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

II B.Tech II Semester Supplimentary Examinations, Apr/May 2008
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) State the Coulomb's law in SI units and indicate the parameters used in the equations with the aid of a diagram. [6]
   (b) Point charges Q_1 and Q_2 are respectively located at (4, 0, -3) and (2, 0, 1). If $Q_2 = 4$ nC, find Q_1 such that. [10]
      i. The E at (5, 0, 6) has no Z-component.
      ii. The force on a test charge at (5, 0, 6) has no X-component.

2. An infinitely long straight conducting rod of radius 'a' carries a current of I in + $\widehat{Z}$ direction. Using Ampere's Circuital Law, find $\widehat{H}$ in all regions and sketch the variation of H as a function of radial distance. If I = 3 mA. and a = 2 cm., find $\widehat{H}$ and β at (0, 1cm., 0) and (0, 4cm., 0). [16]

3. (a) In free space $\overline{D} = D_m$ Sin (wt $+\beta$ z)a_x. Determine $\overline{B}$ and displacement current density. [8]
   (b) Region 1, for which $\mu_{r1} = 3$ is defined by $X < 0$ and region 2, $X < 0$ has $\mu_{r2} = 5$ given $H_1 = 4\ a_x + 3a_y\ \ 6\ a_z$ (A/m). Determine H_2 for $X > 0$ and the angles that H_1 and H_2 make with the interface. [8]

4. Prove that under the condition of no reflection at an interface, the sum of the Brewster angle and the angle of refraction is $\pi/2$ for parallel polarization for the case of reflection by a perfect conductor under oblique incident, with neat sketches. [16]

5. (a) Define and differentiate between the terms: Instantaneous average and complex poynting vectors, giving their mathematical expressions. [8]
   (b) An EM wave of 3 W/m^2 Power density is incident normally from air on a perfect dielectric boundary. If the resulting VSWR is 2.2, find the reflected and transmitted powers. [8]

6. (a) Explain the factors on which cut off frequency of a parallel plate wave guide depend. [8]
   (b) Obtain the frequency in terms of cut off frequency f_c at which the attenuation constant due to conductor losses for the TM_n mode is minimum for a parallel plate wave-guide. [8]

7. (a) Derive a relation between reflection coefficient and characteristic impedance. [8]

(b) Determine the reflection coefficients when [8]

i. $Z_L = Z_0$

ii. Z_L = short circuit

iii. Z_L = open circuit.

iv. Also find out the magnitude of reflection coefficient when Z_L is purely reactive.

8. (a) Explain how UHF lines can be treated as circuit elements, giving the necessary equivalent circuits. [8]

(b) A loss less line of 100 Ω is terminated by a load which produces SWR = 3. The first Maxima is found to be occurring at 320 cm. If f = 300 MHz, determine load impedance. [8]

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

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E M WAVES AND TRANSMISSION LINES
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Time: 3 hours **Max Marks: 80**

Answer any FIVE Questions
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1. (a) State Gauss's law. Using divergence theorem and Gauss's law, relate the displacement density D to the volume charge density ρv. [8]
   (b) A sphere of radius "a" is filled with a uniform charge density of 'ρ_v' c/m^3. Determine the electric field inside and outside the sphere. [8]
2. (a) Define Ampere's Force Law and establish the associated relations. [6]
   (b) A long coaxial cable has an inner conductor carrying a current of 1 mA. along + $\widehat{Z}$ direction , its axis coinciding with Z-axis. Its inner conductor diameter is 6 mm. If its outer conductor has an inside diameter of 12 mm. and a thickness of 2 mm., determine $\widehat{H}$ at (0, 0, 0), (0, 1.5 mm, 0), (0, 4.5 mm, 0) and (0, 1 cm, 0). (No derivations) [10]
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. [6]
   (b) What is the inconsistency in Ampere's Law? How it is rectified by Maxwell? [5]
   (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). [5]
4. (a) Define uniform plane wave. [5]
   (b) Prove that uniform plane wave does not have field components in the direction of the propagation. [6]
   (c) Determine the intrinsic impedance of free space. [5]
5. (a) State and Prove Poynting Theorem. [10]
   (b) A Plane wave traveling in a free space has an average poynting vector of 5 watts/m^2. Find the average energy density. [6]
6. Starting from Maxwell's equations, derive the expressions for the E and H field components for TE waves in a parallel plane wave guide. [16]
7. (a) List out types of transmission lines and draw their schematic diagrams. [5]

(b) Draw the directions of electric and magnetic fields in parallel plate and coaxial lines. [5]

(c) A transmission line in which no distortion is present has the following parameters Z_0= 50Ω, α= 20mNP/m, υ= $0.6\upsilon_0$. Determine R, L, G, C and wavelength at 0.1 GHz. [6]

8. (a) Draw the equivalent circuits of a transmission lines when [8]
   i. length of the transmission line, 1 <$\lambda/4$, with shorted load
   ii. when 1 <$\lambda/4$, with open end
   iii. 1 =$\lambda/4$.

   (b) Find out VSWR if [8]
   i. $Z_0 = 100\ \Omega$, $R_L = 80\ \Omega$
   ii. when $Z_0 = 80\ \Omega$, $R_L = 100\Omega$

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

II B.Tech II Semester Supplimentary Examinations, Apr/May 2008
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) Derive the boundary conditions for the tangential and normal components of Electrostatic fields at the boundary between two perfect dielectrics. [8]
   (b) x-z-plane is a boundary between two dielectrics. Region $y < 0$ contains dielectric material $\varepsilon_{r1} = 2.5$ while region $y > 0$ has dielectric with ε_{r2}= 4.0. If $E = -30a_x + 50a_y + 70a_z$ v/m, find normal and tangential components of the E field on both sides of the boundary. [8]

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. [5]
   (b) Determine the magnetic flux , for the surface described by [6]
      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). [5]

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. [6]
   (b) What is the inconsistency in Ampere's Law? How it is rectified by Maxwell? [5]
   (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). [5]

4. (a) What is polarization of an EM wave? Distinguish between different types of polarizations? Prove that the polarization is circular when the two components of electric field are equal and are 90^o apart. [8]
   (b) A plane EM wave is normally incident on the boundary between two dielectrics. What must be the ratio of refractive indices of the two media in order that the reflected and transmitted waves may have average Power of equal magnitude? [8]

5. (a) State and Prove Poynting Theorem. [10]

(b) A Plane wave traveling in a free space has an average poynting vector of 5 watts/m^2. Find the average energy density. [6]

6. For a Parallel plane wave guide of 3 cm seperation, determine all the propogation characteristics, for a signal at 10 GHz, for [8+8]

   (a) TE_{10} waves

   (b) TEM waves

   Explain the terms used.

7. (a) List out types of transmission lines and draw their schematic diagrams. [5]

   (b) Draw the directions of electric and magnetic fields in parallel plate and coaxial lines. [5]

   (c) A transmission line in which no distortion is present has the following parameters Z_0= 50Ω, α= 20mNP/m, υ= $0.6\upsilon_0$. Determine R, L, G, C and wavelength at 0.1 GHz. [6]

8. (a) Draw the equivalent circuits of a transmission lines when [8]

      i. length of the transmission line, 1 <$\lambda/4$, with shorted load

      ii. when 1 <$\lambda/4$, with open end

      iii. 1 =$\lambda/4$.

   (b) Find out VSWR if [8]

      i. $Z_0 = 100\ \Omega$, $R_L = 80\ \Omega$

      ii. when $Z_0 = 80\ \Omega$, $R_L = 100\Omega$

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

II B.Tech II Semester Supplimentary Examinations, Apr/May 2008
E M WAVES AND TRANSMISSION LINES
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Time: 3 hours **Max Marks: 80**

Answer any FIVE Questions
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1. (a) Explain the following terms: [8]
   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. [8]

2. (a) Using the relation for $\overline{H}$of a finite straight wire, obtain the expressions for the fields due to a semi infinite wire and infinite wire located on z-axis, carrying a current I. [8]
   (b) In a conducting medium $\overline{H}$ =y^2 z $\widehat{\mathrm{X}} + 2(x+1)yz\ \widehat{\mathrm{Y}} - (x+1)\mathrm{z}^2\ \widehat{\mathrm{Z}}$ A/m. Find the current density at (1,0,-3) and calculate the current passing through Y = 1 plane, $0 \leq x \leq 1, 0 \leq z \leq 1$. [8]

3. (a) Derive Maxwell's equations in integral form and differential form for time varying fields. [8]
   (b) Explain how the concept of Displacement current was introduced by Maxwell to account for the production of Magnetic fields in the empty space. [8]

4. (a) Derive the expression for attenuation and phase constants of uniform plane wave. [8]
   (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 [8]
   i. $\sigma = 0$ and
   ii. $\sigma = 10$ mho/m.

5. (a) State and Prove Poynting Theorem. [10]
   (b) A Plane wave traveling in a free space has an average poynting vector of 5 watts/m^2. Find the average energy density. [6]

6. (a) Explain attenuation in parallel-plate wave guides. Also draw attenuation versus frequency characteristics of waves guided between parallel conducting plates. [8]
   (b) A parallel-plate wave guide made of two perfectly conducting infinite planes spaced 3cm apart in air operates at a frequency of 10GHz. Find the maximum time average power that can be propagated per unit width of the guide for TE_1 and TM_1 modes. [8]

7. (a) What are the salient aspects of primary constants of a two wire transmission line. [8]

   (b) A lossless transmission line used in a TV receiver has a capacitance of 50 PF/ m and an inductance of 200 nH/m. Find out the characteristic impedance for 10 meter long section of the line and 500 meter section. [8]

8. (a) Explain the principle of Impedance matching with Quarter wave Transformer? [8]

   (b) A 100 Ω loss less line connects a signal of 100 KHz to a load of 140 Ω. The load power is 100mW . Calculate [8]

   i. Voltage Reflection coefficient,

   ii. VSWR,

   iii. Position of V_{Max}, I_{Max} V_{min} *and* $I_{min.}$

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