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

(An Autonomous Institution affiliated to VTU, Belgaum)

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

Semester End Examination; June - 2016

Electromagnetic Theory

Time: 3 hrs *Max. Marks: 100*

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

UNIT - I

1. a. State and prove Coulomb's law. 5

   b. Explain the concept of Electric field intensity. 5

   c. Point charges of 50nc each are located at A (1, 0, 0), B (-1, 0, 0), C (0, 1, 0) and D (0, -1, 0) m. Find the total force on the charge at A. Also find the $\vec{E}$ at A. 10

2 a. State Gauss Law. Prove the same for various cases. 10

   b. Let $\vec{D} = 5r^2\hat{a}_r \; mC/m^2$ for $r < 0.08\,m$ and $\vec{D} = \frac{0.1}{r^2}\hat{a}_r \; mC/m^2$ for r > 0.08 m.

   i) Find ρ_V for r = 0.06 m

   ii) find ρ_V for r = 0.01 m 10

UNIT - II

3 a. Obtain the expression for potential field due to continuous (i) Line charge (ii) Surface charge distribution. 10

   b. Potential is given by $V = 2(x+1)^2(y+2)^2(z+3)^2\,V$ in free space. At a point P (2, -1, 4). Calculate; (i) Potential (ii) Electric field intensity (iii) Flux density (iv) Volume charge density. 10

4 a. Obtain the equation of continuity. 6

   b. Obtain the tangential and normal components for the boundary between two dielectrics. 8

   c. At the boundary between glass ($\in_r = 4$) and air, the lines of electric field make an angle of 40 with normal to the boundary. If electric flux density in air is 0.25 $\mu C/m^2$, determine the orientation and magnitude of electric flux density in glass. 6

UNIT - III

5 a. Derive expression of capacitance for ;

   i) co-axial cable (ii) two concentric spherical shell. 8

   b. Find the energy stored in free space for the region 2 mm ≤ r ≤ 3 mm, $0 \le \theta \le 90$ and $0 \le \phi < 90$ given the potential field $V = \frac{300\cos\theta}{r^2}$ *volt* 12

Contd…2

6. a State Uniqueness Theorem and prove the same. 10

b. Given $V = Al_n\left[\frac{B(1-\cos\theta)}{1+\cos\theta}\right]$ *volt* 10

i) Show that, V satisfies place equation in spherical co-ordinates.

ii) Find A and B so that V = 1400 V, $|\vec{E}|$=500 V/m at r = 5 m, θ = 90° and ϕ = 60°

UNIT - IV

7 a. Obtain expression for $\vec{H}$ at a point due to a current in a straight conductor of finite length using Biot Savart's law. 7

b. A single turn circular coil of 50 m in diameter carries a I of $28x10^4$ A. Determine the magnetic field intensity $\vec{H}$ at a point on the axis of coil and 100 m from the coil, $\mu_r = 1$. 5

c. State and prove Ampere's circuital law. 8

8 a. Derive ampere's Law in differential form. 10

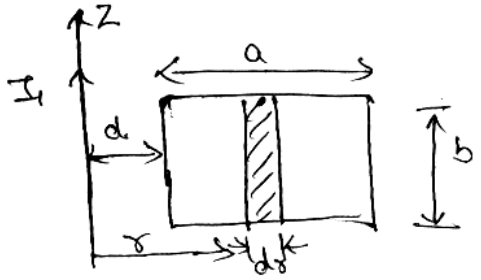
b. Given the field $\vec{H} = 6r\sin\phi\hat{a}_r + 18r\sin\theta\cos\phi\hat{a}_r$. Evaluate each side of Stoke's theorem for portion of a spherical surface specified by r = 4, $0 \le \theta \le 0.1\pi$, $0 \le \phi \le 0.3\pi$ and a closed path forming its perimeter. 10

UNIT - V

9 a. Obtain the expression for force on a differential current element in a magnetic field. 7

b. Obtain the expression of inductance for a solenoid. 5

c. Determine the mutual inductance between a conducting loop and a very long straight wire shown in the Fig.



8

10 a. Derive expression for Faraday's law in integral and point form. 10

b. Given $\vec{E} = E_m\sin(\omega t - \beta_z)\hat{a}_y$ in free space. Calculate $\vec{D}$, $\vec{B}$ & $\vec{H}$ 10

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