*Total No. of Questions :5]* *[Total No. of Printed Pages :4*

**Roll No .....**

# EC 402

## BE IV Semester

Examination, June 2013

## Electro-Magnetic Theory

***Time : Three Hours***

***Maximum Marks : 70/100***

***Note:*** 1. Attempt any two questions in each unit.
2. Each questions having equal marks.

### Unit - I

1. a) A particular scalar field $\alpha$ is given by

i) $\alpha = 20e^{-x}\sin\left(\frac{\Pi Y}{6}\right)$

ii) $\alpha = \frac{40\cos\theta}{r^2}$

Find its gradient at P (0,1,1) for Cartesians and P (3, 60°, 30°)for spherical system.

b) Eight point charges of 1nc each are located at the corners of a cube in free space that is 1m on a side. Find $|\vec{E}|$ at the center of

i) The cube





ii) A face and

iii) An edge

c) Prove that the divergence of the electric field and that of electric flux density in a charge free region is zero.

### Unit - II



2. a) Prove Laplace's and Poisson's equation and show that they have Unique solutions.

b) Given the potential field $V = \left(\frac{50\sin\theta}{r^2}\right)V$ in free space :

i) Determine whether V satisfies Laplace's equation

ii) Find the total charge stored inside the spherical shell $1 < r < 2$.

c) consider a short copper wire of length '2L' and cross-section area a situated in the air coincident with z-axis at the origin. The current density J in positive z-direction. J is uniform through out the wire and constant with respect to time. Find the magnetic flux B every where at a large distance from wire using the concept of vector potential.

### Unit - III

3. a) Given that $\vec{H}_1 = -2\vec{a_x} + 6\vec{a_y} + 4\vec{a_z}$ in region $y - x - 2 \le 0$ where $M_1 = 5\ M_o$. Calculate $\vec{H_2}$ and $\vec{B_2}$ in the region $y - x - 2 \ge 0$ where $M_2 = 2\ M_o$

b) A certain material has $\sigma = 0$ and $H_R = 1$. If $\vec{E} = 800\sin(10^6 + -0.01z)\vec{a_y}\ V/m$ move use of Maxwell's equations to find. $E_R \times$find $\vec{H}(z,t)$

c) Write short notes on :

i) Skin depth

ii) Phase velocity

iii) Intrinsic impedance

**Unit - IV**

4. a) In homogenous regions where $M_r = 1$ and $E_r = 50$, the fields are given as

$\vec{E}=20\pi e^{j(\omega t-\beta z)}\,\vec{a}_x\ V/m$ and

$\vec{B}=M_0H_0\,e^{j(\omega t-\beta z)}\,\vec{a}_y$ T. find $\omega$ and $M_o$ if the wavelength is 1.75 meter.

b) Derive an expression for energy associated with plane electromagnetic wave and define poynting vector. Use it to find time average power density due to uniform plane in perfect dielectric.

c) An FM wave travelling in a dielectric medium having dielectric constant 9 is incident at an angle on the dielectric-air interface. Determine

i) Critical angle

ii) If the angle of incidence is 15°

Calculate the reflection coefficient for the perpendicular polarization.

**Unit - V**

5. a) Derive expression for transmitted and reflected field, when a plane electromagnetic wave is incident on the surface of a perfect dielectric.

b) Light is incident from air to glass at Brewster's angle. Determine the incident and transmitted angles.







c) A generator of 1 volt, 1000 Hz supplier power to 1000 Km long open wire terminated in $z_0$ (characteristics impedance) and having following parameters :

R $=10.4\,\Omega$

L $=0.0037$ H

G $=0.8$ M mhos

C $= 0.00835$Mf.

Calculate the phase velocity characteristic Impedance and propagation constant.

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