Code No: RT22044 **R13** SET - 1

II B. Tech II Semester Regular Examinations, April/May – 2016
EM WAVES AND TRANSMISSION LINES
(Com to ECE, EIE)

Time: 3 hours Max. Marks: 70

Note: 1. Question Paper consists of two parts (**Part-A** and **Part-B)**
2. Answer **ALL** the question in **Part-A**
3. Answer any **THREE** Questions from **Part-B**
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Note: Smith chart is need to solve the problems.

PART –A

1. a) A sheet of charge lies in y-z plane at x=0 and has uniform surface charge density of 5.0 ρ C/m^2 .Find the electric field at a point , P(-5,0,0) on x-axis. (4M)
   b) Prove that ∇ XH = jωD + J (3M)
   c) Define elliptical polarization with suitable equation? (4M)
   d) Define Parallel polarization and perpendicular polarization (4M)
   e) Classify the types of transmission lines? (3M)
   f) What is meant by stub? Explain its use in transmission lines. (4M)

PART –B

2. a) In a spherical region the electric displacement is given by D=10r ^{2} a $_r$ mC / m ^{2}. Find the total charge enclosed by the volume specified by r=40cm , θ =π/4 And Φ=2π. (8M)
   b) Derive the magnetic field 'H' at a point 'p' due to a finite current element (8M)

3. How to convert differential form of 4-Maxwell equations into integral form? Explain? (16M)

4. a) Derive Wave equations in free space? (8M)
   b) An elliptical polarized wave has an Electric field of E=sin (ωt-βz) a $_x$ + 2sin (ωt-βz + 75 ^{0}) a $_y$ V/m. Find the power per unit area Conveyed by the wave in free space. (8M)

5. a) Prove that E $_I$ = - E $_r$ when the wave is normal incidence on a perfect Conductor? (8M)
   b) A perpendicularly polarized wave is incident at an angle of θ $_{I=}$ 15 ^{0} . It 's Propagating from medium 1 to medium 2 . Medium 1 is defined by ε $_{r1}$ =8.5 , μ $_{r1}$ =1 , σ $_1$ =0 and medium 2 is free space . If E $_I$ =1.0 mV/m , Determine E $_r$. H $_I$, H $_{r.}$ (8M)

6. a) From basic Transmission line, derive the secondary constant Equations? (8M)
   b) A lossy cable which has R=2.25Ω/m ,L=1.0μH/m, C=1 pF/m , and G=0 operates at f=0.5GHZ .Find the attenuation constant of the line. (8M)

7. a) For a transmission line which is terminated in normalized impedance Zn, VSWR = 2 . Find the normalized impedance magnitude. (8M)
   b) Write short notes on different lengths of transmission lines with shortend Load? (8M)
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Code No: RT22044 **R13** SET - 2

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PART –A

1. a) An electron has a velocity of 1 Km /s along a_x in a magnetic field whose Magnetic flux density is B =0.2 a_x - 0.3a_y + 0.5 a_z Wb/m^2. Determine the electric field intensity if no force is applied to the electron. (4M)
   b) Represent the second maxwell's equation in integral form (3M)
   c) Define good conductors and good dielectrics ? (4M)
   d) Define Brewster angle? (3M)
   e) Define primary constants & secondary constants? (4M)
   f) What is the equivalent circuit element of transmission line of length l =λ/4 at Short end and open end (4M)

PART –B

2. a) Define potential difference? Mention the characteristics of potential difference? (8M)
   b) Prove that H= -I/ 2πρ a_Φ at point 'p' due to infinite current Element? (8M)

3. How to convert 4-Maxwell's equations into phasor form? Explain? (16M)

4. a) Define uniform plane wave and derive the general solution of uniform plane wave equation (8M)
   b) An circularly polarized wave has an electric field of E = Sin (ωt-βz) a_x V/m. Find power per unit area conveyed by the wave in free space? (8M)

5. a) Define and derive the reflection coefficient of a wave incidence is normal on dielectric ? (8M)
   b) Find the depth of penetration ,δ of an EM wave in copper at f= 60 Hz and f=100 MHz . For Copper , σ = 5.8 x 10^7 mho /m , ε_r =1 , μ_r =1 (8M)

6. a) Define the term characteristic impedance and derive the expression for it. (8M)
   b) A Transmission line in which no distortion is present has the following parameters : Z_0 =50 Ω, α=0.020 m^{-1} , v=0.6 v_0 . Determine R, L, G, C and Wavelength at 0.1 GHz. (8M)

7. a) Write short notes on reflection coefficient and VSWR? Derive the relation between them ? (8M)
   b) By using smith chart, Find the input impedance of 75 Ω losses transmission line of length 0.1λ,When the load is short. (8M)
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Code No: RT22044 **R13** SET - 3

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PART –A

1. a) Calculate the capacitance of parallel plate capacitor of 'N' dielectric slabs with Different thickness? (4M)
   b) What are the boundary conditions between dielectric –dielectric and dielectric Conductor (4M)
   c) Mention the characteristics of E-H fields in Uniform plane wave ? (4M)
   d) Define Poynting Vector Theorm? (3M)
   e) What are the different types of loading? Explain. (3M)
   f) What is the equivalent circuit element of transmission line of length $l = \lambda/2$ at short end and open end? (4M)

PART –B

2. a) Prove that the energy stored in capacitor $W_c = ½ CV^2$ Joules (8M)
   b) The vector magnetic potential , A due to direct current in a conductor in free Space is given by $A = (x^2 + y^2)\ a_z\ \mu Wb/m^2$. Determine the magnetic Field produced by the current element at(1,2,3). (8M)

3. a) Explain the inconsistency in Ampere's law? (8M)
   b) Prove that E_{tan} is continuous and D_{norm} is discontinuous at boundary between 2-dielectric materials? (8M)

4. a) Prove that the intrinsic impedance of the Uniform plane wave is 377Ω (8M)
   b) What is meant by polarization? Explain. (8M)

5. a) Define and derive the transmission coefficient of a wave incidence in normal On dielectric? (8M)
   b) Discuss about power loss in a plane conductor. (8M)

6. a) Prove that the velocity of propagation is same in distortion less line and loss Less transmission line? (10M)
   b) List out the applications of transmission lines (6M)

7. a) Find the input impedance of a 75Ω lossless transmission line of length (0.1λ) If it is terminated in open circuit(using smith chart) (8M)
   b) Write short notes on different lengths of Transmission lines with open end load? (8M)
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PART –A

1. a) The vector magnetic potential , A due to a direct current in a conductor in free space is given by $A = (x^2 + y^2)\, a_z$ μWb /m^2. Find 'B '. (3M)
   b) If $D = 2x^2\, a_x + a_y + 2z^2$ pC/m^2 , derive volume charge density (4M)
   c) Find the depth of penetration , δ of an EM wave in copper at f=60 Hz . For copper , $\sigma = 5.8 \times 10^7$ mho /m , $\mu_r = 1$, $\varepsilon_r = 1$. (4M)
   d) The magnetic field , H of a plane wave has a magnitude of 5 mA/m in a Medium defined by $\varepsilon_r = 4$, , $\mu_r = 1$.Determine the impedence of medium? (4M)
   e) Define Infinite transimission line? (3M)
   f) Define Reflection coefficient and range of reflection coefficient? (4M)

PART –B

2. a) Three parallel line charges , $\rho_{L1} = 5$nC/m , $\rho_{L2} = 4$nC/m , $\rho_{L3} = -6$nC/m are located at (0,0), (3,0) and (0,4)m respectively . Find D and E at (3,4). (8M)
   b) A charge of 12C has velocity of $5\, a_x + 2\, a_y - 3\, a_z$ m/s . Determine F on the charge in the field of i) $E = 18\, a_x + 5\, a_y + 10\, a_z$ V/m
   ii) $B = 4\, a_x + 4\, a_y + 3\, a_z$ Wb/ m^2. (8M)

3. a) Prove that H_{tan} is discontinuous and B norm is continuous at boundary Between 2 –mediums? (8M)
   b) $X < 0$ defines region 1 and $x > 0$ defines region 2 . Region 1 is characterized by $\mu_{r1} = 3.0$ and region 2 characterized by $\mu_{r2} = 5.0$. If the magnetic field in region 1 is given by $H_1 = 4.0\, a_x + 1.5\, a_y + 3.0\, a_z$ A/m , find $\mathbf{H}_2$ and B_2. (8M)

4. a) When the amplitude of the magnetic field in a plane wave is 2A/m, (8M)
   i) Determine the magnitude of the electric field for the plane wave in free space
   ii) determine the magnitude of the electric field when the wave Propagates in a medium which is characterized by $\sigma = 0$, $\mu = \mu_0$ and $\varepsilon = 4\varepsilon_0$.
   b) Prove that E & H are perpendicular to each other in Uniform plane wave ? (8M)

5. a) What is Brewster Angle? Derive the expression for Brewster angle? (8M)
   b) The magnetic field , **H** of a plane wave has a magnitude of 5 mA/m in a medium defined by $\varepsilon_r = 4$, , $\mu_r = 1$. Determine i) the average power flow ii) The maximum energy density in the plane wave. (8M)

6. a) Define phase & group velocities in transmission line and derive the relation between them? (8M)
   b) A lossless transmission line used in a TV receiver has a capacitance of 50pF/m and an inductance of 200 nH/m .Find the characteristic impedance for section of a line 10 meter long? (8M)

7. a) Write short notes on stub matching technique? (8M)
   b) For a uniform transmission line , the open and short circuit impedances are given by $Z_{oc} = 50 + j\,25\Omega$, $Z_{sc} = 60 - j20\Omega$. Find Z_0 of the line. (8M)
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