B.Sc. F.Y. CBCS Pattern Semester-II

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

P. Pages : 3 **GUG/W/23/11591**

Time : Three Hours * 6 5 7 2 * Max. Marks : 50

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

Either:

1. a) i) State and prove Ampere's circuital law of magnetic induction. **3**

ii) Using Biot-Savart's law obtain an equation for magnetic induction at a point due to infinite long straight conductor. **4**

iii) A very long solenoid has 2000 turns per meter and carries a current of 20 A. Find the magnetic field at the center point on axis, and at the end point on the axis. **3**

OR

b) a) Define divergence of magnetic field and show that it is always zero. **2½**

b) Show that, the relation between permeability and susceptibility is $\mu_r = 1 + \chi$. **2½**

c) Define curl of magnetic field and show that $\vec{\nabla} \times \vec{B} = \mu_0 \vec{J}$. **2½**

d) A current in a solenoid produces a magnetizing field of 267 A/m. What is the magnetic induction inside it, if it has an iron core of magnetic susceptibility 3000? **2½**

Either:

2. a) i) What is transformer? What are its types? Describe the construction and working of transformer. **5**

ii) What are the uses of transformer? **2**

iii) A transformer converts 230 V A.C. to 60 V A.C. The secondary has 70 turns and load across it draws 350 mA. Calculate: **3**

i) The number of turns in the primary
ii) The current in the primary and
iii) The power consumed

OR

b) a) Obtain the equation for energy stored in the form of magnetic field. **2½**

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

c) What is mutual induction? Define co-efficient of mutual induction between two coils. Give the units in which it is measured. **2½**

d) A coil of a wire has 600 turns and has a self – inductance of 225 mH. What will be the self-inductance of second coil of same magnitude with 700 turns? **2½**

Either:

3. a) i) Derive Electromagnetic wave equation for Electric field $\vec{E}$ in free space and comment on the speed of EM wave. **3**

ii) Write four Maxwell's equation for free space. Give the physical significance of each equation. **5**

iii) State and prove Poynting theorem. **2**

OR

b) a) Derive the equation of continuity $\vec{\nabla} \cdot \vec{J} + \partial\rho / \partial t = 0$. **2½**

b) Show that, electromagnetic waves are transverse in nature. **2½**

c) Explain displacement current? Give the significance. **2½**

d) If the radius of the sun is 7×10^8 meter and energy emission is 3.8×10^{26} watt/sec. Calculate the Poynting vector of propagation of energy on the surface of the sun. **2½**

Either:

4. a) i) State and explain Kirchhoff's current and voltage law. Apply it to deduce the condition for balance of wheat stone bridge. **4**

ii) Derive Helmholtz growth of current in a circuit with resistance R and inductance L. What is meant by time constant of the circuit? **4**

iii) The current in LR circuit rises to 40% of it's final value in 2sec. Find the time constant of the circuit. **2**

OR

b) a) Derive an equation for decay of charges in CR circuit. **2½**

b) What is dimension and unit of time constant? **2½**

c) What is j – operator? Explain the use of complex number in A.C. circuit. **2½**

d) The capacitor of capacitance 0.4 microfarad is discharged through resistance of 8 Mega ohm. Calculate the time taken by potential difference across the capacitor to fall down to half of its original value. **2½**

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

a) Write any two properties of ferromagnetic material. **1**

b) What is Lorentz force? **1**

c) What is Curie's law? **1**

d) Write any two requirements of Ideal transformer. **1**

e) Define self-induction. **1**

f) What is Physical significance of mutual induction? **1**

g) Write any two characteristics of EM wave. **1**

h) What do you mean by polarization of electromagnetic waves? **1**

i) Distinguish between conduction and displacement current. **1**

j) Write equation of growth of charges through CR circuit. **1**

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

l) If the inductive reactance of the inductor is 10Ω at the frequency of $\left(\frac{1}{\pi}\right)$Hz . What is the inductance of the coil? **1**

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