Roll No											

PRESIDENCY UNIVERSITY
BENGALURU

SCHOOL OF ENGINEERING
MID TERM EXAMINATION - OCT 2023

Semester : Semester III - 2022
Course Code : ECE3004
Course Name : Sem III - ECE3004 - Electromagnetic Theory
Program : B. TECH

Date : 2-NOV-2023
Time : 9:30AM - 11:00AM
Max Marks : 50
Weightage : 25%

Instructions:
(i) Read all questions carefully and answer accordingly.
(ii) Question paper consists of 3 parts.
(iii) Scientific and non-programmable calculator are permitted.
(iv) Do not write any information on the question paper other than Roll Number.

PART A

ANSWER ALL THE QUESTIONS **(5 X 2 = 10M)**

1. If $\overrightarrow{a} = \hat{a}_x + \hat{a}_y + \hat{a}_z$, $\overrightarrow{a} \cdot \overrightarrow{b} = 1$, and $\overrightarrow{a} \times \overrightarrow{b} = \hat{a}_y - \hat{a}_z$, evaluate $\overrightarrow{b}$.

(CO1) [Knowledge]

2. Find the gradient of the function $x^2 + y^2 + z^2 = 9$.

(CO1) [Knowledge]

3. For what numeric value of λ does the vector $\overrightarrow{A} = x^2\hat{i} + \lambda y\hat{j} + z^2\hat{k}$ become solenoidal at the point $(1, 0, 1)$?

(CO1) [Knowledge]

4. Write down the mathematical form of Gauss divergence theorem.

(CO2) [Knowledge]

5. What are the ranges of θ and ϕ in the spherical coordinate system?.

(CO2) [Knowledge]

PART B

ANSWER ALL THE QUESTIONS **(2 X 10 = 20M)**

6. Consider three vectors$\overrightarrow{a}$, $\overrightarrow{b}$ and $\overrightarrow{c}$ such that $\overrightarrow{a} = y\hat{i} + z\hat{j} + x\hat{k}$, $\overrightarrow{b} = z\hat{i} + x\hat{j} + y\hat{k}$ and $\overrightarrow{c} = x\hat{i} + y\hat{j} + z\hat{k}$

(i) Can the scalar potential of $\overrightarrow{a} \times \overrightarrow{b}$ exist? If yes, find the potential. If no, justify your answer.
(ii) If the vector $\overrightarrow{b} \times \overrightarrow{c}$ is solenoidal at a point $(k, 1, 1)$, find the value of k.

(CO1) [Comprehension]

7. Vector functions appear widely in electromagnetics especially as electric and magnetic fields and their derivatives. Let $\overrightarrow{G}$ be a vector function such that $\overrightarrow{G} = \frac{\vec{r}}{r^3}$, then show that $\overrightarrow{G}$ is solenoidal as well as irrotaional where $\vec{r} = x\hat{a}_x + y\hat{a}_y + z\hat{a}_z$.

(CO1) [Comprehension]

PART C

ANSWER THE FOLLOWING QUESTION **(1 X 20 = 20M)**

8. The Stoke's theorem relates a surface integral over a surface S to a line integral around the boundary curve of S and widely appears in electromagnetics. Apply Stoke's theorem to find the value of $\oint_C (ydx + zdy + xdz)$ where C is the curve of intersection of the sphere $x^2 + y^2 + z^2 = a^2$ and the plane $x + z = a$ ..

(CO2) [Application]