B.Sc. Semester-V Examination, 2022-23

ELECTRONICS [Honours]

Course ID : 51712 Course Code : SH/ELC/502/C-12(T)

Course Title : Electromagnetics

Time : 1 Hour 15 Minutes Full Marks : 25

The figures in the right-hand margin indicate marks.

Candidates are required to give their answers in their own words as far as practicable.

1. Answer any **three** of the following questions: 1×3=3

   a) If $\vec{A} = 2i + 3j + k$ and $\vec{B} = 2i + 3j$, find $(\vec{A} \times \vec{B})$.

   b) What is an electric dipole?

   c) State integral form of Gauss's law in electrostatics.

   d) What is motional e.m.f?

   e) What is a wave guide propagation?

   f) What is mutual induction between two coils with self-inductance L_1 and L_2?

2. Answer any **three** of the following questions: 2×3=6

   a) What is the flux of the electric field intensity $\vec{E}(\vec{r})$? 2

   b) State Faraday's laws of electromagnetic induction? 2

   c) State Stokes theorem. 2

   d) Define Biot-Savart law in magnetostatics. What is solid angle? Give its dimensions. 1+1=2

   e) Obtain the integral form of Ampere's circuital law. Frame its differential form in magnetostatics. 1+1=2

   f) Draw the phasor diagram for a series L-C-R circuit. 2

3. Answer any **two** of the following questions: 5×2=10

   a) What is magnetic dipole? Obtain an expression for the force acting on a magnetic dipole placed in a non-uniform magnetic field. 1+4=5

   b) Starting from Maxwell's equations, derive the wave equations for magnetic field $(\vec{B})$ and electric field $(\vec{E})$ in free space. 5

c) In an air field wave guide, radio-wave is propagating in TM mode. Find out the cut-off frequency, phase velocity and characteristic impedance (Z_0) for the particular case. 5

d) Show that if two coils having co-efficient of self-inductance L_1 and L_2 are mutually coupled, then the co-efficient of mutual inductance can be obtained as $M = k\sqrt{L_1 L_2}$ where $0 \leq k \leq 1$. 5

4. Answer any **one** of the following questions: $6 \times 1 = 6$

a) Obtain an expression for Poisson's equation in free space or vacuum. From here obtain $\nabla^2 \varnothing = 0$, which is Laplace's equation in dielectic medium. 4+2=6

b) How Ampere's circuital law has been modified in Maxwell's equations? Explain. 6

c) What amount of energy can be stored in a charged capacitor (C)? Obtain the expression for capacitance for a parallel plate capacitor in air or free space ($\in_0$, μ_0). 2+4=6

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