JENPAS UG 2025 Electromagnetic Theory Sample Questions with Solutions PDF

Here's a list of some of the important JENPAS UG 2025 Electromagnetic Theory Sample Questions with Solutions derived from question banks, previous years' papers, mock tests, and educational resources:

1. State Coulomb's Law and explain its significance.

Answer: Coulomb's law provides the electrostatic force between two point charges. It is proportional to the charges and inversely proportional to the square of the distance between them.

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2. Explain Fleming's left-hand rule for force on a current-carrying conductor in a magnetic field.

Answer: Stretch thumb, forefinger, and middle finger perpendicular to each other. Forefinger along the direction of the magnetic field, middle finger along the direction of the current, and thumb along the direction of the force on the conductor.

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3. Describe wave propagation in lossy and lossless dielectrics.

Answer: Lossless media lose no energy; the wave propagates with unaltered amplitude. Some of the energy is lost as heat in lossy media, represented by the attenuation constant α.

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4. Explain Gauss's law for electric fields.

Answer: Gauss's law for electric fields states that the total electric flux through a closed surface is equal to the net charge enclosed by that surface divided by the permittivity of free space. Mathematically, $\Phi E = Qenc / \epsilon 0$. This law shows the relationship between electric charge and electric field, and is valid for any closed surface regardless of shape or charge distribution. It helps simplify electric field calculations for symmetric charge configurations.

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5. Derive the relation between electric field intensity and potential difference.

Answer: The relation between electric field intensity E and potential difference V is derived from the work done in moving a test charge q0 between two points. The electric field is the negative rate of change of electric potential with distance, expressed as: $E = -dV / dx$.

It means the electric field at a point is equal to the negative rate of change of electric potential with respect to distance. The negative sign indicates that the electric field always points in the direction of decreasing potential.

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6. State and explain Faraday's Law of Electromagnetic Induction.

Answer: Faraday's Law of Electromagnetic Induction states that whenever the magnetic flux linked with a closed conductor changes, an electromotive force (emf) is induced in it. The magnitude of this induced emf is directly proportional to the rate of change of magnetic flux through the conductor. This induced emf lasts as long as the magnetic flux changes, and the direction of the emf opposes the change, as per Lenz's law.

Mathematically, $EMF = -d\Phi / dt$. This principle underlies the working of generators, transformers, and electric motors.

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7. Define displacement current and its importance.

Answer: Displacement current is the current produced by the time rate of change of the electric displacement field D. Unlike conduction current, it does not involve actual charge movement but arises from a changing electric field, especially in capacitors. It is important as it completes Maxwell’s equations and explains electromagnetic wave propagation.

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8. Discuss the propagation of electromagnetic waves in free space.

Answer: In free space, electromagnetic waves propagate as transverse waves with electric and magnetic fields perpendicular to each other and to the direction of propagation. They travel at the speed of light 3×10^8 m/s, without attenuation or energy loss, due to zero conductivity. The wave propagation follows Maxwell's equations with an intrinsic impedance of free space of about 377 Ω. Energy oscillates between electric and magnetic fields equally during propagation.

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9. State and prove the Poynting theorem.

Answer: Poynting's theorem represents the conservation of electromagnetic energy. The Poynting vector, $S = E \times H$, describes the directional energy flux. The theorem relates the rate of energy decrease in volume to the energy flux and work done on charges.

10. Define polarisation of electromagnetic waves and types of polarisation.

Answer: Polarisation of electromagnetic waves refers to the orientation of the electric field vector as the wave propagates through space. It describes how the electric field oscillates in a particular direction. The main types of polarisation are linear (the electric field oscillates in one direction), circular (the electric field rotates forming a circle), and elliptical (the electric field traces an ellipse) polarisation.