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

**II B. Tech II Semester, Regular Examinations, April/May – 2013**
**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
Use of Smith **Chart** Permitted.
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1. a) State and explain Coulomb's law
   b) The area between the circles $x^2+y^2=a^2$ and $x^2+y^2=b^2$ with b>a, is uniformly charged with a density $\rho_s$ (C/m2). Find the force acting on a charge q placed at (0,0,z).

2. a) State and prove Amphere's circuital law.
   b) In the region $0<\rho\leq 0.5$m, in cylindrical coordinates, J = 4.5 exp (-2ρ) $\bar{z}$ ($A/m^2$) and J = 0 elsewhere. Find H, everywhere due to this current distribution.

3. a) Write Maxwell's equation in integral as well as differential forms.
   b) If σ=0, ε=2.5 $\varepsilon_0$ and μ=$\mu_0$, determine whether or not the following pairs of fields satisfy Maxwell's equation.
   $\bar{E}$ = 2y $A_y$; H=5x $A_x$
   $\bar{E}$=100 sin ($6X10^7$ t) sinz $A_y$
   H= -0.1328 cos ($6X10^7$t) cosz $A_x$

4. a) Derive wave equations in $\bar{E}$ and $\overline{H}$ for free space conditions.
   b) A plane wave is propagating in a medium having the properties $\mu_r = 4$, $\varepsilon_r = 36$, σ = 1s/m and the **E** = $100e^{-az}\cos(10^8t-\beta z)a_x$ V/m, determine the associated magnetic field.

5. a) Derive the standing wave equation when a EM wave is incident normally a perfect conductor.
   b) In free space E=50 cos (ωt-βz) $A_z$(V/m). Find the average power crossing a circular area of radius 2.5m in the plane z= constant.

6. a) Write short notes on the attenuation in parallel plane waveguides.
   b) Derive the following expressions.
   i) $\frac{1}{\lambda^2}=\frac{1}{\lambda_g^2}+\frac{1}{\lambda_c^2}$ $\lambda_c = 2a$ (a is the distance between parallel planes)

7. a) Derive an expression for input impedance at any point in a transmission line.
   b) Derive the secondary constants for a low loss transmission line.

8. a) Write short notes on the applications of smith chart.
   b) The input impedance of a short-circuited lossy transmission line of length 2m and characteristic impedance 75Ω is 45+j225Ω.
   i) Find α and β of the line.
   ii) Determine the input impedance if the short circuit is replaced by a $Z_L$=67.5-j4.5Ω



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Code No: R22042 **R10** SET - 2

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(Com. to ECE, EIE)

Time: 3 hours Max. Marks: 75

Answer any **FIVE** Questions
All Questions carry **Equal** Marks
Use of Smith **Chart** Permitted.
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1. a) Derive the expression for Electric field (E) due to a line charge.
   b) An infinitely long uniform line charge is located at y=3, z=5 and $\rho_L$= 30nC/m. Find E at the origin.

2. a) Define magnetic flux and flux density.
   b) Find the magnetic flux density and H at a point 'P' due to a straight conductor carrying current I.

3. a) What is inconsistency associated with Amphere's law? How is it overcome?
   b) Show that the displacement current in the dielectric of parallel-plate capacitor is equal to the conductor current in its leads.

4. a) Define uniform plane wave? Derive the corresponding mathematical expressions for it.
   b) Derive the expressions for α and β in a good conductor?

5. a) How to differentiate conductors and Insulators?
   b) Derive the wave equation for loss less medium and prove that velocity of EM wave is equal to velocity of light in free space.

6. a) Why TEM modes are not possible in hollow rectangular waveguides. Prove it?
   b) A $TE_{10}$ wave at 10 GHz propagates in a rectangular waveguide of (1.5cm X0.6cm) dimensions filled with medium characterized by $\mu_r$=1, $\varepsilon_r$=2.25. Determine guided wavelength and wave impedance.

7. a) Derive an expression for input impedance at any point in a transmission line.
   b) Derive the secondary constants for a low loss transmission line.

8. a) Discuss the stub matching techniques of impedance matching.
   b) A lossless transmission line of length 0.434λ and $Z_0$= 100Ω is terminated in an impedance 260+j180Ω. Find i) VSWR ii) Reflection Coefficient iii) Input impedance iv) location of voltage maximum on the line.



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Code No: R22042 **R10** SET - 3

**II B. Tech II Semester, Regular Examinations, April/May – 2013**
**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
Use of Smith **Chart** Permitted.
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1. a) Derive Possion's and Laplace's equations from fundamentals.
   b) An infinitely long uniform line charge is located at y=3, z=5. If $\rho_L$=30nC/m, find field intensity $\bar{E}$ at i) origin ii) P (5,6,1).

2. a) State and explain Lorentz's force equation.
   b) A conductor of length 2.5m located at z=0, x=48m carries a current of 12A in $-a_y$ direction. Find the uniform 'B' in the region if the force on the conductor is $1.2X10^{-2}$N in the direction $(-\bar{a}_x + \bar{a}_z)/\sqrt{2}$

3. a) State and prove Maxwell's equations concerned to magnetic fields. Give their significance.
   b) Obtain the expression for continuity of current equation.

4. a) Derive the relation E/H = η.
   b) A uniform plane wave propagating in a medium has $E = 2e^{-\alpha z}\sin(10^8 t-\beta z)\ \bar{a}_y$ V/m. If medium is characterized by $\varepsilon_r$=1, $\mu_r$=20, σ=3 mhos /m, Find α, β.

5. a) Using Poynting theorem, show that the power flow along a coaxial cable is the product of Voltage and Current.
   b) Derive expressions for the reflection coefficient when plane waves with perpendicular polarization are incident at an angle on a boundary between two dielectric media.

6. a) Define the terms cut-off wavelength, phase velocity, group velocity and guide wavelength.
   b) Derive an expression for the attenuation factor 'α' for the TE wave.

7. a) Derive the expression for propagation constant of infinite transmission line.
   b) The characteristic impedance of 1 KM long line is 100Ω and is terminated in 200Ω. It is fed with 10V having a source resistance of 50Ω at ω=0.3 rad/sec. Find the input voltage and current.

8. a) Sketch input impedance versus line length for short and open circuited lines with $0 < l < \lambda$.
   b) $Z_{0C} = 900\angle -30^0$ and $Z_{SC}=400\angle -10^0$. Calculate $Z_0$ and γ of a 12km long line.



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Code No: R22042 **R10** SET - 4

**II B. Tech II Semester, Regular Examinations, April/May – 2013**
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Time: 3 hours Max. Marks: 75

Answer any **FIVE** Questions
All Questions carry **Equal** Marks
Use of Smith **Chart** Permitted.
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1. a) Define electric potential and obtain expression for electric potential due to n-point charges.
   b) Find electric flux density at (0,4,3) when a point charge of 30nC is located at the origin and plane y=3 carries charge 10nC/$m^2$.

2. a) Derive the expression for inductance per unit length for a solid wire of radius 'a'.
   b) Given that $H=-2a_x+6a_y+4a_z$ A/m; in the region $y-x\leq 0$ where $\mu=5\mu_0$. Calculate magnetic flux density.

3. a) Express Maxwell's equations in dielectric medium in point and integral forms along with word statements.
   b) State Faraday's laws and derive expression for induced EMF.

4. a) Derive wave equation for source free regions.
   b) Derive attenuation constant and phase constant for the plane wave in conducting medium.

5. a) In free-space the intensity of the field is $\bar{E}\cos(\omega t-\beta z)\bar{a}_z$ V/m. Find the average power crossing a circular area of radius 2.5m in the plane z = constant.
   b) Evaluate the reflection and transmission coefficients for the case an EM wave in air incident normally upon the copper sheet of frequency 1 MHz. Given $\mu_0=\mu_1=\mu_2$, $\varepsilon_1=\varepsilon_2=\varepsilon_0$, $\sigma_1=0$, $\sigma_2=5.8X10^{-7}$/m.

6. Find $Z_0$, $V_p$, $V_g$ for the dominant mode propagating in rectangular wave guide with a=2.2cm, b=1 cm. Frequency of propagation is 10 GHz. Determine any other modes that are propagating in the waveguide.

7. a) Derive the condition for distortionless transmission line.
   b) Sketch input impedance versus line length for shorted and open circuited line with $0<l<\lambda$.

8. A 50 ohm line is terminated with a load $Z_L=75+j65$ ohms. Determine the location to insert a short circuited stub and its length required to match the load to the line. The frequency of operation is 1 GHz. Use Smith chart if necessary.



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