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**Presidency University**

**Bengaluru**

 **SCHOOL OF ENGINEERING**

**Make-Up Examinations, July 2024**

**Course Code**: ECE3004

**Course Name**: Electromagnetic Theory

**Program:** B.Tech

**Date**: 22/07/2024

**Time**: 09:30 AM – 12:30 PM

**Max Marks**: 100

**Weightage**: 50%

 **Instructions:**

1. *Read the all questions carefully and answer accordingly.*
2. *Do not write any matter on the question paper other than roll number.*

**Part A [Memory Recall Questions]**

**Answer all the Questions. Match the following columns (20Qx 2M= 40M)**

|  |  |
| --- | --- |
| **Column A** | **Column B** |
| 1. Laplace equation (C.O.No. 1) [Knowledge]
 | 1. $∇⋅\vec{D}=ρ\_{v}$
 |
| 1. Gauss’s law of magnetostatics (C.O. 2) [Comprehension]
 | 1. H/m
 |
| 1. Gauss’s law of electrostatics (C.O 2) [ Comprehension ]
 | 1. $ε\vec{E}$
 |
| 1. Magnetic permeability (C.O. 2) [ Comprehension]
 | 1. No magnetic monopole
 |
| 1. Electric flux density (C.O. 1) [Knowledge]
 | 1. $∇^{2}V=0$
 |
| 1. Volume of a cuboid with sides $\vec{A}$, $\vec{B}$ and $\vec{C}$ (C.O.1) [Knowledge]
 | 1. Law of conservation of charge
 |
| 1. Gradient of a curl of a vector (C.O.2) [Comprehension]
 | 1. $σ⟶\infty $
 |
| 1. Gaussian surface for a charged infinite sheet (C.O.2) [Comprehension]
 | 1. $E\_{t\_{1}}=E\_{t\_{2}}$
 |
| 1. Equation of continuity (C.O.1) [Knowledge]
 | 1. $ \vec{A}⋅\left(\vec{B}×\vec{C}\right)$
 |
| 1. Static magnetic field (C.O.3) [Application]
 | 1. F/m
 |
| 1. Dielectric-dielectric boundary (C.O.3) [Application]
 | 1. Null (zero)
 |
| 1. Ampere’s circuital law (C.O.2) [Comprehension]
 | 1. Sphere
 |
| 1. Faraday’s law of EM induction (C.O.3) [Application]
 | 1. Cuboid
 |
| 1. “*BAC-CAB*” rule (C.O.2) [Comprehension]
 | 1. $σ=0$
 |
| 1. Conductor-dielectric boundary (C.O.3) [Application]
 | 1. Induced emf
 |
| 1. Perfect conductors (C.O.2) [Comprehension]
 | 1. Spherical coordinate system
 |
| 1. Perfect dielectrics (C.O.2) [Comprehension]
 | 1. $∇×\vec{H}=\vec{J}$
 |
| 1. Gaussian surface for a point charge (C.O. 1) [Knowledge]
 | 1. Tangential component of E-field is 0
 |
| 1. SI unit of $ε$ (C.O.No. 1) [Knowledge]
 | 1. $∇×\vec{E}=-\frac{∂\vec{B}}{∂t}$
 |
| 1. $\hat{a}\_{r}, \hat{a}\_{θ}, \hat{a}\_{ϕ}$ (C.O.No. 1) [Knowledge]
 | 1. Vector triple product
 |

**Part B [Thought Provoking Questions]**

**Answer all the Questions. Each question carries 15 marks. (3Qx15M=45M)**

1. The Poisson’s and the Laplace’s equation are two of the most important equations used for finding electric field distributions from a given charge distribution. Answer the following questions based on these two equations
2. Write down the expression for Poisson’s and Laplace’s equation
3. Does the potential given by $V=xy+yz+zx$ satisfy the Laplace’s equation?
4. If $ϕ=\sinh(\left(x\right)\cos(ky)e^{pz})$ satisfy the Laplace’s equation, what is the relationship between $k $and $p$?

 (C.O. 2) [Comprehension]

22. Consider a hollow cylinder of inner radius a and an outer radius b as shown in the figure below. The cylinder is placed along the Z-axis lengthwise and carries a current $I$. Using Ampere’s circuital law, find the magnetic field intensity $\vec{H}$ in the following regions (i)$r<a \left(ii\right)a<r<b \left(iii\right) r>b$ (C.O. 2) [Comprehension]



1. In a certain region of free-space, the electric potential is found to be a function of $x$ only and is given by $V=150x^{^{4}/\_{3}}$ for $x>0$. Find:
2. $\vec{E}, \vec{D} $and $ρ\_{v}$ as functions of $x$
3. (ii) Find $ \vec{D}$ if the free-space is replaced by a medium having $ε\_{r}=3$ (C.O. 3) [Application]

**Part C [Problem Solving Questions]**

**Answer all the Questions. Each question carries 15 marks. (1Qx15M=15M)**

1. Three point-charges $+Q$, $-2Q$ and $+Q $are located at three points $\left(P\_{1 }, P\_{2} , P\_{3}\right)$ in vacuum such that the coordinates of the points are $P\_{1 }\left(-a,0,0\right)$, $P\_{2 }\left(0,0,0\right)$ and $P\_{3 }\left(+a,0,0\right)$ . With the aid of proper equations, deduce that the electric field intensity at a point $P\left(h,0,0\right) $where $h\gg a$ is given by $\frac{1}{4πε\_{0}}\left[\frac{6Qa^{2}}{h^{4}}\right]$. (C.O. 3) [Application]