Code No: RR220403 **Set No.1**

II B.Tech. II Semester Regular Examinations, April/May -2005
E M WAVES AND TRANSMISSION LINES
(Common to Electronics & Communication Engineering and Electronics & Telematics)

Time: 3 hours **Max Marks: 80**

Answer any FIVE Questions
All Questions carry equal marks

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1. (a) Establish Poisson's and Laplace's equations from Gausss law.
   (b) Obtain the expressions for the far field and the potential due to a small electric dipole oriented along Z-axis.

2. Define Ampere's work law for magneto static fields. Hence derive the expressions for the magnetic fields in the different regions of a coaxial cable, having inner conductor radius of a , outer conductor of inner radius b and thickness t .Sketch the field variations with radial distance.

3. (a) Show that $\overline{E}$ and $\overline{H}$ are Perpendicular to each other, in phase and the ratio of their magnitudes is a contant for a uniform plane wave.
   (b) In a material for which $\sigma = 5$ siemen/m and $\varepsilon_r = 1$, the electric field intensity E = 250 sin 10^{10}t V/m. Calculate the conduction and displacement current densities and the frequency at which they have equal magnitudes.

4. (a) What is meant by the polarization of wave? When is the wave linearly polarized and circularly polarized?
   (b) A traveling wave has two linearly polarized components $E_x = 2$ Cos Wt and $E_y = 3Cos(Wt + \pi/2)$
      i. What is the axial ratio.
      ii. What is the tilt angle of the major axis of the polarization ellipse?
      iii. What is the sense of rotation?

5. (a) Define plane of incidence and reflection coefficient?
   (b) Derive an expression for reflection when a wave is incident on a dielectric obliquely with parallel polarization.

6. For a Parallel plane wave guide of 3 cm seperation, determine all the propogation characteristics, for a signal at 10 GHz, for
   (a) TE_{10} waves
   (b) TEM waves
   Explain the terms used.

7. (a) Define characteristic impedance and propagation constants of transmission lines and obtain lossless conditions.

(b) A lossless transmission line of length 100m has an inductance of 28 μ H and capacitance of 20 nF. Find out

i. propagation velocity

ii. phase constant at an operating frequency of 100 KH_z

iii. characteristic impedance of the line.

8. (a) Describe all the characteristics of UHF Lines?

(b) Explain the significance and design of single stub impedance Matching. Discuss the factors on which stub length depends.

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Code No: RR220403 **Set No.2**

II B.Tech. II Semester Regular Examinations, April/May -2005
E M WAVES AND TRANSMISSION LINES
(Common to Electronics & Communication Engineering and Electronics & Telematics)

Time: 3 hours **Max Marks: 80**

Answer any FIVE Questions
All Questions carry equal marks

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1. (a) A uniform line of length 2 m with total charge 3 nC is situated coincident to the z-axis with its center point 2 m from the origin. At a point on the x-axis, 2m from the origin, find V and $\overline{E}$.
   (b) A point charge of 3 nC is on the z-axis, 2 m away from the origin. Find the resultant V and $\overline{E}$

2. Define Ampere's work law for magneto static fields. Hence derive the expressions for the magnetic fields in the different regions of a coaxial cable, having inner conductor radius of a , outer conductor of inner radius b and thickness t .Sketch the field variations with radial distance.

3. (a) From the Maxwell's Curl's equations, derive the wave equations for a plane wave traveling in the Positive X-direction in a medium with constants $\mu = \mu_0, \varepsilon = \varepsilon_0$ and $\sigma \neq 0$.
   (b) If distilled water has constants $\mu_r = 1, \varepsilon_r = 81$ and Power factor = 0.05 at 1GHz, Calculate the Depth of penetration.

4. (a) Explain the terms "Linear Polarization", "Elliptical polarization" and "Circular polarization".
   (b) In a medium $\overline{\mathrm{E}} = 16\mathrm{e}^{-\mathrm{x}/20}\ \ \mathrm{Sin}(2 \times 10^8\mathrm{t} - 2\mathrm{x})\ \ \widehat{\mathrm{Z}}\mathrm{V/m}$. Find the direction of propogation, the propogation constant, wavelength, speed of the wave and skin depth.

5. (a) Define plane of incidence and reflection coefficient?
   (b) Derive an expression for reflection when a wave is incident on a dielectric obliquely with parallel polarization.

6. (a) For a parallel plane wave guide having z-propogation, explain the nature of variation and sketch the variation of E and H for TM_{10} waves.
   (b) Starting from the characteristic equation for propogation constant, establish the mathematical relations for the characteristics of TE and TM waves in a parallel plane guide.

7. (a) Define the i/p impedance of a transmission line and derive the expression for it.

(b) The characteristic impedance of a certain line is $710 \lfloor \underline{14}^{0}\ \Omega$ and $\gamma = 0.007 + j0.028$ per km. The line is terminated in a 300 Ω resistor. Calculate the i/p impedance of the line if its length is 100 km.

8. (a) An open-wire transmission line having $Z_0 = 650 \lfloor \underline{-12}^{0}\ \Omega$ is terminated in Z_0 at the receiving end. If this line is supplied from a source of internal resistance 300Ω , calculate the reflection factor and reflection loss at the sending end terminals.

(b) A two wire line has a characteristic impedance of 300 Ω and is to feed a 90 Ω resistor at 100 MHz. A Quarter wave line is to be used as a tube, 0.25 inch in diameter. Find centre-to-centre spacing in air?

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Code No: RR220403 **Set No.3**

II B.Tech. II Semester Regular Examinations, April/May -2005
E M WAVES AND TRANSMISSION LINES
(Common to Electronics & Communication Engineering and Electronics & Telematics)

Time: 3 hours **Max Marks: 80**

Answer any FIVE Questions
All Questions carry equal marks

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1. (a) A uniform line of length 2 m with total charge 3 nC is situated coincident to the z-axis with its center point 2 m from the origin. At a point on the x-axis, 2m from the origin, find V and $\overline{E}$.
   (b) A point charge of 3 nC is on the z-axis, 2 m away from the origin. Find the resultant V and $\overline{E}$

2. (a) Find the field at the centre of a circular loop of radius ' a' , carrying a current I along $\widehat{\phi}$ in z = 0 plane.
   (b) Determine the magnetic flux , for the surface described by
      i. $\rho = 1m., 0 \leq \phi \leq \pi/2, 0 \leq z \leq 2m.$,
      ii. a sphere of radius 2 m., if the magenic field is of the form $\overline{H} = \left[\frac{1}{\rho}Cos\phi\right]\widehat{\rho}A/m.$
   (c) A conducting plane at y = 1 carries a surface current of 10 $\widehat{Z}$ mA/m. Find H and B at (0, 0, 0) and at (2, 2, 2).

3. (a) State the boundary conditions satisfied by electromagnetic fields E and H at the interface of air and a perfect dielectric. If the dielectric material is replaced by a perfect conductor, how do the boundary conditions get modified?
   (b) In a medium of $\mu_r = 2$, find $\overline{\text{E}}$,$\overline{\text{B}}$ and displacement current density if $\overline{H} = 25$ Sin (2 x 10^8t + 6x) $\widehat{y}$ mA/m.

4. (a) Drive the expression for attenuation and phase constants of uniform plane wave.
   (b) If $\varepsilon_r = 9, \mu = \mu 0$ for the medium in which a wave with frequency f = 0.3 GHz is propagating, determine propagation constant and intrinsic impedance of the medium when
      i. $\sigma = 0$ and
      ii. $\sigma = 10$ mho/m.

5. (a) Define surface impedance and explain how it exists?
   (b) Derive expression for reflection and transmission coefficients of an EM wave when it is incident normally on a dielectric.
   (c) The reflected magnetic field $H_r = -\sqrt{2}mA/m$, and the incident electric field in medium 1 (free space) os 1.0 mv/m. The medium2 has $\varepsilon_{r2} = 18.0$ and $\sigma_2 = 0$. Determine the permeability of medium2.

6. Derive the expressions for the E and H field components for TM waves in a parallel plane wave guide, using Maxwell's equations approach.

7. (a) Define the reflection coefficient and derive the expression for the i/p impedance in terms of reflection coefficient.

   (b) Explain how the i/p impedance varies with the frequency with sketches.

8. (a) Explain the method of determining the input impedance of line using Smith chart, for a loss less Line of length Ω , at any frequency f, for a complex bad of Z_R.

   (b) A loss less Line of 300 Ω is terminated by a load of Z_R. If the VSWR at 200MHz is 4.48, and the first V_{min} is located at 6 cm from the load. Calculate the reflection coefficient and Z_R.

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Code No: RR220403 **Set No.4**

II B.Tech. II Semester Regular Examinations, April/May -2005
E M WAVES AND TRANSMISSION LINES
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Time: 3 hours **Max Marks: 80**

Answer any FIVE Questions
All Questions carry equal marks

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1. (a) Explain the following terms:
   i. Homogeneous and isotropic medium and
   ii. Line, surface and volume charge distributions.
   (b) A circular ring of radius 'a' carries uniform charge ρ_L C/m and is in xy-plane. Find the Electric Field at Point (0, 0, 2) along its axis.

2. (a) A square conducting loop of side a carries a current I in clockwise direction, and is in z = 0 plane. Find the field and flux density at the centre of the loop.
   (b) Compare and explain the field expressions for the cases of
   i. a long solenoid and
   ii. a toroid, considering the inside and outside regions.

3. (a) In a perfect dielectric medium, the EM wave has maximum value for E of 10 V/m with $\mu_r = 1$ and $\varepsilon_r = 4$. Find the velocity of the wave, peak poynting vector, average poynting vector, impedance of the medium and peak value of the magnetic field.
   (b) What is the inconsistency in Ampere's Law? How it is rectified by Maxwell?
   (c) Show that the total displacement current between the condenser plates connected to an alternating voltage sources is exactly the same as the value of charging current (conduction current).

4. (a) Drive the expression for attenuation and phase constants of uniform plane wave.
   (b) If $\varepsilon_r = 9, \mu = \mu 0$ for the medium in which a wave with frequency f = 0.3 GHz is propagating, determine propagation constant and intrinsic impedance of the medium when
   i. $\sigma = 0$ and
   ii. $\sigma = 10$ mho/m.

5. (a) Determine the condition under which the magnitude of the reflection coefficient equals to that of the transmission co-efficient for a uniform plane wave at normal incidence on an interface between two lossless dielectric media. What is the Standing Wave Ratio in dB under this condition?

(b) A short vertical transmitting antenna erected on the surface of a perfectly conducting earth produces an effective field strength E = 100 sin θ V/m at a distance of 1 km from the antenna. Compute the Poynting Vector and total power radiated.

6. Derive the expressions for the E and H field components for TM waves in a parallel plane wave guide, using Maxwell's equations approach.

7. (a) Show that for any uniform transmission line the following relations are valid.
$Z_0 = \sqrt{Z_{OC}.Z_{SC}}$
TanhPl $= \sqrt{\frac{Z_{SC}}{Z_{OC}}}$
What will be their modifications for loss less lines?

(b) Short-circuited and open-circuited measurements at frequency of 5000 Hz on a line length 100 km yields the following results:
$Z_{OC} = 570 \angle -48^0$
$Z_{SC} = 720 \angle 34^0$

Find the characteristic impedance and propagation constant of the line.

8. (a) A transmission line of length 70 meters is terminated in an impedance of Z_R=125+j48. If the frequency is 3 MHz and the characteristic impedance is 230 Ω , find the sending end impedance using Smith chart, explaining the procedure.

(b) What is meant by inductive loading? With the help of suitable expressions explain the advantages of loading and also discuss the disadvantages.

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