Code No: R1622043 **R16** SET - 1

II B. Tech II Semester Regular Examinations, April - 2018
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 **FOUR** Questions from **Part-B**

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PART –A

1. a) Write the Poisson's and Laplace equations. (2M)
   b) State Ampere's circuit law. (3M)
   c) Define skin depth. (2M)
   d) Write the applications of Poynting theorem. (2M)
   e) What is the expression for propagation constant in terms of Z_{oc} and S_{oc}. (2M)
   f) List the parameters to find using Smith chart. (3M)

PART -B

2. a) Using Gauss's law, derive the expressions for electric field intensity and electric flux density due to an infinite sheet of conductor of charge density ρ C/cm. (7M)
   b) A line charge ρ_L= 400pC/m lies along the X-axis. The surface of zero potential passes through the point P(0,5,12)m. Find the potential at point (2,3,-4)m. (7M)

3. a) Explain the concept of Magnetic vector potential (7M)
   b) Write Maxwell's equations in different final forms and in word Statements. (7M)

4. a) Define uniform plane wave. Prove that uniform plane wave does not have field component in the direction of propagation. (7M)
   b) If $\varepsilon_r = 9$, $\mu = \mu_0$. For the medium in which a wave with a frequency of f = 0.3 GHz is propagating , determine the propagation constant and intrinsic impedance of the medium when $\sigma = 0$ (7M)

5. a) Define Brewster angle and derive the expression for Brewster angle when a wave is parallel polarized. (7M)
   b) A plane wave travelling in free space has an average pointing vector of 5 watts/ m^2. Find the average energy density. (7M)

6. a) List out types of transmission lines and draw their schematic diagrams. (7M)
   b) A transmission line in which no distortion is present has the following parameters $Z_0 = 60\Omega$, α = 20m NP/m, $v = 0.7v_0$. Determine R,L,G,C and wavelength at 0.1 GHz. (7M)

7. a) Derive the expression for the input impedance of a transmission line length L. (7M)
   b) List out applications of smith's chart. How to measure them? (7M)
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PART –A

1. a) Name few applications of Gauss's law in electrostatics. (2M)
   b) Explain about transformer EMF (3M)
   c) Define circular polarization. (2M)
   d) What is meant by Total Internal Reflection? (2M)
   e) What is the relation between primary constants and γ? (2M)
   f) For a lossless line, the characteristic impedance is Z_0 and VSWR is S. What is the maximum impedance on the line? (3M)

PART -B

2. a) State and explain Coulomb's law. Obtain an expression in vector form. (7M)
   b) Two uniform line charges of density 8nC/m are located in a plane with y=0 at x= ± 4m. Find the Electric field at a point P(0m, 4m, 10m) (7M)

3. a) Find magnetic field strength, H, on the Z-axis at a point P (0, 0, h), due to a current carrying circular loop, $x^2+y^2= A^2$ in Z=0 plane. (7M)
   b) Derive Maxwell's equations from their basics. (7M)

4. a) Derive the wave equations for source free regions. (7M)
   b) A uniform plane wave at a frequency of 1GHz is travelling in a large block of Teflon with $\varepsilon_r= 2.1$, $\mu = 1$ and $\sigma =0$. Determine λ, γ, β and η. (7M)

5. a) Define and distinguish between the terms perpendicular polarization, parallel polarization, for the case of reflection by a perfect conductor under oblique incidence. (7M)
   b) Obtain an expression for the power loss in a plane conductor in terms of the surface impedance. (7M)

6. a) Derive the expression for characteristic impedance (7M)
   b) Draw an equivalent circuit of a two wire transmission line and mention its applications. (7M)

7. a) Explain the significance and utility of $\lambda/8$, $\lambda/4$ and $\lambda/2$ lines. (7M)
   b) A 50Ω loss less line connects a signal of 50 KHz to a load of 140Ω. The load power is 75Mw. Calculate (i) Voltage Reflection coefficient (ii) VSWR (iii) Position of V_{max}, I_{max}, $V_{min}$and I_{min}. (7M)
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Code No: R1622043 **R16** SET - 3

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PART –A

1. a) What is the electric field intensity at a distance of 20cm from a charge of 2μC in vacuum? (2M)
   b) Write down the magnetic boundary conditions. (3M)
   c) Calculate the characteristic impedance of free space. (2M)
   d) Define surface impedance. (2M)
   e) Write the expression for Z_o in terms of primary constants. (2M)
   f) A λ/4 length transmission line having impedance Z_0 is terminated with Z_R, What is the input impedance? (3M)

PART -B

2. 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). (7M)
   b) A charge of -0.3mC is located at A(25, -30, 15)cm and a second charge of 0.5mC 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. (7M)

3. a) Derive equation of continuity for static magnetic fields. (7M)
   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 in x-z plane and 'r' distant from the origin. Hence deduce expressions for H due to semi-infinite length of the conductor. (7M)

4. a) Determine the resultant Electric and Magnetic fields of plane wave when it is incident on a perfect conductor normally. (7M)
   b) Explain skin depth and derive an expression for depth of penetration for good conductor. (7M)

5. a) State and prove Poynting theorem. (7M)
   b) An EM wave travelling in air is incident normally on boundary between air and a dielectric having permeability same as free space and permittivity as 4. Prove that one-ninth of the incident power is reflected and eight-ninths of it is transmitted into the second medium. (7M)
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6. a) Starting from the equivalent circuit, derive the transmission line equations for V and I, in terms of the source parameters. (7M)
   b) A two wire line has a characteristic impedance of 300Ω and is fed to a 90 Ω resistor at 100 MHz. A quarter wave line is to be used as a tube, 0.25 inch in diameter. Find centre-to-centre spacing in air? (7M)

7. a) Define the reflection coefficient and derive the expression for the input impedance in terms of reflection coefficient (7M)
   b) Give details about smith chart and write steps how to calculate impedance, reactance, and wavelength using this chart. (7M)

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PART –A

1. a) Write the point form of continuity equation and explain its significance. (2M)
   b) A circular coil of radius 2m carries a current of 4A. What is the value of magnetic field intensity at the centre? (3M)
   c) Define Attenuation constant. (2M)
   d) Write the expression for instantaneous power flow in electromagnetic field and instantaneous Poynting vector. (3M)
   e) What are the conditions for minimum attenuation? (2M)
   f) For a transmission line VSWR is 4. What is the reflection coefficient? (2M)

PART -B

2. a) State Gauss's law. Using divergence theorem and Gauss's law, relate the displacement density D to the volume charge density ρ_v. (7M)
   b) A sphere of radius "a" is filled with a uniform charge density of ' ρ_v' C/ m^3. Determine the electric field inside and outside the sphere. (7M)

3. a) Find the magnetic field strength, H at the centre of a square conducting loop of side '2a' in z=0 plane if the loop is carrying a current, I, in anti-clockwise direction. (7M)
   b) Derive the boundary conditions for the tangential and normal components of Electrostatic fields at the boundary between two perfect dielectrics. (7M)

4. a) Find the relations between E and H in a uniform plane wave. Find the value of intrinsic impedance of free space. (7M)
   b) A plane sinusoidal EM wave travelling in space has E_{max}= 1500 μv/m. Find the (I) H_{max} (ii) The average power transmitted. (7M)

5. a) Define Brewster angle and Critical angles. State where these are required. (7M)
   b) A plane wave travelling in free space has an average Poynting vector of 10 Watts/m^2. Find the average energy density. (7M)

6. a) What is loading? Explain different types of loading in transmission lines. (7M)
   b) An air line has a characteristic impedance of 70 Ω and a phase constant of 3 rad/m at 100 MHz. Calculate the inductance per meter and the capacitance per meter of the line. (7M)
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7. a) Explain the principle of impedance matching with quarter wave transformer. (7M)

   b) Write about smith chart. How the smith charts are useful to calculate transmission line parameters? (7M)