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

IV B.Tech I Semester Examinations,November 2010
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 and explain Coulomb's law using vector form of Coulomb's force expression.
   (b) Find the force on a charge of -100 mC located at P (2, 0, 5) in free space due to another charge 300 μ C located at Q (1, 2, 3).
   (c) State and express Gauss's law in both integral and differential forms. [8+4+4]

3. (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]

4. (a) A plane sinusoidal electromagnetic wave travelling in space has $E_{max} = 1500 \mu v/m$
      i. Find the accompanying H_{max}
      ii. The average power transmitted
   (b) The electric field intersity associated with a plane wave travelling in a perfect dielectric medium is given by E_x(z, t) = 10 cos (2π x 10^7 t - 0.1 πz)v/m
      i. What is the velocity of propagation
      ii. Write down an expression for the magnetic field intesity associated with the wave if $\mu = \mu_0$ [4+4+8]

5. (a) Find magnetic field strength, H, on the Z- axis at a point P(0,0,h), due to a current carrying circular loop, $x^2 + y^2 = A^2$ in Z=0 plane.
   (b) Find the total magnetic flux crossing a surface, $\phi = \frac{\pi}{2}$, $1 \leq \rho \leq 2 \ and \ 0 \leq Z \leq 5$ due to a vector magnetic potential $\overline{A} = (-\rho^2/4).\widehat{z}$ webers/m. [8+8]

6. (a) Determine the resultant Electric and Magnetic fields of plane wave when it is incident on a perfect conductor normally.
   (b) A plane wave traveling in a medium of $\varepsilon_r = 1, \mu_r = 1$ has an electric field intensity of $100 \times \sqrt{\pi}$V/m. Determine the energy density in the magnetic field and also the total energy density. [8+8]

7. (a) Explain what is meant by voltage reflection coefficient in a transmission line The voltage reflection coefficient due to load connected to a lossless transmission line of characteristic impedance 100 Ω and working at 3 GHz is 0.5, 45^0. Assuming the load voltage to be 10 V, calculate the r.m.s voltage and current at intervals of one fourth wave length from the load up to a distance 5 cm.

   (b) A 75 Ω line is terminated by a load of 120 + j80 Ω . Find the maximum and minimum impedances on the line. [10+6]

8. (a) An open-wire transmission line having $Z_0 = 650, -12^0\Omega$ 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 600 Ω and is to feed a 180 Ω resistor at 200 MHz. A half wave line is to be used as a tube, 1.2cm in diameter .Find centre to-centre spacing in air? [8+8]

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

IV B.Tech I Semester Examinations,November 2010
EM WAVES AND TRANSMISSION LINES
Electronics And Computer Engineering

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

Answer any FIVE Questions
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1. (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]

2. (a) 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.
   (b) Explain the impossibility of TEM wave propagation in wave guides. [10+6]

3. (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]

4. (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]

5. (a) Given H=800az cos $(3x10^8 t - y)$A/m in free space. Find the emf developed in the general 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]

6. (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]

7. The compex Electric field vector of a uniform plane wave propagated in free space is given by $E = \left(-i - 2\sqrt{3}j + \sqrt{3}\,\mathrm{k}\right) e^{-j0.04\pi\left(\sqrt{3}x - 2y - 3z\right)} v/m$ [4 × 4]

   (a) What is the direction of propagation

   (b) Find the wave length in the direction of propagation

   (c) Find the frequency of wave

   (d) Find the apparent wave - lengths and the apparect velocities along x, y and z axes

8. An EM wave in dielectric medium 1 (ε_1, μ_0) impinges obliquely on a boundary plane with dielectric medium 2 (ε_2, μ_0). Let θ_1, θ_t denote the incident and refraction angles respectively and show that for perpendicular polarization, reflection coefficient is equal to

$$\frac{\sin(\theta_t - \theta_i)}{\sin(\theta_t + \theta_i)}$$

and transmission coefficient is

$$\frac{2\sin\theta_t\cos\theta_i}{\sin(\theta_i + \theta_t)}$$

[16]

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1. (a) Obtain an expression Reflection coefficient when a wave is incident on a dielectric obliquely with perpendicular polarization.
   (b) Define surface impedance and explain how it exists. [8+8]

2. (a) What is the inconsistency of Amperes law?
   (b) A circular loop conductor of radius 0.1m lies in the z=0plane and has a resistance of 5Ω given B=0.20 sin 10^3 t az T. Determine the current. [8+8]

3. (a) State and prove Gauss's law. Express Gauss's law in both integral and differential forms.
   (b) Discuss the salient features and limitations of Gauss's law .
   (c) Derive Poisson's and Laplace's equations starting from Gauss's law. [6+4+6]

4. (a) A low loss co-axial cable of characteristic impedance of 50 ohms is terminated with a resistive load of 75 ohms. The peak voltage across the load is found to be 30 volts . Calculate
      i. The reflection coefficient of the load.
      ii. The amplitude of the forward and reflected voltage waves.
      iii. The amplitude of the forward and reflected current waves.
      iv. The VSWR
   (b) What are the applications of smith chart? Explain any one of it? [8+8]

5. (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]

6. Given E = Em sin $(wt - \beta z)$ ay in free space. Find D, β and H. Show that E and H fields constitute a wave travelling in Z direction verify that the speed and $\frac{E}{H}$ depend only on the properties of free space. [16]

7. (a) Prove that a line of finite length and terminated by its characteristic impedance Z_0 is equivalent to a line of infinite length.
   (b) Draw the equivalent circuit of a transmission line and explain all parameters for the cases of

i. lossy lines,

ii. lossless line. [6+10]

8. (a) Explain about attenuation in parallel-plate wave guides. Also draw attenuation versus frequency characteristics of waves guided between parallel conducting plates.

   (b) A parallel plate wave guide made of two perfectly conducting infinite planes spaced 3 cm apart in air operates at a frequency of 10 GHz. Find the maximum time average power that can be propagated per unit width of the guide for TE_1 and TM_1 modes. [8+8]

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

IV B.Tech I Semester Examinations,November 2010
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) State and prove Poynting theorem.
   (b) In a non-magnetic medium E = 4 sin($(2\pi x\ 10^7$ t - 0.8 x) a_z V/m. Find
      i. the time-average power carried by the wave
      ii. total power crossing 100 cm^2 of plane 2x+y = 5. [8+8]

2. (a) Find the differential magnetic field dH due to a differential current element, I dl placed at the origin in the positive Z- direction, at a point $P(r, \theta, \phi)$.
   (b) A current filament of 5 Amperes is placed along a parallel line to the x-axis at y=2m and Z= -2m. Find the magnetic field strength, H at the origin. [8+8]

3. (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]

4. (a) Derive the expression for the input impedance of a transmission line of length L
   (b) Explain the application of smith's chart. [8+8]

5. (a) Obtain the relation between E and H in a uniform plane wave.
   (b) A Uniform plane wave propagating in a medium has $E = 2e^{-\alpha z} sin(10^8 t - \beta z)$ay v/m. If the medium is characterized by ∈ r=1, μ r=20 and σ =3 mho /m. find α, β and H .
   [8+8]

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) Derive Maxwell's equations from their basics.
   (b) Given the time-varying magnetic field B=$(0.5\bar{a}x + 0.6\bar{a}y - 0.3\bar{a}z)$ Cos 5000t T and a square filamentary loop with its corners at (2,3,0), (2,-3,0), (-2,3,0) and (-2,-3,0). Find the time varying current flowing in the general aϕ direction if the total loop resistance is 400kΩ. [8+8]

8. (a) Explain the meaning of the terms characteristic impedance and propagation constant of a uniform transmission line and obtain the expressions for them in terms of Parameters of line?

   (b) A telephone wire 20 km long has the following constants per loop km resistance 90 Ω, capacitance 0.062 μF, inductance 0.001H and leakage = 1.5 x 10^{-6} mhos. The line is terminated in its characteristic impedance and a potential difference of 2.1 V having a frequency of 1000 Hz is applied at the sending end. Calculate :

      i. The characteristic impedance
      ii. Wavelength.
      iii. The velocity of propagation [8+8]

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