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

USPHT04 - Physics Paper-II - Magnetostatics and Electromagnetic Waves

P. Pages : 3 **GUG/S/25/11591**

Time : Three Hours * 1 5 4 1 * Max. Marks : 50

Notes : 1. All questions are compulsory.
2. Draw neat labelled diagram wherever necessary.
3. Scientific calculator is allowed.

Either:

1. A) i) Define the terms: **2**
1) Magnetic vector potential.
2) Magnetic susceptibility.

ii) Obtain an equation for magnetic field at a point on the axis of a circular coil carrying a current using Biot-Savart's law. Hence find the magnetic field at the center of coil. **6**

iii) Calculate the magnitude of magnetic field at a distance of 5 m from an infinite straight conductor carrying current of 100 A. **2**

OR

B) a) State and explain Biot-Savart's law. Express it in vector form. **2½**

b) Define Curl of magnetic field and show that $\nabla \times B = \mu_0 J$. **2½**

c) Define paramagnetic substances with three examples. State their characteristics. **2½**

d) The maximum value of permeability of a material is $0.126\,N/A^2$. Find the relative permeability and magnetic susceptibility. **2½**

Either:

2. A) i) Explain self induction and mutual induction. **3**

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

iii) A lamp of 24 W and 12 V is to be run on a step-down transformer to operate on 240 V a. c. mains. Find the current in the primary and transformer ratio assuming the transformer to be an ideal. **2**

OR

B) a) State Faraday's and Lenz's law of electromagnetic induction. **2½**

b) Explain energy losses in transformer. **2½**

c) Obtain an expression for energy stored in magnetic field. **2½**

d) A step-up transformer operates on 240V and line supplies a load of 5 A. The ratio primary to secondary is 1: 20. Calculate
i) Voltage across secondary ii) Primary current. **2½**

Either:

3. A) i) Derive the Maxwell's four equations in differential form. **8**

ii) The Sun radiates the power $= 3.8 \times 10^{26}$ watt . Calculate the Poynting vector at the surface of sun if its radius is 7×10^{8} m. **2**

OR

B) a) Explain the Poynting vector and its physical significance. **2½**

b) Derive the equation of energy density of a electromagnetic wave. **2½**

c) Show that the electromagnetic waves travels with velocity of light in the free space. **2½**

d) Explain the characteristics of electromagnetic wave. **2½**

Either:

4. A) i) Explain the Wheatstone's bridge network to determine unknown resistance. **3**

ii) Derive equation for decay of current in LR circuit. Show that the time constant of LR circuit has a dimensions of time. **4**

iii) A coil of inductance 30 H and resistance 30 ohm is connected with a battery of 60 V. How long will it take for current to reach one half its final value. **3**

OR

B) a) Define RMS value and peak value of an AC. State the relation between them. **2½**

b) What is j-operator? State its physical significance. **2½**

c) Using j-operator obtain an expression for instantaneous current in LR circuit when connected to sinusoidal alternating emf. **2½**

d) A capacitor of capacitance $20 \mu F$ and resistance of 25 ohm is connected in series to the source of emf 240V (peak), 50 Hz AC. Find (i) Capacitive reactance
(ii) impedance of the circuit and (iii) maximum current in the circuit. **2½**

5. Solve **any ten** from the followings.

a) Define magnetic intensity. **1**

b) State Ampere's circuital law of magnetic induction. **1**

c) State magnetic field vector. **1**

d) What is electromagnetic induction? **1**

e) Give any three characteristics of an ideal transformer. **1**

f) What is step-down transformer? Draw its symbol. **1**

g) What is displacement current? **1**

h) Define intensity of the electromagnetic wave. **1**

i) What is electromagnetic wave. **1**

j) Define time constant CR circuit. **1**

k) Define complex number. **1**

l) Find the reactance of capacitor of capacity 1μF at a frequency 1KHz. **1**

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