Code: 15A04403

R15

B.Tech II Year II Semester (R15) Supplementary Examinations December 2018

ELECTROMAGNETIC THEORY & TRANSMISSION LINES

(Electronics & 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) State the relation between electric flux density and electric field intensity.

(b) Obtain Poisson's equation from Gauss's law.

(c) Define magnetic dipole.

(d) Write the expression for inductance of a toroid.

(e) Define displacement current.

(f) Write the Maxwell's equation from ampere's law both in integral and point form.

(g) Define electromagnetic wave.

(h) Mention any two properties of uniform plane wave.

(i) Derive the relationship between SWR and reflection co-efficient.

(j) Find the characteristic impedance of a line at 1600 Hz, if Z_{OC} = 750 $\angle$-30°Ω and Z_{SC} = 600 $\angle$-20°Ω.

PART – B

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

UNIT – I

2 Find the curl of the following vector fields:

(i) $\vec{A} = e^{xy}\overrightarrow{a_x} + \sin(xy)\,\overrightarrow{a_y} + cos^2(xz)\overrightarrow{a_z}$.

(ii) $\vec{B} = \rho z^2\ cos\phi\overrightarrow{a_\rho} + zsin^2\phi\overrightarrow{a_z}$.

OR

3 State and prove Gauss law.

UNIT – II

4 Explain the vector potential and drive its expression.

OR

5 State and prove Biot-Savart law.

UNIT – III

6 Express Maxwell's equations for good conductors.

OR

7 Describe Faraday's disc generator with a neat sketch. Derive the expression for the emf induced.

UNIT – IV

8 Electric field intensity associated with a plane wave traveling in a perfect dielectric medium is given by Ex = 10 sin $(2\pi \times 10^7 t - 0.1\pi z) v/m. \varepsilon_r = 1$.

(i) What is the velocity of propagation?

(ii) Write down the expression for the magnetic field associated with the wave if $\mu = \mu_0$.

OR

9 Derive the generalized wave equation.

UNIT – V

10 Derive the general solution of a transmission line and explain its physical significance.

OR

11 A generator of 1 V, 1000 Hz supplies power to a 100 km open wire line terminated in Z_o having the following line parameters: R = 10.4 Ω/km , L = 0.00367 H/km, G = 0.8 x 10^{-6} mho/km, C = 0.00835 $\mu F/km$. Calculate the characteristic impedance, propagation constant, attenuation and phase constant, velocity of propagation, sending end current, input power.

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(a) State and explain the Coulomb's law.

(b) Derive the Passion's and Laplace equations for electrostatic field.

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

(d) Write down the Maxwell's equations in word statement.

(e) Define the uniform plane wave.

(f) Define polarization. Explain different types of polarization.

(g) Define the propagation constant in terms of primary constants.

(h) Define the group velocity.

(i) Define the stub.

(j) Write down the applications of smith chart.

PART – B

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

UNIT – I

2 (a) Given the field $D = 6\rho \sin\frac{1}{2}\phi \hat{a}_\rho + 1.5\cos\phi\, \hat{a}_\phi c/m^2$, evaluate both sides of the divergence theorem for the region bounded by $\rho = 2, \phi = 0\ to\ \phi = \pi\ and\ \ z = 0\ to\ z = 5$.

(b) At given points A(5,70^0,-3) and B(2,-30^0,1), find :

(i) A unit vector in Cartesian co-ordinates at A directed towards B.

(ii) A unit vector in cylindrical co-ordinates at A directed toward B.

(iii) A unit vector in cylindrical co-ordinates at B directed towards A.

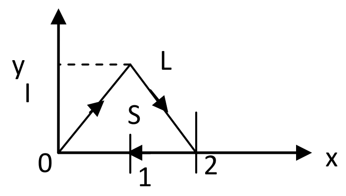
OR

3 Express the vector field $\vec{D} = (x^2 + y^2)^{-1}\left(x\hat{a}_x + y\hat{b}_y\right)$ in cylindrical components and cylindrical variables. Determine the vector normal to $S(x, y, z) = x^2 + y^2 - z\ at\ point\ (1,3,0)$.

UNIT – II

4 Given that $\vec{F} = \left(x^2 y\hat{a}_x - y\hat{a}_y\right)$, find:

(a) $\oint_L \ \overrightarrow{F} \bullet dL$, where L is shown in the figure below.



(b) $\int_S \left(\nabla X \vec{F}\right) \bullet ds$, where S is the area bounded by L.

OR

5 A uniform line charge of 16 nC/m is located along the line defined by y = -2, z = 5. If $\varepsilon = \varepsilon_0$, find $\vec{E}$, at point P(1,2,3). Plane x + 2y = 5 carries charge $\rho_s = 6nC/m^2$. Determine $\vec{E}$ at (-1,0,1).

Contd. in page 2

UNIT – III

6 A dielectric material contains 2 X 10^{19} polar molecules/m^3, each of dipole moment 1.8 X 10^{-27} cm. Assuming that all dipoles are aligned in the direction of electric field $\vec{E} = 10^5 a_x$ V/m, find polarization $\vec{P}$ and relative permittivity ε_r.

OR

7 Region 1 (z<0) contains a dielectric for which ε_{r1} = 2.5, while region 2 (z>0) is characterized by ε_{r2} = 4. Let $\overrightarrow{E_1} = -30a_x + 50a_y + 70a_z \frac{V}{m}, find\ \overrightarrow{D_2}\ \&\ \overrightarrow{P_2}$.

UNIT – IV

8 (a) Derive the equation for uniform plane wave in terms of H.

(b) A 100 MHz uniform plane wave propagates in a lossless medium for which ε_r = 5 and μ_r = 1 find V_p, β, λ, E_s, H_s.

OR

9 (a) State and prove the Pointing vector theorem.

(b) Write short notes on: (i) Surface impedance. (ii) Brewster angle.

UNIT – V

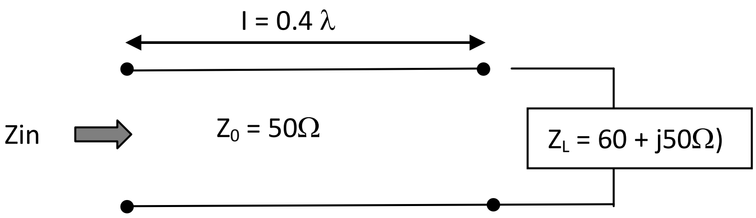
10 A lossless transmission line of electrical length = 0.4 λ is terminated with a complex load impedance as shown in the accompanying figure below. Find the following using smith chart.

(a) Reflection coefficient at the load.

(b) The SWR on the line.

(c) The reflection coefficient at the input of the line.

(d) The input impedance to the line



OR

11 Derive the transmission line equation for lossless line and obtain the expressions for propagation constant (γ) and Z_0.

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(g) Define the propagation constant in terms of primary constants.
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PART – B

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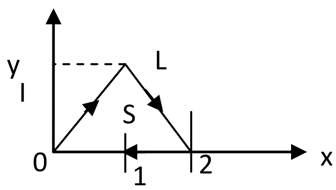

(b) $\int_S (\nabla X\vec{F}) \bullet ds$, where S is the area bounded by L.

OR

5 A uniform line charge of 16 nC/m is located along the line defined by y = -2, z = 5. If ε = ε$_0$, find $\vec{E}$, at point P(1,2,3). Plane x + 2y = 5 carries charge $\rho_s = 6nC/m^2$. Determine $\vec{E}$ at (-1,0,1).

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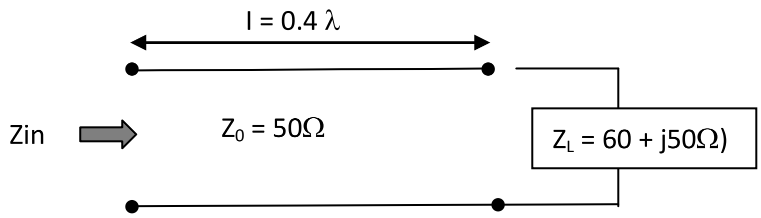

OR

11 Derive the transmission line equation for lossless line and obtain the expressions for propagation constant (γ) and Z_0.

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B.Tech II Year II Semester (R15) Regular Examinations May/June 2017

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(Electronics & Communication Engineering)

Time: 3 hours Max. Marks: 70

PART - A

(Compulsory Question)

*****

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

(a) Define electric field and electric flux density.

(b) Define electric dipole. Differentiate between polar and nonpolar dielectrics.

(c) State and express the Stokes theorem.

(d) Write down the Maxwell's equations in free space condition.

(e) Define skin depth or depth of penetration.

(f) State and express the Poynting theorem.

(g) Write down the distortion less line.

(h) Define transmission line. Explain different types of transmission lines.

(i) Define the voltage standing wave ratio.

(j) Difference between the single stub matching and double stub matching.

PART - B

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

UNIT - I

2 Uniform line charge of 0.4 μC and -0.4 μC are located in the $x = 0$ plane at $y = -0.6$ and 0.6 m respectively. Let $\varepsilon = \varepsilon_0$. Find E at:

(a) $P(x, 0, z)$

(b) $Q(2, 3, 4)$

OR

3 Given $D = 8\rho \ \sin\phi \hat{a}_\rho + 4\rho \ \cos\phi \hat{a}_\phi \ C/m^2$.

Find the volume charge density at $P(2.6, 38°, -6.1)$.

How much charge is located inside the region defined by $0 < \rho < 1.8, 0° < \phi < 70°, 2.4 < z < 3.1$.

UNIT - II

4 A unit vector directed from region 1 to region 2 at the planar boundary between two perfect dielectrics is given as $\hat{a}_{N12} = (-2/7)\hat{a}_x + (3/7)\hat{a}_y + (6/7)\hat{a}_z$. Assume $\varepsilon_{r1} = 3$, $\varepsilon_{r2} = 2$ and electric field in region 1 is $\vec{E}_1 = 100\hat{a}_x + 80\hat{a}_y + 60\hat{a}_z \ V/m$. Find the electric field $\vec{E}_2$, polarization vector $\vec{P}_2$ in region 2 and the angles made by the vectors $\vec{E}_1$ and $\vec{E}_2$ with the normal to the interface.

OR

5 Derive an equation for magnetic field intensity due to:

(a) Infinite line placed along z-axis at an observation point P on y axis.

(b) Infinite sheet with uniform current density placed in z = 0 plane.

Contd. in page 2

UNIT - III

6 In a lossless medium $\eta = 40\pi$, $\mu_r = 1$ and $H = 2\cos(\omega t - z)\hat{a}_x + 5\sin(\omega t - z)\hat{a}_y A/m$. Find ε_r, ω and E for the medium.

OR

7 In a medium $\vec{E} = 16e^{-0.05x}\ \sin(2 \times 10^8 t - 2x)a_z\ V/m$ find:

(a) Propagation constant.

(b) Wavelength.

(c) Speed of the wave.

UNIT - IV

8 In a nonmagnetic material $H = 30\cos(2\pi \times 10^8 t - 6x)\hat{a}_y\ mA/m$. Calculate:

(a) The intrinsic impedance.

(b) The Poynting vector.

(c) The time average power crossing the surface.

$x = 1,\ 0 < y < 2,\ 0 < z < 3\ m$.

OR

9 Explain reflection of uniform plane wave by a perfect conductor in the case of oblique incidence for parallel polarization.

UNIT - V

10 A transmission line 100 km long has the following impedance measurements at 1796 Hz, $Z_{oc} = 328\angle -29.2°$, $Z_{sc} = 1548\angle 6.8°$. Determine the primary line constants.

OR

11 Using Smith chart, determine VSWR, the input impedance and reflection coefficient at the input end of a transmission line of 50 Ω, terminated by a load impedance of $Z_L = 25 + j50\ \Omega$. The length of the line is 60 cm and the wavelength on the line $\lambda = 2\ cm$.

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