SET - 1

Code No: 3220404

II B. Tech II Semester Regular Examinations April/May 2009
ELECTROMAGNETIC WAVES AND TRANSMISSION LINES
(Electronics and Communications Engineering)

Time: 3 Hours **Max. Marks: 80**

Answer any FIVE questions.
All questions carry equal marks
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1. a) Derive Poisson's and Laplace equations.
   b) A point charge of 3nc is on the z-axis 2m away from the orgin.Find the result V and E (8+8)
2. a) Define and explain the Biot- Savarts law. Hence obtain the field due to a straight current carrying filamentary conductor of finite length.
   b) Given $E=E_m$ Sin $(\omega t-\beta z)a_y$ in free space, find D,B and H (8+8)
3. a) Derive the boundary conditions for the tangential and normal components of Electrostatic fields at the boundary between two perfect dielectrics.
   b) In a medium of $\mu_r=2$, find E, B and displacement current density if H=25 Sin$(2x10^8$ t +6X)Y mA/m. (8+8)
4. a) Find all the relations between E and H in a uniform plane wave. Find the value of intrinsic impedence of free space.
   b) Explain the terms linear polarization, circular polarization and elliptical polarization. (8+8)
5. a) Derive an expression for reflection when a wave is incident on a dielectric obliquely with parallel polarization.
   b) State and prove pointing theorem. (8+8)
6. For a parallel plane wave guide of 3cm separation, determine all the propagation characteristics for a signal at 10 GHz for i)TE_{10} waves ii) TEM waves (8+8)
7. a) 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.
   b) What is meant by inductive loading? What are its advantages and disadvantages. (8+8)
8. a) Explain the significance and utility of $\lambda/8$, $\lambda/4$ and $\lambda/2$ lines.
   b) Explain the principle of impedance matching with quarter wave transformer. (8+8)

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1. a) Define and distinguish between the terms electric field, electric displacement and electric flux density with necessary mathematical relations.
   b) A charge of 8 nc is distributed uniformly along a line of length 8m. Find the field intensity at radial distance of 2m from the centre of the line assuming air medium. (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) Derive an expression for magnetic field intensity at a radial distance R due to an infinite conductor carrying a current I (8+8)
3. a) What are the transformer and motional electromotive forces (emfs)in the context of Faraday's law.
   b) In a medium characterized by $\sigma = 0$, $\mu=\mu o, \varepsilon = \varepsilon_0$ and $E=20 \sin(10^8 t-\beta z)a_y$ v/m. Calculate β and H using Maxwell's equations. (8+8)
4. a) For the wave propagation in good dielectrics, derive the expression for intrinsic impedence of a good dielectric
   b) Derive the expression for skin depth of a good conductor (10+6)
5. a) For the case of reflection by a perfect dielectric with oblique incidence, explain the two possible polarizations with appropriate sketches and explain the snells laws.
   b) Define poynting theorem (12+4)
6. a) Explain the significance of TEM waves in parallel plane guide. Derive an expression for the attenuation factor for TEM waves
   b)Explain the factors on which cut off frequency of a parallel plate wave guide depend (8+8)

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7. a) Draw the equivalent circuit of a two wire transmission line.
   b) List out the applications of a transmission lines.
   c) Define input impedance of a transmission line and derive the expression for it. (5+5+6)
8. a) What is the significance of standing wave ratio in a transmission line. Calculate the reflection coefficient and VSWR for a 50Ω line terminated with i) Matched load ii) short circuit
   iii) +j75Ω load iv) –j75Ω load
   b) Explain why short circuited stubs are preferred over open circuited stubs. (10+6)

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1. a) State the Coulomb's law in SI units and indicate the parameters used in the equation.
   b) Three equal positive charges are placed at the corners of an equilateral triangle with a side of 'd' meters. Determine the magnitude and direction of the electric field at the point bisecting each side of the equilateral triangle. (8+8)
2. a) Define magnetic flux density and vector magnetic potential.
   b) In free space D= 5.0 $\sin(\omega t-\beta z)\, a_x$. Find B using Maxwell's equations. (8+8)
3. a) Explain the equation of continuity for time varying fields.
   b)Starting from first principle derive Maxwell's equation using Faraday's law and show that div B=0 (8+8)
4. a) Prove that in a uniform plane wave propagation in X-direction has no longitudinal components of electric and magnetic fields.
   b)Obtain the expression for surface impedance of conductor in terms of skin depth(8+8)
5. a)Define reflection and transmission coefficient of plane wave.
   b) A plane wave travelling in free space has an average poynting vector of 5 watts/m^2 Find the average energy density. (8+8)
6. What are the field components for TE waves .Derive them and draw the sketches for TE_{10} mode. (16)
7. a) List out types of transmission lines and draw their schematic diagrams.
   b) Determine the reflection coefficient when i) $Z_L = Z_0$ ii) Z_L =Short circuit
   iii) Z_L= open circuit. Also find out the magnitude of reflection coefficient when Z_L is purely reactive. (8+8)
8. Write a detailed note on double stub matching on a line using smith chart (16)

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Time: 3 Hours **Max. Marks: 80**

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1. a) Explain the following terms.
   i) Homogeneous and isotropic medium and
   ii) Line, surface and volume charge distributions
   b)What is the electric field intensity at a distance of 20cm from a charge of 0.2 micro coulombs in a vacuum (8+8)
2. a) Define Lorentz force equation and explain its significance.
   b) A circular loop of 3 units radius is centered at the origin in z=0 plane and carries a D.C current of 10 mA, along φ direction. Find the magnetic flux density at (0, 0, ± 4). (8+8)
3. a) Derive Maxwell's equations in integral form and differential form for time varying fields.
   b) Two magnetic materials with relative permeabilities 500 and 300 are separated by a plane boundary . The magnetic field in the first material makes an angle of 30 degrees with a normal to the plane boundary. Find the corresponding angle in the second material. (8+8)
4. a) What is meant by polarization of a wave? Explain.
   b) Derive the expression for attenuation and phase constants of uniform plane wave (8+8)
5. a) Define the significance and applications of poynting theorem.
   b) Explain the utility of pointing vector. If the peak pointing vector in free space is $10N/m^2$, find the amplitudes of electric and magnetic fields. (8+8)
6. a) Starting from Maxwell's equations, derive the expressions for the E and H field components for TE waves in a parallel plane wave guide.
   b)Define and explain the significance of following terms i) wave impedence ii) Phase and group velocities. (8+8)

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7. a) What are primary constants? Explain the features of primary constants.

   b) Find the characteristic impedance of a line at 1600Hz, if the following measurements have been made on the at 1600 Hz, $Z_{oc} = 650\Omega$ and $Z_{sc} = 550\Omega$ (8+8)

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

   b) Derive a relation between reflection coefficient and characteristic impedance. (8+8)