

4E4133

Roll No. _____

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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.

1. _____

2. _____

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 $\nabla \cdot \vec{A}$ at point (1,-1,1)

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

OR

Q.1. (a) A vector field is given by $\vec{A} = yz \vec{a}_x + xz \vec{a}_y + xy \vec{a}_z$

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]

$$\vec{A} = x^2 \vec{a}_x + (xy)^2 \vec{a}_y + 24 x^2 y^2 z^2 \vec{a}_z$$

Evaluate the volume integral of $\nabla \cdot \vec{A}$ through the volume of a unit 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 they 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 $r_0 > r$ 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} Am²

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

(iii) $B = 3 \times 10^{-5}$ wb/m³ 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_0 and permittivity $\epsilon_r = 4$. [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 $\epsilon_r=2.2$. 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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