WEST BENGAL STATE UNIVERSITY

B.Sc. Honours 5th Semester Examination, 2021-22

ELSACOR12T-ELECTRONICS (CC12)

Time Allotted: 2 Hours | Full Marks: 40

The figures in the margin indicate full marks.
Candidates are required to give their answers in their own words as far as practicable.
All symbols are of usual significance.

GROUP-A

1. Answer any ***five*** questions from the following: 2×5 = 10

(a) What is meant by solenoidal vector?

(b) Show that the electric field is always perpendicular to an equipotential surface.

(c) Is it possible for a metal sphere of 1 cm radius to hold a charge of one coulomb?

(d) Define M.M.F.

(e) What was the inconsistency in Ampere's Law?

(f) Define phase and group velocity.

(g) For a position vector $\vec{r} = \hat{i}x + \hat{j}y + \hat{k}z$, prove that $\vec{J} \times \vec{r} = 0$.

(h) An amount of charge Q is divided amongst two particles. Find the charge on each particle such that the effective force between them is maximum.

GROUP-B

Answer any *six* questions from the following 5×6 = 30

2. (a) State and prove Poynting theorem. 5

(b) What is skin effect? Derive an expression for skin depth. 1+4

(c) If $\vec{E} = \hat{i}\, E_0 \cos\omega\left(\frac{z}{c} - t\right) + \hat{j}E_0 \sin\omega\left(\frac{z}{c} - t\right)$. Calculate the magnetic field $\vec{B}$. 5

(d) Show that in free space the electric field $\vec{E}$, magnetic field $\vec{B}$ and the propagation vector $\vec{k}$ are perpendicular to each other. 5

(e) Establish electrostatic boundary condition of electric field and electric displacement vector (both normal and tangential component) at the interface of two linear dielectrics. 5

(f) Write down Maxwell's equation in integral form and explain the physical significance of each equation. 5

(g) An a.c. voltage source $V = V_0 \sin \omega t$ is connected across a parallel plate capacitor C. Prove that the displacement current through the capacitor is the same as the conduction current in the wire. 5

(h) (i) Show that the electric field is equal to the negative gradient of the electric potential. 2+3

(ii) A magnetic field of $4\times10^{-3}\hat{k}$ Tesla exerts a force of $\left(4\hat{i}+3\hat{j}\right)\times10^{-10}$ N on a particle having a charge of 1×10^{-9}C and moving in the *x-y* plane. Calculate the velocity of the particle.

(i) (i) State Gauss' law. Derive Coulomb's law from Gauss's law. 1+2+2

(ii) Apply Gauss's law to calculate the electric field due to an infinite sheet of charge.

N.B. : *Students have to complete submission of their Answer Scripts through E-mail / Whatsapp to their own respective colleges on the same day / date of examination within* 1 *hour after end of exam. University / College authorities will not be held responsible for wrong submission (at in proper address). Students are strongly advised not to submit multiple copies of the same answer script.*

——×——