*Total No. of Questions: 6* *Total No. of Printed Pages:3*

**Enrollment No.....**

# Faculty of Engineering

## End Sem (Even) Examination May-2019

## EC3CO08 Engineering Electromagnetics

Programme: B.Tech. Branch/Specialisation: EC

**Duration: 3 Hrs.** **Maximum Marks: 60**

Note: All questions are compulsory. Internal choices, if any, are indicated. Answers of Q.1 (MCQs) should be written in full instead of only a, b, c or d.

Q.1 i. In a (r,θ,z) co-ordinate system, the differential area directed in the +ve θ -direction is **1**

(a) $rdrd\theta\ a_z$ (b) $rdrd\theta\ a_\theta$ (c) $drdz\ a_\theta$ (d) $rdzd\theta\ a_r$

ii. The matric parameter $h_3$ for spherical co-ordinate system is **1**

(a) 1 (b) $rsin\theta$ (c) $r$ (d) None of these

iii. The Laplace Equation is **1**

(a) $\nabla^2 V = \varepsilon\rho$ (b) $\nabla^2 V = -\rho$

(c) $\nabla^2 V = 0$ (d) $\nabla . D = \rho$.

iv. The potential distribution in a given region of free space is of the form $V = 10x^3$ V the electric field at a point (1, 1, 1) is **1**

(a) $-30a_x$ V/m (b) $-30a_y$ V/m

(c) $-30a_z$ V/m (d) None of these.

v. The permeability for free space is **1**

(a) $4\pi\ H/m$ (b) $4x10^{-7}\ H/m$

(c) $10^{-7}\ H/m$ (d) None of these.

vi. What is the magnetic field intensity $\bar{H}$ for infinitely long straight conductor placed on Z-axis carrying current I Amp at a distance r? **1**

(a) $I\,a_y$ (b) $\frac{I}{2r}a_y$ (c) $\frac{I}{2\pi r}a_\Phi$ (d) Zero

vii. Which one of the following is a correct Maxwell's equation? **1**

(a) $\nabla \times \bar{H} = \frac{\partial \bar{D}}{\partial t} + -\bar{J}$ (b) $\nabla \times \bar{E} = \frac{-\mu \partial \bar{H}}{\partial t}$

(c) $\nabla . \bar{D} = \rho s$ (d) $\nabla . \bar{B} = J$

viii. The divergence of which quantity will be zero: **1**

(a) E (b) D (c) H (d) B

P.T.O.

ix. The Brewster angle for oblique incidence is **1**
(a) $tan^{-1}\frac{\varepsilon_1}{\varepsilon_2}$ (b) $tan^{-1}\frac{\varepsilon_2}{\varepsilon_1}$ (c) $1/\sqrt{\mu\varepsilon}$ (d) None of these

x. The electric field reflection co-efficient R for normal incidence at the interface of two media is **1**
(a) $\frac{\eta_1}{\eta_2}$ (b) $\frac{\eta_1-\eta_2}{\eta_1+\eta_2}$ (c) $\frac{\eta_2-\eta_1}{\eta_1+\eta_2}$ (d) None of these

Q.2 i. Find the dot product of A = $(3a_\rho + 3a_\emptyset + 5a_z)$ and B = $(3a_\rho + 3a_\emptyset + 3a_z)$ **2**

ii. Prove that divergence of gradient of A = (4xy+ 3zx + 5xyz) is zero. **3**

iii. Convert A = $(4a_\rho + 3a_\emptyset + 5a_z)$ at the point (3, $90^0$, 5) in spherical coordinates. **5**

OR iv. Find the nature of field (irrotational or solenoidal) **5**
F = $\frac{150}{r^2}\ a_r + 10a_\emptyset + 5a_\theta$

Q.3 i. State the Gauss' Divergence theorem in point and integral form. **2**

ii. A charged spherical shell having radius a charged with Q coulomb. Find the following quantities: **8**
(a) Electric field every where
(b) Potential difference every where
(c) Capacitance
(d) Plot the electric and potential field Vs distance

OR iii. Derive the Electric Field due to an infinite sheet of charge situated at z=0 using Coulomb's Law. **8**

Q.4 i. (a) State Modified Ampere Circuital Law? **4**
(b) Define Magnetic Vector Potential.

ii. Determine the magnetic field intensity due to infinite sheet current of current density $\bar{K}a_z A/m$ in yz-plane by using Biot-Savart's law. **6**

OR iii. A copper disc of 0.5m in diameter is rotated at a constant speed 2000 rpm in a horizontal axis perpendicular to and through the centre of the disc. The axis lies in magnetic meridian. Two brushes contact the disc, one at the edge and other at the centre of the disc. If the horizontal component of earth field is .2 Gauss, find the EMF between the brushes. **6**



Q.5 i. Write the Maxwell Equation in Integral Form for time harmonically varying fields. **2**

ii. (a) Define skin depth. Explain Faraday's law for time varying fields. **8**
(b) Derive the attenuation constant, phase constant, intrinsic impedance, and phase velocity for a good dielectric.

OR iii. If an electric field is given by $\bar{E} = \frac{E_0\, Sin\theta Cos(\omega t-\beta r)}{r}\, a_\theta$, find **8**
(a) Magnetic field associated with it.
(b) Poynting Vector
(c) Total power radiated
(d) Average power radiated.

Q.6 i. What is total internal reflection? **2**

ii. Derive the reflection co-efficient and transmission coefficient for horizontal polarization. **8**

OR iii. A parallel polarized wave is obliquely incident with an angle of $30^0$ in between the two dielectrics with dielectric constants $4\varepsilon_0$ and $9\varepsilon_0$. Find the reflection coefficient and transmission coefficient. **8**

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# Marking Scheme

## EC3CO08 Engineering Electromagnetics

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ii. The matric parameter $h_3$ for spherical co-ordinate system is **1**
(b) $rsin\theta$

iii. The Laplace Equation is **1**
(c) $\nabla^2 V = 0$

iv. The potential distribution in a given region of free space is of the form $V = 10x^3$ V the electric field at a point (1, 1, 1) is **1**
(a) $-30a_x$ V/m

v. The permeability for free space is **1**
(d) None of these.

vi. What is the magnetic field intensity $\bar{H}$ for infinitely long straight conductor placed on Z-axis carrying current I Amp at a distance r? **1**
(c) $\frac{I}{2\pi r}$ $a_\Phi$

vii. Which one of the following is a correct Maxwell's equation? **1**
(b) $\nabla \times \bar{E} = \frac{-\mu \partial \bar{H}}{\partial t}$

viii. The divergence of which quantity will be zero: **1**
(d) B

ix. The Brewster angle for oblique incidence is **1**
(b) $tan^{-1}\frac{\varepsilon_2}{\varepsilon_1}$

x. The electric field reflection co-efficient R for normal incidence at the interface of two media is **1**
(c) $\frac{\eta_2 - \eta_1}{\eta_1 + \eta_2}$

Q.2 i. Find the dot product of A = $(3a_\rho + 3a_\emptyset + 5a_z)$ and B = $(3a_\rho + 3a_\emptyset + 3a_z)$ **2**
Stepwise marking

ii. Prove that divergence of gradient of A = (4xy+ 3zx + 5xyz) is zero. **3**
Stepwise marking

iii. Convert A = $(4a_\rho + 3a_\emptyset + 5a_z)$ at the point (3, $90^0$, 5) in spherical coordinates. **5**
Stepwise marking

OR iv. Find the nature of field (irrotational or solenoidal) **5**
Stepwise marking

Q.3 i. State the Gauss' Divergence theorem **2**
In point 1 mark
Integral form. 1 mark

ii. A charged spherical shell having radius a charged with Q coulomb. Find the following quantities: **8**
(a) Electric field every where 2 marks
(b) Potential difference every where 2 marks
(c) Capacitance 2 marks
(d) Plot the electric and potential field Vs distance 2 marks

OR iii. Derive the Electric Field due to an infinite sheet of charge situated at z=0 using Coulomb's Law. **8**
Stepwise marking

Q.4 i. (a) State Modified Ampere Circuital Law 2 marks **4**
(b) Define Magnetic Vector Potential. 2 marks

ii. Determine the magnetic field intensity due to infinite sheet current of current density $\bar{K}a_z A/m$ in yz-plane by using Biot-Savart's law. **6**
Stepwise marking

OR iii. Find the EMF between the brushes. **6**
Stepwise marking

Q.5 i. Write the Maxwell Equation in Integral Form for time harmonically varying fields. **2**

ii. (a) Define skin depth. 2 marks **8**
Explain Faraday's law for time varying fields. 2 marks
(b) Attenuation constant 1 mark
Phase constant 1 mark
Intrinsic impedance 1 mark
Phase velocity for a good dielectric. 1 mark

OR iii. If an electric field is given by $\bar{E} = \frac{E_0\, Sin\theta Cos(\omega t - \beta r)}{r} a_\theta$, find **8**
(a) Magnetic field associated with it. 2 marks
(b) Poynting Vector 2 marks
(c) Total power radiated 2 marks
(d) Average power radiated. 2 marks

Q.6 i. Total internal reflection **2**

ii. Reflection co-efficient 4 marks **8**
Transmission coefficient 4 marks

OR iii. Reflection coefficient 4 marks **8**
Transmission coefficient. 4 marks

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