Code No: 07A71002 **R07** **Set No. 2**

IV B.Tech I Semester Examinations,May 2011
EM WAVES AND TRANSMISSION LINES
Electronics And Computer Engineering

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

Answer any FIVE Questions
All Questions carry equal marks
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1. (a) Define and derive the equations for phase and group velocities in a parallel plane guide. On which factors do they depend.
   (b) Explain the impossibility of TEM wave propagation in wave guides. [8+8]

2. (a) Explain uniform plane wave propagation
   (b) A lossy dielectric has an intrinsic impedance of $200\angle 30^0\Omega$ at a particular frequency. If at that frequency, the plane wave propagating through the dielectric has the magnetic field component H=10e^{-ax} cos(Wt-1/2x)ay A/m. Find α *and* δ [8+8]

3. (a) What is Poynting theorem and Poynting vector . How can you apply this over the cross-section of co-axial cable.
   (b) Obtain an expression for the power loss in a plane conductor in terms of the surface resistance R_s . [8+8]

4. (a) Derive a relation between reflection coefficient and characteristic impedance.
   (b) Determine the reflection coefficients When
      i. $Z_L = Z_0$
      ii. $Z_L = shortcircuit$
      iii. Z_L = open circuit Also find out the magnitude of reflection coefficient When Z_L is purely reactive . [8+8]

5. (a) Develop Maxwell's equation involving $\nabla \times E$ from fundamental considerations of closed circuit.
   (b) A square loop of side 20 Cm is located in free space adjacent to a straight conductor that carries a sinusoidal current of 0.5 A (rms) at 5KHz. If a small gap of 5cm is introduced in to the loop what is the induced voltage across the gap. [8+8]

6. (a) Explain the different types of transmission lines. What are limitations to the maximum power that they can handle.
   (b) A coaxial limes with an outer diameter of 8 mm has 50 ohm characteristic impedance. If the dielectric constant of the insulation is 1.60, calculate the inner diameter.
   (c) Describe the losses in transmission lines [8+4+4]

7. (a) Apply Gauss's law to obtain expressions for electric field strength on a Gaussian surface of radius ρ in a co-axial cable of inner and outer radii, 'a' and 'b' respectively, for $\rho \leq a \, and \, a \leq \rho \leq b$. Hence deduce expressions for voltage between the two conductors.

   (b) Find the electric field due to an infinitesimally small electric dipole assuming existence of only far fields. [8+8]

8. (a) Obtain an expression for differential magnetic field strength dH due to differential current element I dl at the origin in the positive Z- direction.

   (b) Find the magnetic field strength, H at the centre of a square conducting loop of side '2a' in Z=0 plane if the loop is carrying a current , I, in anti clock wie direction. [6+10]

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Code No: 07A71002 **R07** **Set No. 4**

IV B.Tech I Semester Examinations,May 2011
EM WAVES AND TRANSMISSION LINES
Electronics And Computer Engineering

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

Answer any FIVE Questions
All Questions carry equal marks
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1. (a) Derive wave equations for sinusoidal time variations.
   (b) A 100v/m plane wave of frequency 300 MHz travels in an infinite, lossless medium having $\mu r = 1, \in r = 9$, $\sigma = 0$ write the complete time domain experements for E and H field vectors. [8+8]
2. (a) Derive and explain the Maxwell's equations in point form and integral form.
   (b) Given the conduction current density in a lossy dielectric as $J_c = 0.02 sin 10^9 t (A/m^2)$. find the displacement current density if $\sigma = 10^3 S/m \; and \in r = 6.5$. [8+8]
3. (a) Explain the difference between the Intrinsic Impedance and the Surface Impedance of a conductor. Show that for a good conductor , the surface impedance is equal to the intrinsic impedance.
   (b) Define and distinguish between the terms perpendicular polarization, parallel polarization, for the case of reflection by a perfect conductor under oblique incidence. [8+8]
4. (a) State Maxwell's equations for magneto static fields.
   (b) Show that the magnetic field due to a finite current element along Z axis at a point P, 'r' distance away along y- axis is given by $H = (I/4\pi r)(\sin\alpha_1 - \sin\alpha_2).\widehat{a}_\phi$ where I is the current through the conductor , α_1 and α_2 are the angles made by the tips of the conductor element at P. [6+10]
5. (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 advantage of loading and also discuss the disadvantages. [8+8]
6. (a) Derive an expression for the field strength due to a volume of uniform charge density at an arbitrary point P(r, θ, ϕ).
   (b) A point charge Q is located at the center of a neutral spherical conducting shell. Find the surface charge density at the inner surface and also at the outer surface. Assume the inner and outer diameters of the spherical shell to be '2a' and '2b' respectively. [8+8]
7. Derive the expressions for the E and H field components for TM waves in a parallel plane wave guide, using Maxwell's equations approach. [16]

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

   (b) Explain with sketches how the i/p impedance varies with the frequency. [8+8]

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Code No: 07A71002 **R07** **Set No. 1**

IV B.Tech I Semester Examinations,May 2011
EM WAVES AND TRANSMISSION LINES
Electronics And Computer Engineering

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

Answer any FIVE Questions
All Questions carry equal marks

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1. (a) Explain about attenuation in parallel-plate wave guides. Also draw attenuation versus frequency characteristics of waves guided between parallel conducting plates.
   (b) Derive the relation $\lambda = \frac{\lambda_c \quad \lambda_g}{\sqrt{\lambda_g^2 + \lambda_c^2}}$
   where λ is free space wave length, λ_g is the wave length measured in the guide, and λ_c is the cut off wave length. [8+8]

2. (a) State Ampere's circuital law. Specify the conditions to be met for determining magnetic field strength, H, based on Ampere's circuital law.
   (b) A long straight conductor with radius 'a' has a magnetic field strength $H = (Ir/2\pi a^2)\,\hat{a}_\phi$. within the conductor $(r < a)$ and $H = (I/2\pi r)\,\hat{a}_\phi$ outside the conductor $(r > a)$ Find the current density J in both the regions (r < and r > a)
   (c) Define Magnetic flux density and vector magnetic potential. [4+8+4]

3. (a) Define polarization explain in detail about the following polarization.
      i. Linear
      ii. Elliptical
      iii. Circular.
   (b) Determine the depth of peretration of 1 MHz wave into copper which has a conductivity $\sigma = 5.8\text{x}10^7$ mhos/m and $\in \; = \; \in 0$, $\mu = \mu 0$. [8+8]

4. (a) List out the applications of transmission lines.
   (b) Draw an equivalent circuit of a two wire transmission line
   (c) A lossy cable which has R = 2.50 Ω /m, L = 1.0 μ H/m, C = 1ρ F/m and G = 0 operates at f = 0.5 GHz. Find out the attenuation constant of the line. [4+4+8]

5. (a) Give a neat sketch for a smith chart and explain clearly, step by step how would you use this chart to
      i. Calculate the complex reflection coefficient
      ii. Transfer impedance from one point to other along the line.
      iii. Determine the length and location of a short circuited stub line for impedance matching purpose.
   (b) Discuss the merits and demerits of stub matching techniques [12+4]

6. (a) State and Prove Gauss's law. List the limitations of Gauss's law.
   (b) Derive an expression for the electric field strength due to a circular ring of radius 'a' and uniform charge density, ρ_L C/m, using Gauss's law. Obtain the value of height 'h' along z-axis at which the net electric field becomes zero. Assume the ring to be placed in x-y plane.
   (c) Define Electric potential. [6+8+2]

7. (a) Given H=800az cos $(3x10^8 t - y)$A/m in free space. Find the emf developed in the general af direction about the closed path having corners at
      i. (0,0,0)(1,0,0), (1,1,0) and (0,1,0)
      ii. $(0, 0, 0), (2\pi, 0, 0), (2\pi, 2\pi, 0) and (0, 2\pi, 0)$
   (b) Define boundary conditions for conductor- conductor surface. [8+8]

8. (a) What is Poynting theorem and Poynting vector . How can you apply this over the cross-section of a co-axial cable.
   (b) A plane EM wave is normally incident on the boundary between two dielectrics. What must be the ratio of the refractive indices of the two media in order that the reflected and transmitted waves may have equal magnitudes of average power . [8+8]

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Code No: 07A71002 **R07** **Set No. 3**

IV B.Tech I Semester Examinations,May 2011
EM WAVES AND TRANSMISSION LINES
Electronics And Computer Engineering

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

Answer any FIVE Questions
All Questions carry equal marks

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1. (a) For a parallel plane wave guide having z-propagation, explain the nature of variation and sketch the variation of E and H for TM_{10}waves.
   (b) Explain the impossibility of TEM wave propagation in wave guides. [10+6]

2. (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. [8+8]

3. (a) What is capacitance? Derive an expression for capacitance of two parallel plates of surface area 'A' separated by a distance 'd' and filled with a dielectric of relative dielectric constant, '$\in_r$' in between the plates, neglect fringing effects.
   (b) Derive an expression for energy stored in a capacitor.
   (c) A parallel plate capacitor with free space between the plates is connected to a constant source of voltage. Determine the energy stored in the capacitor, capacitance value, and the difference in surface charge density by inserting a dielectric of $\in_r = 2$ between the plates. [6+4+6]

4. (a) Give the word statement of Maxwells equations.
   (b) Given H= 300 cos $(3 \times 10^8 t - y)\bar{a}_z$ A/m in free space. Find the emf developed in the general aϕ direction about the closed path having corners at
      i. (0,0,0), (1,0,0), (1,1,0) and (0,1,0)
      ii. $(0, 0, 0), (2\pi, 0, 0), (2\pi, 2\pi, 0) and (0, 2\pi, 0)$. [8+8]

5. (a) Show that for distortion less transmission line L /R = C /G
   (b) For a loss less show that β = w $\sqrt{\text{L}c}$. [8+8]

6. (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. [6+10]

7. (a) Obtain an expression for magnetic field strength, H inside a toroid. Assume the necessary parameters.
   (b) Find H at origin, which is also the centre of a square current carrying loop located in x-y plane. The length of the side of the square loop is 'L' and the loop is symmetrically placed around origin with its sides parallel to x and y axis. [8+8]

8. (a) A plane sinusoidal electromagnetic wave traveling in space has E_{max}=1500 μυ/m. Find
   (i) the accompanying H_{max}
   (ii) the average power transmitted

   (b) The electric field intensity associated with a plane wave traveling in a perfect dielectric medium is given by $E_x(z,t) = 10 \cos(2\pi \times 10^7 t - 0.1 \pi z)$v/m
   (i) What is the velocity of propagation?
   (ii) Write down an expression for the magnetic field intensity associated with the wave if $\mu = \mu_0$. [8+8]

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