Tanta University	Department of Electronics and Electrical Communication Engineering	Faculty of Engineering

Course: **Electromagnetic Waves (1)**	Course Code: **EEC2208,**	Students: **2nd year**
Date: **Tue., 11-June-2013,**	Time Allowed: **Three hours,**	No. of Pages: **1,**

Final Exam

(Total marks: 85 Marks)

Answer the following questions:

Q1: [20 marks]

a) State the Maxwell's equations in the point and integral forms.

b) Drive the wave equations that represents the field components for a wave traveling through a loss-less medium.

c) If the electric field $E = E_m e^{j(\omega t - \beta z)}.a_x$. Find all other electric and magnetic field components in a source free medium with permeability μ_r and permittivityϵ_r. Prove that this electromagnetic wave travels in the z-direction.

Q2: [25 marks]

a) Obtain the parameters: α, β, η, skin depth (δ), and the phase velocity for a wave propagating in lossy media then write down the wave equations for each case.

b) An electric field of a plane wave with the value $E(y,t) = 2 \times 10^{-4} e^{-\alpha y}.\cos(0.4\pi \times 10^9 t + \beta y)$ is propagating in a medium with $\sigma = 10^{-6}\ \Omega^{-1}/m$, $\epsilon_r = 40$.

i. Determine if this medium where the wave propagates is a good dielectric or good conductor.

ii. Evaluate $\alpha, \beta, \eta, \delta$ and the phase velocity and then find H.

iii. Find the poynting vector in this medium.

Q3: [20 marks]

a) Drive the relation between tangential and normal components of the electric and magnetic fields at the boundary between two dielectric media.

b) Two dialectic media, which are interfaced at the yz-plane. If the electric field in the first medium is $E_1 = 0.3a_x - 10a_y + 0.3a_z$ and the magnetic field in the second medium is $H_2 = 1.2a_x + 5a_y$. Find all the fields in the two media if $\sigma_1 = \sigma_2 = 0, \epsilon_{r_1} = 10, \epsilon_{r_2} = 40, \mu_{r_1} = 0.5\mu_{r_2} = 2$.

Q4: [20 marks]

a) What is meant by wave polarization? What are its types? Drive the equations relating the magnitude of electric field components for each type.

b) An electric field is propagating in a medium that is found to be,

$$E(x,t) = 3 \times 10^{-3} e^{-5x} \cos(2\pi \times 10^9 - 10\pi x)\,\hat{y} + E_o e^{-\alpha x} \cos(\omega t - kx + \theta_o)\hat{z}$$

i. Find the type of the medium and σ, ϵ_r. Consider $\mu_r = 1$. $(u_o = 4\pi \times 10^{-7}\ H/m, \epsilon_o = \frac{1}{36\pi} \times 10^{-9}\ F/m$.

ii. Find E_o, θ_o if:

1. The wave is linearly polarized and inclined by 20^o on the y-axis
2. The wave is circularly polarized
3. The wave is elliptically polarized

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Good Luck