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P.E.S. College of Engineering, Mandya - 571 401

(An Autonomous Institution affiliated to VTU, Belagavi)

Fourth Semester, B.E. - Electronics and Communication Engineering

Semester End Examination; May / June - 2019

Electromagnetic Field Theory

Time: 3 hrs *Max. Marks: 100*

***Note**: Answer **FIVE** full questions, selecting **ONE** full question from each unit.*

UNIT - I

1 a. Obtain an expression for electric field intensity at a point due to infinite sheet charge having uniform charge density ρ_s. 8

b. Describe Coulomb's law in vector form. 5

c. The electron beam in a certain cathode ray tube possesses cylindrical symmetry and the charge density is represented by $\rho_r = {}^{-0.1}\!/_{(\rho^2+10^{-8})}\ {}^{pC}\!/_{m^3}$ for $0 < \rho < 3\times10^{-4}$ m and $\rho_r = 0$ for $\rho > 3\times10^{-4}$ m 7

i) Find the total charge per meter along the length of the beam

ii) Find the beam current with 1 C/s and Electron velocity is $5x10^7$ m/s

2 a. In cylindrical coordinates, let $\rho_r = 0$ and $\rho < 1$ mm, $\rho_r = 2sin(2000\pi\rho)n$ C/m^3 for 1 mm $< \rho <$ 1.5 mm and $\rho r = 0$ for $\rho >$ 1.5 mm. Find D everywhere. 10

b. Write Dir $\overline{D}$ in rectangular, cylindrical and spherical coordinates. 6

c. State and prove Gauss's Law. 4

UNIT - II

3 a. With usual notations, illustrate the relationship between E and V. Find E and D for the potential field, $V = 2x^2y - 5z$ and a point P(–4, 3, 6). 10

b. A uniform surface charge density of 20 nC/m^2 is present on the spherical surface r = 0.6 cm in free space; 10

i) Find the absolute potential at P(r = 1 cm, $\theta = 25°$, $\phi = 50°$)

ii) Find V_{AB}, given points A(r = 2 cm, $\theta = 30°$, $\phi = 60°$) and B(r = 3 cm, $\theta = 45°$, $\phi = 90°$)

4 a. Illustrate Boundary conditions for perfect dielectric materials. 10

b. A large brass washer has a 2 cm inside diameter, a 5 cm outside diameter, and is 0.5 cm thick. Its conductivity is $\sigma = 1.5x10^7$ S/m. The washer is cut half along a diameter, and a voltage is applied between the two rectangular faces of one part. The resultant electric field in interior of the half-washer is $E = 0.5/\rho\ a_\phi$ V/m in cylindrical coordinates, where washer is along Z - axis; 10

i) Potential difference exists between 2 rectangular faces

ii) What total current is flowing?

iii) What is the total resistance between the two faces?

Contd….2

UNIT - III

5 a. Describe scalar and vector magnetic potential in detail. 10

b. A current filament on the Z-axis carries a current of 7 mA in a $\bar{a}_z$ direction and current sheets of 0.5 a_z A/m and –0.2 a_z A/m are located at ρ = 1 cm and ρ = 0.5 cm respectively. Calculate H. 10

i) ρ = 0.5 cm ii) ρ = 1.5 cm iii) ρ = 4 cm

iv) What current sheet should be located at ρ = 4 cm so that H = 0 for all ρ > 4 cm?

6 a. Illustrate magnetic Boundary conditions for tangential and normal components. 8

b. A point charge for which Q = $2x10^{-6}$ C and M = $5x10^{-26}$ kg is moving in the combined fields E = $100a_x – 200a_y + 300a_z$ V/m and B = $–30a_x + 2a_y – a_z$ mT. If the charge velocity at t = 0 is $V(0) = (2a_x–3a_y–4a_z)$ 10^5 m/s 12

i) Give the unit vector showing the direction in which the charge is accelerating at $t = 0$

ii) Find the kinetic energy of the charge at t = 0.

UNIT - IV

7 a. Summarize point and integral form of Maxwell's $\in_0^m$. 8

b. Discuss displacement current density in detail using appropriate equations and analysis. 12

8 a. The phasor magnetic field intensity for a 400 MHz uniform plane wave propagating in a certain losses material is $(2a_y – j5a_z)\ e^{-j25e}$A/m. Knowing that the maximum amplitude of E is 1500 V/m. Find β, n, λ, V_p, $\in_r$, μ_r and H (x, y, z, t). 12

b. Write a note on plane wave reflection and its coefficient. 8

UNIT - V

9 a. What is wave tilt and mention the salient features of wave tilt. 8

b. Describe field strength due to the space wave using appropriate equations and mention any two considerations of it. 12

10 a. Mention the characteristics parameters of Ionosphere propagation. 10

b. Write a note on:

i) Critical frequency f_c

ii) MUF 10

iii) LUF

iv) OWF

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