4E4133

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4E4133

B. Tech. IV Sem. (Main/Back) Exam., June/July-2014
Electronics & Communication Engg.
4EC4A Electromagnetic Field Theory

Time: 3 Hours **Maximum Marks: 80**
Min. Passing Marks: 24

Instructions to Candidates:-

*Attempt any **five questions**, selecting **one question** from **each unit**. All Questions carry **equal** marks. Schematic diagrams must be shown wherever necessary. Any data you feel missing suitably be assumed and stated clearly.*
Units of quantities used/ calculated must be stated clearly.
Use of following supporting material is permitted during examination.

UNIT-I

Q.1. (a) A vector field is given by the expression $\vec{A} = \frac{1}{r}\vec{a}_r$

(i) in cylindrical co-ordinates and

(ii) in spherical co-ordinates. Determine $\vec{A}$ in each case in Cartesian form, at a point (1, 1, 1) [10]

(b) Determine the value of $\nabla.\vec{A}$ at point (1,-1,1)

if $\vec{A} = \vec{i}\,x^2 z - \vec{j}\,2y^2z^2 + \vec{k}\,xy^2z$ [6]

OR

Q.1. (a) A vector field is given by $\vec{A} = yz\,\vec{a_x} + x_z\,\vec{a_y} + x_y\,\vec{a_z}$

Show that it is both irrotational (i.e. has zero curl) and solenoidal (i.e. has zero divergence) [8]

(b) Find the divergence of the vector function [8]

$\vec{A} = x^2\,\vec{a_x} + (xy)^2\,\vec{a_y} + 24\,x^2y^2z^2\,\vec{a_z}$

Evaluate the volume integral of $\nabla.\vec{A}$ through the volume of a units cube centered at the origin.

UNIT-II

Q.2. (a) Derive an equation for calculating the capacitance of a coaxial cable. [8]

(b) Derive Maxwell curl equation for static electric field. [8]

OR

Q.2. (a) Two small identical conducting spheres have charges of 2.0×10^{-9} coulomb and -0.5×10^{-9} coulomb respectively. When there are placed 4cm apart, what is the force between them? If they are brought into contact and then separated by 4cm; what is the force between them? [8]

(b) Derive an expression for electric field intensity $\vec{E}$ due to charge uniformly distributed over an infinite plane with surface charge density P_s. [8]

UNIT-III

Q.3. (a) State and explain Ampere's Law. A solid cylindrical conductor of radius R has a uniform current density. Derive expression for H both inside and outside of the

conductor. Plot the variation approximately of H as a function of radial distance from the centre of wire. [8]

(b) An iron ring of 10cm diameter and cross-section $4cm^2$ has a radial 8cm cut 1mm long. If the ring is wound with 56 turns of wire and the iron has a constant permeability (relative) of 200, determine the current required in the coil in creating a flux density of 1.0T in the air gap. Assume a leakage factor of 1.1 and neglect fringing. [8]

OR

Q.3. (a) Find the magnetic field and its curl at radius r within a copper conductor of radius $r_o > r$ Carrying current I uniformly distributed over the cross-section. [8]

(b) Explain the term magnetization. Find the magnitude of magnetization in a material in which

(i) There are 8.1×10^{28} atom / m^3 and the atoms have equal dipole moments of 1.7×10^{-33} Am^2

(ii) The relative permeability is 1.00038 and the magnetic field intensity is 0.31 A/m

(iii) $B = 3 \times 10^{-5}$ wb/m^3 and the magnetic susceptibility is -4×10^{-6}. [8]

UNIT-IV

Q.4. (a) By integrating the poynting vector over the cross section of a coaxial cable, show that the total power carried by the cable is VI, where V is the voltage and I is the current. [8]

(b) Find the reflection coefficient and transmission coefficient of an electric field wave travelling in air and incident normally on a boundary between air and dielectric having permeability of μ_o and permittivity $\varepsilon_r = 4$. [8]

OR

Q.4. (a) A plane electromagnetic wave having a frequency of 10MHz has an average poynting vector 1w/m^2. If the medium is lossless with relative permeability 2 and relative permittivity 3. Find

(i) The velocity of propagation

(ii) The wave length

(iii) The impedance of the medium and

(iv) The r.m.s electric field E. [10]

(b) A plane wave travelling in air is normally incident on a block of paraffin with ε_r=2.2. Find the reflection coefficient and standing wave ratio. [6]

UNIT-V

Q.5. (a) Explain in detail about retarded potential and concept of radiation. [8]

(b) What do you understand by EMI testing? Explain in detail emission testing and susceptibility testing. [8]

OR

Q.5. (a) Explain different EMI standards. What are different types of coupling modes? [8]

(b) Explain with examples different methods of eliminating interference, shielding and grounding. [8]

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