USPHT04 - Physics (Paper-II) : Magnetostatics and Electromagnetic Waves

P. Pages : 2

Time : Three Hours

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* 0 5 3 5 *

Max. Marks : 50

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Notes : 1. All questions are compulsory.
2. Draw neat labelled diagram wherever necessary.

Either

1. a) i) State and explain Biot-Savart' law . Express it in vector form. **3**

ii) Obtain an expression of magnetic field at the center of circular coil currying current. **3**

iii) Show that curl of magnetic field $\vec{\nabla} \times \vec{B} = \mu_0 J$. **2**

iv) Calculate the magnitude of magnetic field at a distance of 5m from an infinite straight conductor currying current 200A. $\left(\frac{\mu_0}{4\pi} = 10^{-7} \right)$ **2**

OR

b) 1) State and prove Amper's law. **2½**

2) Define diamagnetic materials and explain its properties. **2½**

3) Obtain the relation $\mu_r = 1 + \chi_m$ **2½**

4) The magnetic susceptibility of medium is 94×10^{-3} . Find its absolute and relative permeability. ($\mu_0 = 4\pi \times 10^{-7}$) **2½**

Either

2. a) i) State parameters of ideal transformer. **3**

ii) Explain construction and working of transformer. **5**

iii) Self inductance of primary and secondary coil of a transformer is 2H and 80 mH respectively. Calculate turns ratio and mutual inductance. **2**

OR

b) 1) State Faraday's and Lenz's law of electromagnetic induction. **2½**

2) Explain self and mutual inductance. **2½**

3) Obtain an equation for energy stored in the magnetic field. **2½**

4) The back emf in the inductance coil is 400V when the current in the coil changes from 0 to 2A in 0.01 sec. Calculate the self inductance of coil. **2½**

Either

3. a) i) Write four Maxwell's equation. Explain physical significance of each. **8**

ii) If a 500 watt laser beam is concentrated by a lens into a cross-sectional area $10^{-10} \, m^2$. Find the value of Poynting vector and the amplitude of electric field. ($\epsilon_0 = 9 \times 10^{-12}$ SI unit) **2**

OR

b) 1) Explain the characteristics of Electromagnetic wave. **2½**

     2) Derive the relation $\nabla^2 E = \mu_0 \in_0 \dfrac{\partial^2 E}{\partial t^2}$. **2½**

     3) Explain Poynting vector and its physical significance. **2½**

     4) Explain displacement current. Give its significance. **2½**

Either

4. a) i) State and explain Kirchhoff's voltage and current law. Give an example of each. **4**

      ii) Using Kirchhoff's law. Derive balancing condition of wheat stone bridge. **4**

      iii) Find the unknown resistance S when the bridge is balance. **2**
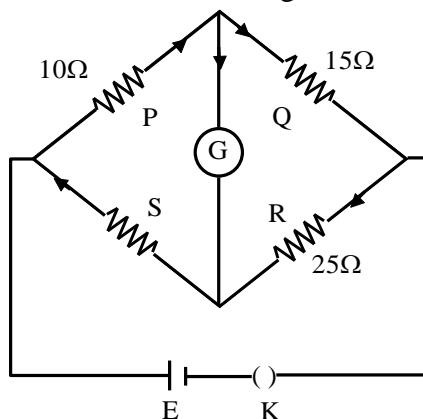
OR

b) 1) Derive the expression for current when AC $E = Eoe^{jwt}$ is applied to capacitor and resistor in series. **2½**

     2) Derive the equation of decay of current in CR circuit. **2½**

     3) Derive the equation of growth of current in LR circuit. **2½**

     4) In LR circuit the current rises to one third of its maximum value in 10 ses. Find the time constant of the circuit. **2½**

5. Attempt **any ten** of the following.

     a) Define divergence of magnetic field. **1**

     b) What is susceptibility? **1**

     c) Define relative permeability. **1**

     d) Define electromagnetic induction. **1**

     e) What is step up transformer? Draw its symbol. **1**

     f) What is efficiency of transformer? **1**

     g) What is electromagnetic wave? **1**

     h) State any two application of EM wave. **1**

     i) What is the value of charge density and current density for free space? **1**

     j) Define time constant of LR circuit. **1**

     k) What is complex number? **1**

     l) What is J operator? **1**

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