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B.M.S. College of Engineering, Bengaluru-560019

Autonomous Institute Affiliated to VTU

December 2023 Supplementary Examinations

Programme: B.E. **Semester: III**
Branch: Electrical & Electronics Engineering **Duration: 3 hrs.**
Course Code: 22EE3PCFTH **Max Marks: 100**
Course: FIELD THEORY

Instructions: 1. Answer any FIVE full questions, choosing one full question from each unit.
2. Missing data, if any, may be suitably assumed.

UNIT - I

1	a)	State and explain coulombs law in vector form.	**06**
	b)	Using Gauss law, find the electric field intensity at all points due to a charged concentric spherical shell of radius 'R' m having a charge of Q coulombs distributed uniformly on its surface. Sketch the variation of field intensity with respect to distance.	**08**
	c)	Given $\vec{D} = \frac{5r^2}{4}\hat{a}_r\, Cm^{-2}$. Evaluate both sides of divergence theorem for the volume enclosed by r=4m & θ=π/4.	**06**

UNIT - II

2	a)	Estimate and analyse the work done in carrying a -2 C charge from $P_1(2\ \ 1\ \ -1)$ to $P_2\ (8\ \ 2\ \ -1)$ in the field $\bar{\boldsymbol{E}}$= y $\mathbf{a_x}$ + x $\mathbf{a_y}$ V/m. i). Along parabola $x = 2y^2$ ii). Along the straight line joining P_1 and P_2	**08**
	b)	Analyses and develop an expression for electric boundary conditions between conductor and free space of the medium.	**07**
	c)	Show that $\nabla . J = \frac{-\partial \rho_v}{\partial t}$ as per continuity of current equation	**05**

OR

3	a)	Show that electric field intensity is equal to negative potential gradient.	**06**
	b)	Given $\vec{E}$= 40xy $\hat{a}_x$ + 20x^2 $\hat{a}_y$ + 2 $\hat{a}_z$. Calculate the potential difference between the points P(1,-1,0) & Q(2,1,3).	**06**
	c)	Analyses and develop an expression for electric boundary conditions between conductor and dielectric of the medium.	**08**

UNIT - III

4	a)	Derive an expression for Poisson's & Laplace equations and hence express them in all three coordinate systems. And also verify whether Laplace equation satisfied or not? of following equations: i) $V = x^2 - y^2 + z^2$ ii) $V = r \cos \emptyset + z$ iii) $V = r \cos \theta + \emptyset$	**10**

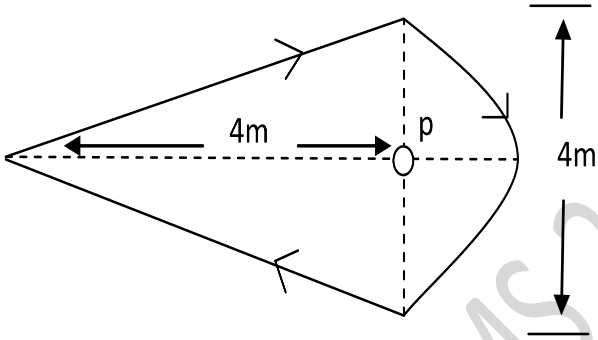
Important Note: Completing your answers, compulsorily draw diagonal cross lines on the remaining blank pages. Revealing of identification, appeal to evaluator will be treated as malpractice.

	b)	Write Laplace equation in cylindrical co-ordinates using this equation find an expression for potential distribution in the angular space between two infinite long co-axial cylinder.	10

UNIT - IV

5 a) Derive an expression for magnetic field intensity at a point using Biot Savart's law. **06**

b) Find the value of magnetic flux density at a point 'p' for the current circuit carrying a current of 10 A shown. **08**



c) Explain the Lorentz force equation due to force on a moving point charge. **06**

UNIT - V

6 a) Write Maxwell's equations in point form and integral for time varying field in free space. **05**

b) Consider the region defined by |x|, |y| & |z| and |z| <1: **07**

$let\ \varepsilon_R = 5, \mu_R = 4\ and\ \sigma = 0. if\ J_d = 20\cos\left(1.5\times 10^8 t - bx\right) a_y \mu A/m^2$

:Evaluate: a).$\overline{D}$&$\overline{E}$; b). Use the point form of Faraday's law and an integration with respect to time to find H &B; c). Use $\nabla X \vec{H} = \vec{J_d} + \vec{J_c}$ to evaluate $\vec{J}_d$.

c) Analyze and develop an expression for electromagnetic waves in free space. **08**

OR

7 a) Analyze and develop an expression for Electromagnetic wave in good conductor **10**

b) State and explain Poynting theorem and in phasor form, the electric field intensity of uniform plane wave in free space is expressed as **10**

$E_x = (40 - j30)e^{-j20z} a_x V/m$.

$Evaluate\ \boldsymbol{w}; \boldsymbol{\beta}, \boldsymbol{f}, \boldsymbol{\lambda}, \boldsymbol{H_s}\ \boldsymbol{and}\ \boldsymbol{H}(\boldsymbol{z}, \boldsymbol{t})\ \boldsymbol{at}\ \boldsymbol{P}(\boldsymbol{6}, -\boldsymbol{1}, \boldsymbol{0.07}), \boldsymbol{t} = \boldsymbol{71ps}$

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