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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 - 2018

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. Derive an expression for the electric field intensity due to infinite line charge. 10

b. Charger of 20 nc and -20 nc are located at (3, 0, 0) and (-3, 0, 0) respectively. Determine $\vec{E}$ at P(0, y, 0). 6

c. Explain electric field intensity at a point due to a point charge. 4

2 a. State and explain Gauss's Law. Mention the limitations of Gauss's law. 10

b. Given $\vec{D} = \frac{5r^2}{4}\hat{a}_r \; {}^{c}\!/_{m^2}$. Evaluate both the sides of divergence theorem for the volume enclosed by r = 4 m and $\theta = {}^{\pi}\!/_{4}$. 10

UNIT - II

3 a. Show that $\vec{E} = -\nabla V$ where $\vec{E}$ is the electric field intensity and V is the scalar potential. 6

b. Obtain the point form of continuity equation. 7

c. Given $V = 2x^2y - 5z$ at point P (-4, 3, 6) find the potential, electric field intensity and volume charge density. 7

4 a. Find the capacitance of a conducting sphere of 2 cm in diameter, covered with a layer of polyethylene with $\varepsilon_r = 2.26$ and 3 cm thick. 10

b. Use Laplace's equation to find the capacitance per unit length of a co-axial cable of inner radius '*a*' m and outer radius '*b*' m. Assume $V = V_0$ at r = a and V = 0 at r = b. 10

UNIT - III

5 a. Obtain the expression for the magnetic field intensity at a point due to a current carrying straight conductor of infinite length. 10

b. Given the vector magnetic potential $\vec{A} = x^2\hat{a}_x + 2yz\,\hat{a}_y + \left(-x^2\right)\hat{a}_z$ find the magnetic flux density. 6

c. List any four properties of curl. 4

6 a. Derive an expression for the force on a differential current element placed in a magnetic field. 10

b. Explain the concept of magnetic boundary conditions for normal component and tangential component. 10

Contd…2

UNIT - IV

7 a. A parallel plate capacitor with plate area of 5 cm^2 and plate separation of 3 mm has a voltage of 50 sin 10^3t V applied to its plates. Calculate the displacement current assuming E = $2\varepsilon_0$. 8

b. For time varying field, show that $\vec{E} = -\nabla V - \frac{\partial \vec{A}}{\partial t}$ where $\vec{A}$ is vector magnetic potential. 8

c. A 10 GHz plane wave travelling in a free space has an amplitude of $\vec{E}$ as E_x =10 V/m. Find β, η, v and λ. 4

8 a. Write a short note on skin effect in good conductors. 6

b. A uniform plane wave of 200 MHz travelling in a free space impinges normally on a large block of material having ε_r = 4, μ_r = 9, σ = 0. Calculate transmission and reflection coefficient at the interface. 6

c. State and explain Poynting theorem. 8

UNIT - V

9 a. Explain the effect of spherical earth surface on radio waves. 10

b. Explain different types of signals fading. 10

10 a. Define :

i) Skip distance

ii) MUF

iii) Virtual height 6

b. A distance of 1500 m is to be established along earth surface using communication link, if the reflection region of ionosphere has f_{cr} = 6 MHz and f_{mup} = 7.5 MHz. Calculate the height of the region. 8

c. Explain the characteristics of E and F layers of ionosphere layers. 6

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