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

Autonomous Institute Affiliated to VTU

December 2018 / January 2019 Semester End Main Examinations

Programme: B.E. **Semester : III**
Branch : ELECTRONICS AND COMMUNICATION ENGG **Duration: 3 hrs.**
Course Code: 15ES3GCFAW **Max Marks: 100**
Course: FIELDS AND WAVES **Date: 05.01.2019**

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

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.

UNIT - I

1 a) State the vector form of Coulomb's Law of the force between two point charges and indicate the units of the quantities in the equation. **6**

b) Define Electric flux Density 'D'. Find the D at P(6, 8, -10) caused by **8**
a. a point charge of 30 mC at origin.
b. a uniform line charge of $\rho_L = 40\ \mu C/m$ on z-axis

c) State and Prove Integral form of Gauss law. **6**

OR

2 a) Define potential difference. Establish the relation $\mathbf{E} = -\nabla V$. **6**

b) Find the work done in moving a **5μC** charge from **origin** to **P(2, -1, 4)** through the electric field $\mathbf{E} = 2xyz\,\mathbf{a}_x + x^2z\,\mathbf{a}_y + x^2y\,\mathbf{a}_z$ **V/m** via the path : **8**
i) Straight line segments **(0, 0, 0)** to **(2, 0, 0)** to **(2, -1, 0)** to **(2, -1, 4);**
ii) Straight line **x = -2y, z = 2x.**

c) Given Current density $\mathbf{J} = 10\rho^2 z\,\mathbf{a}_\rho - 4\rho\cos^2\phi\,\mathbf{a}_\phi\ \mathbf{mA/m^2}$. Find **J** at **P(3, 30°, 2).** Determine the total current flowing outward through a circular band $\rho = 3;\ 0 \le \phi \le 2\pi;\ 2 \le z \le 2.8$ **6**

UNIT - II

3 a) Starting from Biot-Savart's law, develop the expression for the magnetic field intensity at a point due to finite length current carrying conductor . **6**

b) In cylindrical coordinates magnetic field is given as **6**

$\mathbf{H} = (2\rho - \rho^2)a_\phi A/m \quad for\ 0 \le \rho \le 1.$

i) Determine the current density **J**
ii) Total current passing through surface $z = 0,\ 0 \le \rho \le 1.$

c) The point charge Q = 18 nC has a velocity of 5×10^6 m/s in the direction $a_r = 0.60\,\mathbf{a}_x + 0.75\,\mathbf{a}_y + 0.30\,\mathbf{a}_z$. Calculate the magnitude of the force exerted on the charge by **8**
a) $\mathbf{B} = -3\,a_x + 4\,a_y + 6a_z$ mT.
b) $\mathbf{E} = -3\,a_x + 4\,a_y + 6a_z$ KV/m

UNIT - III

4 a) State and explain Faraday's law of induction **4**

b) Given $\mathbf{B = (0.5\ a_x + 0.6\ a_y - 0.3\ a_z)\cos(5000t)}$ **Tesla** and a filamentary loop with corners at **(2,3,0), (2, -3,0), (-2,-3,0)** and **(-2,3,0) m** find e.m.f developed in the loop. **6**

c) State & list Maxwell's Equation in point form & Integral form **10**

UNIT - IV

5 a) State and Prove Poynting Theorem **10**

b) Starting from Maxwell equation derive expression for intrinsic impedance of perfect dielectrics and also show that intrinsic impedance for free space =377ohms **10**

UNIT - V

6 a) Derive the expression for transmission coefficient and reflection coffecient **10**

b) A 50MHz wave having amplitude of Electric field 10V/m propagates in x, y plane at an angle of 30^0 with x axis and is linearly polarized along z axis. If ε_R is real is equal to 9 and $\mu_R = 1$, find the phasor equation for electric field **E.** Write the phasor expression for the electric field , calculate λx, λy, Vpx, Vpy **10**

OR

7 a) A uniform plane wave is incident from air on to glass at an angle from the normal of 30^0. Determine the fraction of the incident power that is reflected and transmitted for p-polarization. (Glass has refractive index 1.45) **10**

b) Write a short notes on wave propagation in dispersive media. **4**

c) Consider a medium in which the refractive index varies linearly with frequency over a certain range $n(w)=n_0 \frac{w}{w_o}$. Determine the group velocity and phase velocity of wave at frequency w_o **6**