \vec{J}$ D) $\nabla \times \vec{E}$**Answer: B**

21. **Magnetic vector potential $\vec{A}$ is defined such that:** A) $\vec{B} = \nabla \cdot \vec{A}$ B) $\vec{B} = \nabla \times \vec{A}$ C) $\vec{B} = \vec{A}$ D) $\vec{B} = \mu_0\vec{A}$**Answer: B**

22. **Ampere's Circuital Law in integral form is:** A) $\oint \vec{B} \cdot d\vec{l} = \mu_0 I$ B) $\oint \vec{E} \cdot d\vec{l} = \frac{q}{\epsilon_0}$ C) $\oint \vec{B} \cdot d\vec{l} = \frac{I}{\epsilon_0}$ D) $\oint \vec{E} \cdot d\vec{A} = 0$**Answer: A**

23. **A magnetic dipole consists of:** A) Two north poles B) A current loop C) Two isolated magnetic charges D) A moving electron only **Answer: B**

24. **According to the Gilbert model, a magnetic dipole is formed by:** A) Current loop B) Magnetic monopoles C) Moving charges D) Circular electric field **Answer: B**

25. **In Ampere's model, magnetic dipole arises from:** A) Stationary charges B) Electric fields C) Magnetic monopoles D) Circulating currents **Answer: D**

26. **Magnetization $\vec{M}$ is defined as:** A) Electric field per unit volume B) Magnetic moment per unit volume C) Current per unit area D) Magnetic field times permeability **Answer: B**

27. **Auxiliary field $\vec{H}$ is given by:** A) $\vec{H} = \vec{B} - \vec{M}$ B) $\vec{H} = \frac{1}{\mu_0}\vec{B} - \vec{M}$ C) $\vec{H} = \mu_0\vec{M}$ D) $\vec{H} = \vec{B} + \vec{M}$**Answer: B**

28. **Magnetic susceptibility χ_m relates magnetization and field as:** A) $\vec{M} = \chi_m\vec{H}$ B) $\vec{M} = \chi_m\vec{B}$ C) $\vec{M} = \chi_m\vec{E}$ D) $\vec{M} = \chi_m\vec{D}$**Answer: A**

29. **Relative permeability μ_r is defined as:** A) $\mu_r = \frac{\mu_0}{\mu}$ B) $\mu_r = \mu_0\mu$ C) $\mu_r = \frac{\mu}{\mu_0}$ D) $\mu_r = \mu + \mu_0$**Answer: C**

30. **A material is paramagnetic if:** A) $\chi_m < 0$ B) $\chi_m = 0$ C) $\chi_m > 0$ and small D) It has permanent dipole alignment **Answer: C**

Unit-2

11. **Faraday's First Law states that:** A) Magnetic field induces current B) A changing magnetic field produces an EMF C) EMF is constant in a magnetic field D) A conductor always opposes magnetic fields **Answer: B**

12. **Lenz's Law indicates:** A) Induced EMF supports the change B) Direction of induced EMF opposes the cause C) Magnetic field vanishes D) EMF is inversely proportional to magnetic flux **Answer: B**

13. **Faraday's Second Law is mathematically expressed as:** A) $\mathcal{E} = \frac{d\Phi}{dt}$ B) $\mathcal{E} = -\frac{d\Phi}{dt}$ C) $\mathcal{E} = -\Phi B$ D) $\mathcal{E} = \int B \cdot dl$**Answer: B**

14. **The displacement current was introduced by:** A) Ampere B) Faraday C) Maxwell D) Gauss **Answer: C**

15. **Displacement current arises due to:** A) Constant electric fields B) Steady current C) Time-varying electric field D) Moving charges only **Answer: C**

16. **Equation of continuity expresses:** A) Charge quantization B) Conservation of charge C) Ohm's Law D) Displacement current **Answer: B**

17. **Mathematical form of equation of continuity is:** A) $\nabla \cdot \vec{E} = \frac{\rho}{\varepsilon_0}$ B) $\nabla \cdot \vec{J} = 0$ C) $\nabla \cdot \vec{J} + \frac{\partial \rho}{\partial t} = 0$ D) $\nabla \times \vec{B} = \mu_0 \vec{J}$**Answer: C**

18. **Modified Ampere's Law (Maxwell–Ampère Law) includes:** A) Magnetic monopoles B) Displacement current term C) Electric potential D) Polarization **Answer: B**

19. **Mathematical form of Maxwell–Ampère Law is:** A) $\nabla \times \vec{B} = \mu_0 \vec{J}$ B) $\nabla \times \vec{B} = \mu_0 (\vec{J} + \varepsilon_0 \frac{\partial \vec{E}}{\partial t})$ C) $\nabla \cdot \vec{B} = 0$ D) $\nabla \cdot \vec{E} = \rho / \varepsilon_0$**Answer: B**

20. **The displacement current is crucial for:** A) Induction motors B) Continuity in a capacitor circuit C) Magnetic shielding D) Ohm's law **Answer: B**

16. **Self-inductance of a coil depends on:** A) Material only B) Current only C) Geometry and core material D) Voltage across coil **Answer: C**

17. **Unit of inductance is:** A) Tesla B) Henry C) Weber D) Joule **Answer: B**

18. **Mutual inductance between two coils is maximum when:** A) They are far apart B) Magnetic flux of one does not link with the other C) Magnetic flux of one fully links with the other D) Their axes are perpendicular **Answer: C**

19. **Application of mutual induction:** A) Resistor B) Transformer C) Voltmeter D) Ammeter **Answer: B**

20. **Ballistic galvanometer is used to measure:** A) Voltage B) Charge C) Resistance D) Capacitance **Answer: B**

21. **A ballistic galvanometer has:** A) High damping B) No moving parts C) Small resistance and large time period D) High current sensitivity **Answer: C**

22. **The charge q passed is proportional to:** A) Square of deflection B) Logarithmic decrement C) First deflection D) Time period **Answer: C**

23. **One application of a ballistic galvanometer is:** A) AC current measurement B) Detection of magnetic materials C) Measurement of flux change D) Resistance calculation **Answer: C**

19. **Maxwell's equations unify:** A) Thermodynamics and mechanics B) Electrostatics and magnetostatics C) Electricity, magnetism, and optics D) Quantum and classical mechanics **Answer: C**

20. **Electromagnetic energy density in free space is:** A) $\frac{1}{2}\varepsilon_0 E^2 + \frac{1}{2\mu_0}B^2$ B) $\varepsilon_0 E^2$ C) $\mu_0 B^2$ D) $\varepsilon_0 E + \mu_0 B$**Answer: A**

21. **Poynting vector represents:** A) Electric field direction B) Power loss C) Rate of energy flow per unit area D) Magnetic energy storage **Answer: C**

22. **Mathematical form of the Poynting vector is:** A) $\vec{S} = \vec{E} \cdot \vec{B}$ B) $\vec{S} = \vec{E} \times \vec{B}$ C) $\vec{S} = \vec{E} \cdot \vec{J}$ D) $\vec{S} = \vec{B} \cdot \vec{J}$**Answer: B**

31. **Speed of EM wave in vacuum is:** A) $c = \frac{1}{\sqrt{\mu_0 \varepsilon_0}}$ B) $c = \sqrt{\mu_0 \varepsilon_0}$ C) $c = \mu_0 \varepsilon_0$ D) $c = \frac{1}{\mu_0 \varepsilon_0}$**Answer: A**

32. **A homogeneous plane wave has:** A) Varying amplitude in space B) Constant amplitude and uniform phase fronts C) No electric field D) Varying magnetic permeability **Answer: B**

33. **An inhomogeneous wave shows:** A) Constant amplitude everywhere B) Attenuated amplitude in direction of propagation C) Only longitudinal fields D) Phase speed equal to group speed **Answer: B**

34. **Dispersive medium implies:** A) Phase velocity = constant B) Phase velocity depends on frequency C) Magnetic field vanishes D) Group velocity is always zero **Answer: B**

35. **Non-dispersive medium is one in which:** A) Electric field is zero B) Phase velocity is frequency-independent C) Magnetic field is variable D) No wave can propagate **Answer: B**

28. **Law of reflection states:** A) $\theta_i + \theta_r = 90°$ B) $\theta_i = \theta_r$ C) $\theta_r = \theta_t$ D) $\theta_r = 0$**Answer: B**

29. **Snell's Law relates:** A) $\sin\theta_i / \sin\theta_t = \mu_1/\mu_2$ B) $n_1 \sin\theta_1 = n_2 \sin\theta_2$ C) $\tan\theta_1 = \tan\theta_2$ D) $n_1 \cos\theta_1 = n_2 \cos\theta_2$**Answer: B**

30. **Fresnel's formula for reflectance at normal incidence is:** A) $R = \left(\frac{n_1 - n_2}{n_1 + n_2}\right)^2$ B) $R = n_1/n_2$ C) $R = \frac{2n_1}{n_1 + n_2}$ D) $R = \left(\frac{n_1 + n_2}{n_1 - n_2}\right)^2$ **Answer: A**