Code: 13A04403 **R13**

B.Tech II Year II Semester (R13) Supplementary Examinations December/January 2015/2016

ELECTROMAGNETIC THEORY & TRANSMISSION LINES

(Electronics and Communication Engineering)

Time: 3 hours Max. Marks: 70

PART – A

(Compulsory Question)

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1 Answer the following: (10 X 02 = 20 Marks)

(a) Express unit vectors of cylindrical coordinates in terms of unit vectors of rectangular coordinates with help of suitable diagram.

(b) Given the potential field, $V = 2x^2y - 5z$, find the electric field intensity $\vec{E}$ at point $P(-4, 3, 6)$.

(c) State and explain Biot-Savart's law.

(d) There are two current loops placed apart and are carrying I_1 & I_2 respectively. Give the expression for magnetic force on current loop 1 due to current loop 2.

(e) A parallel – plate capacitor with plate area of 5 cm^2 and plate separation of 5 mm has a voltage $36\pi \sin 1000t$ V applied to its plates. Calculate the displacement current assuming $\varepsilon_r = 2$ of the medium between the plates.

(f) State the two boundary conditions for the magnetic fields at the interface of two different media.

(g) Let us consider two perfect dielectric media 1 & 2 with their intrinsic impedances $\eta_1 = 100\,\Omega$ & $\eta_2 = 300\,\Omega$ respectively. If the maximum amplitude of incident electric field intensity (in medium1) $E_1^+ = 100\,V/m$, determine amplitude of the transmitted electric field intensity E_2^+.

(h) What is skin depth? Give the expression for skin depth in case of good conductors.

(i) Define: (i) A losses line. (ii) A distortionless line.

(j) A certain microstrip line has fused quartz $(\varepsilon_r = 3.8)$ as a substrate. If the ratio of line width to substrate thickness is $\frac{w}{h} = 4.5$, determine effective relative permittivity of the substrate.

PART – B

(Answer all five units, 5 X 10 = 50 Marks)

UNIT – I

2 (a) Derive the expression for Electric field intensity $(\vec{E})$ at any point due to finite length line charge with suitable sketches.

(b) A plane at $y = -5$ carries a surface charge of $15\ nC/m^2$. If a line x = 0, z = 2 carries charge $10\Pi\ nC/m$, calculate the electric flux density $(\vec{D})$ at (1, 1, 1) due to the charge distributions. Assume free space.

OR

3 (a) Obtain the expression for electric field intensity $\vec{E}$ at a far point due to a dipole located at the origin.

(b) Given the potential field $V = 50\sin\theta/r^2\ V$ in free space, determine whether potential V satisfies Laplace's equation or not. Justify the statement.

UNIT – II

4 (a) State Ampere's circuital law. Apply this law to determine magnetic field intensity $\vec{H}$ at any point in free space due to (i) An infinite line current. (ii) An infinite current sheet.

(b) A strait solid wire segment carrying a current 2 $\hat{a}_y$ A extends from a point (0,1,2) to another point (0,4,2) in free space. This wire is subjected to the magnetic field of an infinite current filament lying along the z – axis and carrying 25 A in the $\hat{a}_z$ direction. Find the vector torque on the wire segment about an origin at a point (0, 0, 2).

OR

5 (a) Establish the relationship between magnetic energy and the magnetic field intensity.

(b) One infinite current filament of 10 A lies on y-axis along $\hat{a}_y$ & another infinite current filament of 20 A lies on z-axis along $-\hat{a}_z$. Find the magnetic field intensity $\vec{H}$ at (-3, 4, 5).

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UNIT – III

6 Derive all the Maxwell's equations for time varying fields from the fundamental principles of electromagnetic fields.

OR

7 (a) Express the Maxwell's equations in phasor form and give their word statements.

(b) The region $z < 0$ contains a perfect dielectric for which $\varepsilon_{r_1} = 2.5$, while the region $z > 0$ is characterized by $\varepsilon_{r_2} = 4$. If $\vec{E}_1 = -30\,\hat{a}_x + 50\hat{a}_y + 70\hat{a}_z\ V/m$, find the electric flux density in the region 2.

UNIT – IV

8 (a) Derive the Helmholtz's equation using electric field intensity for lossy dielectrics from the Maxwell's equations & solve the same in rectangular coordinates to obtain the expression for electric field intensity.

(b) In nonmagnetic medium $\vec{E} = 4\,sin(2\pi \times 10^7 t - 0.8x)\hat{a}_z\ V/m$. Find the time averaged power carried by the wave.

OR

9 (a) State and prove the Poynting theorem. Give its word statement.

(b) For a copper coaxial cable, let a = 2 mm, b = 6 mm and thickness t = 1 mm. Calculate the resistance of 2 m length of the cable at 100 MHz. Assume that the conductivity of copper material is $5.8 \times 10^7\ mho/m$.

UNIT – V

10 (a) Derive the expression for input impedance of a transmission line when it is terminated by a load.

(b) A distortionless line has $Z_0 = 60\,\Omega$, attenuation constant a = 20 mNp/m, signal velocity $u = 1.8 \times 10^8\ m/s$. Find the primary parameters of the transmission line at 100 MHz.

OR

11 (a) Explain the importance of Smith chart with all its details.

(b) A 30 ohm lossless transmission line has $Z_0 = 50\,\Omega$ operating at 2 MHz is terminated with a load $Z_L = 60 + j40\,\Omega$. If the signal velocity on the line is 60% of velocity of light, then find the reflection coefficient and input impedance.

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