Code No: R050211001 **Set No. 1**

II B.Tech I Semester Regular Examinations, November 2006
ELECTROMAGNETIC WAVES TRANSMISSION LINES
(Electronics & Instrumentation Engineering)

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

Answer any FIVE Questions
All Questions carry equal marks

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1. (a) Obtain an expression for electric field intensity at a point, P(x, y, z) due to a point charge located at $Q(x^1, y^1, z^1)$ [4M]
   (b) Derive an expression for the electric field intensity due to an infinite length line charge along the z-axis at an arbitrary point Q (x, y, z). [6M]
   (c) A charge of $-0.3\mu C$ is located at A (25, -30, 15) Cm and a second charge of 0.5 μ C is located at B (-10, 8, 12) Cm. Find the electric field strength, E at
      i. The origin
      ii. Point P (15, 20, 50) Cm [6M]

2. (a) State Biot- Savart law [4]
   (b) Derive an expression for magnetic field strength, H, due to a finite filamentary conductor carrying a curent I and placed along Z- axis at a point 'P' on y-axis. Hence deduce the magnetic field strength for the length of the conductor extending from - ∞ to + ∞. [12]

3. Let the internal dimensions of coaxial capacitor be a=1.2cm, b=4cm and l=40cm. the Homogeneous material inside the capacitor has the parameters $\in= 10^{-11}F/m, \mu = 10^{-5}H/m\ and\ \sigma = 10^{-5}$s/m. if the electric field intensity is $E = (10^6/\rho)cos10^5ta\rho$ v/m find
   (a) J
   (b) The total conduction current Ic through the capacitor
   (c) The total displacement current Id through the capacitor
   (d) The ratio of the amplitude of Id to that of Ic, the quality factor of the capacitor - [4*4]

4. (a) Explain about uniform plane waves. [8+8]
   (b) In a loss less medium for which $\eta = 60\pi, \mu r = 1$ and H=-0.1 cos (wt-z)ax+0.5 sin (wt-z)ay A/m. calculate $\in$ r and w.

5. (a) What is a standing wave and explain how it is produced.
   (b) Determine the resultant Electric and Magnetic fields of plane wave when it is incident on a perfect conductor normally. [8+8]

6. For a parallel plane wave guide of 3 cm separation, determine all the propagation characteristics, for a signal at 10 GHz, for

(a) TE_{10} waves

(b) TEM waves [16]

Explain the terms used.

7. (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. [10]

   (b) What is meant by inductive loading? With the help of suitable expressions explain the advantages of loading and also discuss the disadvantages. [6]

8. (a) Explain clearly why the short circuited stubs are preferred over to a open circuited stubs? [6]

   (b) Derive the expression for the input impedance of a loss-less line. Hence evaluate Z_{SC} and Z_{OC} and sketch their variation with line length [10]

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Code No: R050211001 **Set No. 2**

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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) Define conductivity of a material. [4]
   (b) Apply Gauss's law to derive the boundary conditions at a conductor-dielectric interface. [6]
   (c) In a cylindrical conductor of radius 2mm, the current density varies with distance from the axis according to $J = 10^3 e^{-400r} A/m^2$. Find the total current I. [6]

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 [4]
   (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 $(r < a \; and \; r > a)$
   \- [8]
   (c) Define Magnetic flux density and vector magnetic potential. [4]

3. (a) Give the word statement of Maxwells equations. [8]
   (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]

4. (a) For good dielectries derive the expressions for $\alpha, \beta, \nu \, and \, \eta$.
   (b) For a uniform plane wave in space λ =12cm. In a loss less material of unknown characteristics λ=8cm. In this material E=50V/m, H = 0-1 A/M find f, $\mu r \in r$
   \- [8+8]

5. (a) What is a standing wave and explain how it is produced.
   (b) Determine the resultant Electric and Magnetic fields of plane wave when it is incident on a perfect conductor normally. [8+8]

6. (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]

7. (a) Starting from the equivalent circuit, derive the transmission line equations for V and I, in terms of the source parameters

   (b) Give T and π equivalent network representation for a transmission line [10+6]

8. (a) In uniform line there exists, in general two traveling waves . Explain how the Superposition of the two waves produces standing waves of voltage and current in a. short circuit transmission line. [8]

   (b) An open wire unloaded line, 75 km is operated at a frequency of 1000 Hz. The open circuit Impedance if found to be $330 - 30^0\Omega$ and short circuit impedance is 540 $7^0\Omega$. Calculate the parameters of line. [8]

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Code No: R050211001 **Set No. 3**

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

Answer any FIVE Questions
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1. (a) Using Gauss's law derive expressions for electric field intensity and electric flux density due to an infinite sheet of conductor of charge density ρ C/cm [8]

   (b) A parallel plate capacitance has 500mm side plates of square shape separated by 10mm distance. A sulphur slab of 6mm thickness with $\in_r = 4$ is kept on the lower plate find the capacitance of the set-up. If a voltage of 100 volts is applied across the capacitor, calculate the voltages at both the regions of the capacitor between the plates. [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 [4]

   (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 $(r < a \textit{ and } r > a)$
   -
   [8]

   (c) Define Magnetic flux density and vector magnetic potential. [4]

3. (a) Derive Maxwell?s equations from their basics. [8]

   (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]

4. (a) For a conducting medium derive expressions for $\alpha and \beta$

   (b) Determine the phase velouty of propagation, attenuation constant, phase constant and intrinsic impedance for a forward travelling wave in a large block of copper at 1 MHz $(\sigma = 5.8 \times 10^7, \in r = \mu r = 1)$ determine the distance that the wave must travel to be attenuated by a factor of 100 (40 dB) [8+8]

5. (a) Define Brewster angle and derive an expression for Brewster angle when a wave is paralely polarized.

   (b) A plane wave traveling in a medium of $\varepsilon_r = 1, \mu_r = 1$ has an electric field intensity of 200 $\times \sqrt{\pi}$ V/m. Determine the energy density in the magnetic field and also the total energy density. [8+8]

6. (a) Define and derive the equations for phase and group velocities in a parallel plane guide. On which factors do they depend ?.

(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]

7. (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]

8. (a) What is the significance of standing wave ratio in a transmission line? Calculate the Reflection coefficient and VSWR for a 50Ω lines, terminated with

   i. matched Load
   ii. Short circuit
   iii. +j75Ω loads
   iv. -j75Ω load. [8]

   (b) A 50 Ω transmission line is terminated by an unknown impedance. The VSWR is 4 and the first minimum is formed at 2 cm from the load end. The frequency of Operation is 1 GHz. Design a single stub line matching for the above conditions

   [8]

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1. (a) State and explain Coulombs law. Obtain an expression in vector form. [6]
   (b) Two uniform line charges of density 8nC/m are located in a plane with y = 0 at x = ±4m. find the E- field at a point P(0m, 4m, 10m) [10]
2. (a) Derive equation of continuity for static magnetic fields. [6]
   (b) Derive an expression for magnetic field strength, H, due to a current carrying conductor of finite length placed along the y- axis, at a point P in x-z plane and 'r' distant from the origin. Hence deduce expressions for H due to semi-infinite length of the conductor. [10]
3. (a) Explain faradays law for time varying fields. [8]
   (b) Verify that the displacement current in the parallel plate capacitor is the same as the conduction current in the connecting wires. [8]
4. A Hallow tubular conductor is constructed from a type of brass having a conductvity of $1.2X10^7$ S/m. The inner and outer radii are 9 mm and 10 mm respectively. Calculate the resistance per meter langth at a frequency of
   (a) dc
   (b) 20MHz
   (c) 2GHz [5+5+6]
5. (a) State and explain Poynting theorem.
   (b) A plane wave traveling in free space has an average poynting vector of 5 $watts/m^2$. Find the average energy density. [8+8]
6. (a) Define and explain the significance of the following terms as applicable to parallel plane guides:
      i. Wave impedance
      ii. Phase and group velocities
      iii. Principal wave and its characteristics [10+6]
   (b) Explain the factors on which cut off frequency of a parallel plate wave guide depend.
7. (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. [8]

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

(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]

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