Code No: R22042 **R10** SET - 1

II B. Tech II Semester, Supplementary Examinations, Dec – 2012
ELECTRO MAGNETIC WAVES AND TRANSMISSION LINES
(Com. to ECE, EIE)

Time: 3 hours Max. Marks: 75

Answer any **FIVE** Questions
All Questions carry **Equal** Marks
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1. a) Derive an expression for the electric field intensity due to a finite length line charge along the Z-axis at an arbitrary point Q(x, y, z).
   b) Two uniform line charges of density 8nC/m are located in a plane with y=0 at x=±8m.Find the E- field at a point P (5, 4, 8) m. (7M+8M)

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) Given $\mathbf{E}=E_m \sin(\omega t-\beta z)\ \mathbf{a_y}$ in free space. Find the D, B and H. (7M+8M)

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 non magnetic medium $\mathbf{E}=50 \cos(10^9 t-8x)\ \mathbf{a_y}+40 \sin(10^9 t-8x)\ \mathbf{a_z}$ V/m. Find the dielectric constant ε_r and corresponding H (7M+8M)

4. a) Derive the expression for the phase shift constant and attenuation constant of a plane wave propagation in a lossy dielectric medium.
   b) For a uniform plane wave in space λ=12cm.In a loss less material of unknown Characteristics λ=8 cm. In this material E=50V/m, H=0.1 A/m. Find f, μ_r and ε_r. (6M+9M)

5. a) Derive an expression for reflectioncoefficient when a wave is incident on a dielectric obliquely with parallel polarization.
   b) In a plane wave travelling in a free space has an average pointing vector of 5 watts/m^2.Find the average energy density. (9M+6M)

6. a) Derive the field components for TE wave between parallel plates
   b) A parallel plate wave guide made of two perfectly conducting infinite planes spaced 3 cm apart in air operates at frequency of 10GHz.Find the maximum time, average power that can be propagated per unit width of guide for TE1, TM1 modes. (9M+6M)

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) A lossy cable which has R=2.25Ω/m, L=1.0μH/m, C=1pF/m, and G=0 operates at f=0.5GHz. Find out the attenuation constant of the line (9M+6M)

8. a) Discuss about single and double stub matching.
   b) Explain the principle of impedance matching with quarter wave transformer (8M+7M)
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1. a) Show that the electric field intensity due to an infinite sheet of charge is independent of the distance of the point from the sheet.
   b) A Parallel plate capacitance has 500mm side plates of square shaped separated by 10mm. A Sulphur slab of 6mm thickness with ε_r=4 is kept on the lower plate. Find the capacitance of the setup. If a voltage of 100Volts is applied across the capacitor; calculate the voltages at both the regions of the capacitor between the plates. (7M+8M)

2. a) Define Lorentz force equation and explain its significance.
   b) A circular loop of 3 units radius is centered at origin in z=0 plane and carries a DC current of 10mA, along Φ-direction. Find the magnetic flux density at (0, 0, ±4) (7M+8M)

3. a) Derive the Maxwell's two equations in integral form and differential form for time varying fields.
   b) In a medium characterized by σ =0, $\mu=\mu_0$, $\varepsilon=\varepsilon_0$ and E=20 Sin $(10^8 t-\beta z)a_y$V/m. Calculate β and H using Maxwell's equations. (8M+7M)

4. a) For a wave propagating in good dielectrics, derive the expression for intrinsic impedance of a good dielectric.
   b)Determine the phase velocity of propagation, attenuation constant, phase constant and intrinsic impedance for a forward travelling wave in a large block of copper at 1MHz ($\sigma=5.8x10^7$,$\varepsilon_r=\mu_r=1$).Determine the distance that the wave must travel to be attenuated by a factor of 100 (40 dB) (7M+8M)

5. a) Explain the significance of Poynting theorem and Pointing Vector.
   b) A perpendicularly polarized wave in incident at an angle of $\theta_i=15^0$.It is propagating from medium 1 to medium 2.Medium 1 is defined by ε_{r1} = 8.5, μ_{r1} =1, and σ_1=0 and medium 2 is free space. If E_i=1.0mV/m. Determine E_r, H_i, H_r, E_t and H_t. (6M+9M)

6. a) Explain the significance of TEM waves in a parallel plane wave guide, and derive an expression for the attenuation factor for TEM waves.
   b) If a wave of 6 GHz is propagation between two parallel conducting plates separated by 30mm .Find the cutoff wave length ,guide wavelength for TE_1 mode (9M+6M)

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. (4M+4M+7M)

8. a) Explain the significance and utility of λ/8,λ/4 and λ/2 lines.
   b) A low transmission line of 100Ω characteristic impedance is converted to a load of 400Ω. Calculate the reflection coefficient and standing wave ratio. (7M+8M)
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Code No: R22042 **R10** SET - 3

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1. a) Derive an expressions for the field strength due to a volume of uniform charge density at an arbitrary point P(r,θ, Ø).
   b) A circular ring of radius 'a' carries uniform change ρ_LC/m and is in the xy-plane. Find the electric field at point (0, 0, 2) along the axis. (7M+8M)

2. a) Define and explain the Biot- Savart's law. Hence obtain the field due to a straight current carrying filamentary conductor of finite length
   b) In free space **D**=5.0 Sin (10t-βz) $\mathbf{a}_x$. Find the B using Maxwell's equation (9M+6M)

3. a) Explain the concept of displacement current introduced by Maxwell to account for the production of magnetic fields in the empty space.
   b) A parallel plate capacitor with a plate area of $5cm^2$ and plate separation of 3mm has a voltage 50 $Sin10^3$tV applied to its plates. Calculate the displacement current assuming $\varepsilon=2\varepsilon_0$. (7M+8M)

4. a) Explain the terms :
   i) Linear polarization ii) Circular polarization iii) Elliptical polarization
   b) A 300MHz uniform plane wave propagates through fresh water for which σ=0,μ_r=1 and ε_r=78.Calculate i) the attenuation constant ii)the phase constant iii) the wave length iv) Intrinsic impedance. (6M+9M)

5. a) Derive the expression for the resultant Electric field and resultant magnetic field when a wave incidents normally on a perfect conductors.
   b) An EM wave in free space is incident normally on a dielectric whose ε_r=5.0,Find the reflection and transmission coefficients. (7M+8M)

6. a) What are the field components for TM waves? Derive them and draw the sketches for TM_{10} mode.
   b) Explain the factors on which cutoff frequency of parallel plate wave guide depend. (10M+5M)

7. a) Write a short notes on
   i)Lossless Transmission lines. ii) Distortion less line
   b) A transmission line operating at 500MHz has Z_0=80 Ohms, α=0.04Np/m, β=1.5rad/m. Find the line parameters R, L, G, and C (6M+9M)

8. a) Derive a relation between reflection coefficient and characteristic impedance.
   b) A 100Ω loss less line connects a signal of 100 KHz to load of 140 Ω. The load power is 100mW.calculate i)Voltage reflection Coefficient ii) VSWR iii)Position of V_{max},I_{max},V_{min} and I_{min} (6M+9M)
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1. a) State and prove Gauss's law .list the limitations of Gauss's law
   b) The non uniform field $\mathbf{E} = y\mathbf{a}_x + x\mathbf{a}_y + 2\mathbf{a}_z$, determine the work expended in carrying 2C from B(1,0,1) to A(0.8,0.6,1) along the shorter arc of the circle, $x^2 + y^2 = 1, z=1$ (7M+8M)

2. a) Derive the Maxwell's two equations for magneto static fields in point and integral forms. Give their word statements and explain their significance.
   b) Find the vector magnetic field intensity in Cartesian coordinates P (1.8, 2, 5. 3) caused by a current filament of 24A in a_z direction along Z-axis and extending from z=0 to z=6. (8M+7M)

3. a) Derive the equation of continuity for the time varying fields.
   b) In a medium of $\mu_r = 2$ Find E,B and displacement current if $\mathbf{H}=25\text{Sin}(2X10^8t+6x)\mathbf{a}_y$ mA/m. (6M+9M)

4. a) Define uniform plane wave. Prove that uniform plane wave does not have field components in the direction of propagation.
   b) Find the depth of penetration S of an EM wave in copper at f=60Hz and f=100MHz.For Copper $\sigma=5.8*10^7$, $\mu_r = 1$, and $\varepsilon_r=1$. (8M+7M)

5. a) Obtain the expression for surface impendence of conductors in terms of skin depth
   b) A plane wave with E=2.0V/m and has a frequency of 300MHz is moving in free space impinging on thick copper sheet located to the direction of the propagation .Find i) E and H at the plane surface ii) Depth of penetration iii) the surface impedance (6M+9M)

6. a) Explain and sketch the nature of variations of attenuation with frequency in parallel plate waveguide for TE, TM and TEM waves.
   b) For a parallel plane waveguide of 3Cm separation, determine all the propagation characteristics for a signal at 10GHz for TE_{10} waves (9M+6M)

7. a) Derive the relationship between secondary constants and primary constants of a transmission line
   b) Show that a line will be distortion free if CR=LG. (8M+7M)

8. Write a detailed notes on
   i) Stub matching ii) Smith chart and its applications. (8M+7M)
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