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

II B. Tech II Semester Supplementary Examinations, November-2018
ELECTRO MAGNETIC 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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PART-A

1. a)Three equal point charges of 4μc are in free space at (0, 0, 0), (2, 0, 0) and (0, 2, 0), respectively. Find net force on Q4 = 6 μc at (2, 2, 0)
   b) Which Maxwell's equation is used to remove inconsistency of ampere's law? Give the equation with appropriate reason
   c) A right-hand circularly polarized plane wave of frequency 10 GHz propagates along +z axis direction in air. The E-field magnitude is 1 V/m. (a) Find the $\tilde{E}$ vector phasor as function of z.
   d) State Poynting theorem and define Poynting vector
   e) Define characteristic impedance and propagation constants of a transmission line
   f) Describe how matching is achieved using single stub matching.

(4M+3M+4M+4M+4M+3M)

PART-B

2. a) State Gauss law. Apply Gauss law to calculate the electric field both inside outside of an insulating sphere of radius a, a uniform charge density ρ and a total positive charge Q.
   b) In a charge free region for which σ=0, $\varepsilon=\varepsilon_0\varepsilon_r$ *and* $\mu=\mu_0$, $\overline{H}=5\cos(10^{11}t-4y)\overline{a_z}$ A/m
   Find i) $\overline{J}_d$ ii) $\overline{D}$ and iii) ε_r (8M+8M)

3. a) The field intensity $\overline{E}=250\sin 10^{10}t\ V/m$ for a field operating in the medium for which $\varepsilon_r=1, \sigma=5\ mho/m$. Calculate the displacement current density $\overline{J_D}$ and conduction current density $\overline{J}_c$. Also find the frequency at which $\overline{J_C}=\overline{J_D}$
   b) The electric field intensity is given by $E=E_m\sin(\omega t-\beta z)\overline{a_y}$ in free space. Find D, B, H using Maxwell's Equations (8M+8M)
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4. a) Calculate the attenuation constant and phase constant for the uniform plane wave with the frequency of 10GHz in a medium for which $\mu=\mu_0, \in_r=2.3, \sigma=2.54\times10^{-4}\ mho/m$

b) The electric field of a uniform plane wave in vacuum is given by

$E(z,t)=10\cos(\omega t-kz)\bar{x}+10\cos\left(\omega t-kz-\frac{\pi}{2}\right)\bar{y}\quad V/m$ i) Convert E (z,t) into a phasor $\tilde{E}$

ii) what is the wave number k at the frequency f_0 of 3GHz iii) what is the wave impedance η iii) what is the type of polarization of the wave like linear, circular or elliptic? What is the sense of rotation? (8M+8M)

5. a) Define Brewster angle and derive an expression for Brewster angle when a wave is parallel polarized.

b) In a non magnetic medium $E=4\sin\left[(2\pi x10^7 t-0.8x)\right]a_z V/m$ Find

i) the time average power carried by the wave

ii) total power crossing 100 cm^2 of plane 2x+y = 5. (8M+8M)

6. a) A lossless transmission line of length 100m has an inductance of 28 μH and a capacitance of 20 nF. Find out i) propagation velocity ii) phase constant at an operating frequency of 100 KHz iii) characteristic impedance of the line.

b) The dimensions of a certain coaxial transmission line are a = 0.8 mm and b = 4mm. The outer conductor thickness is 0.6mm, and all conductors have σ = 1.6×10^7 mhos/m

(i)Find R, resistance per unit length at an operating frequency of 2.4 GHz

(ii) Find α and β if $\alpha+j\beta=\sqrt{j\omega C(R+j\omega L)}$ (8M+8M)

7. a) The voltage reflection coefficient due to load connected to a lossless transmission line of characteristic impedance 100 Ω and working at 3 GHz is 0.5, 45^0 . Assuming the load voltage to be 10 V, calculate the r.m.s voltage and current at intervals of one fourth wave length from the load up to a distance 5 cm.

b) An infinite length of uniform line charge has $\rho_L=10\,pC/m$ = 10 pC/m, and it lies along the z-axis. Determine electric field $\bar{E}$ at (4, 3, 3) (8M+8M)