Fields and Waves
Tutorial-11 (12th April, 2016)

Q1. The electric field of a 1-MHz plane wave travelling in the +z-direction in air points along the x-direction. If the peak value of the electric field is 1.2π (mV/m) and it is maximum at t=0 and z=50, obtain expressions for **E**(z,t) and **H**(z,t).

Q2. A uniform plane wave is travelling downwards in the +z-direction in seawater. The x-y plane denotes the sea surface and z=0. The parameters of seawater are ε_r=80, μ_r= 1 and σ=4 S/m. The magnetic field at z=0 is given by **H**(0,t)= y 100 $\cos(2\pi * 10^3\ t + 15^o)$ (mA/m).

a) Obtain the expression for **E**(z,t) and **H**(z,t).
b) Determine the depth at which the amplitude of **E** is 1% of its value at z=0.

Q3. For a wave travelling in a medium with skin depth 'x', what is the amplitude of **E** at a distance of 3x when compared to its initial value.

Home Assignment to be submitted and discussed during tutorial session.

Q1. a) The electric field phasor of a uniform plane wave travelling in a lossless medium of intrinsic impedance 188.5 Ω is given by **E**= **z** $10e^{-j4\pi y}$ (mV/m). Determine the associated magnetic field phasor and the instantaneous electric and magnetic fields if the medium is *non-magnetic*.

b) The magnetic field phasor of a uniform plane wave travelling in a medium of intrinsic impedance 100 Ω is given by **H**= (**y** 10+ **z** 20) e^{-j4x} (mA/m). Determine the associated electric field phasor.

Q2. Assume that solar illumination results in a power density of 1kW/m^2 at the Earth's surface. Find:

a) Total power radiated
b) Total power intercepted by the Earth
c) Electrical field of the power density incident upon the Earth's surface. Assume all solar radiation is at a single frequency.

Use radius of Earth's orbit as $1.5 * 10^8$ km and Earth's mean radius as 6380 km for your calculations.