COLLEGE OF ENGINEERING & TECHNOLOGY

Campus : Smart Village Campus
Department : Electronics and Communications
Course : Electromagnetic Wave Propagation
Course Code: EC442
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Sheet (1)

1. A uniform plane wave with electric field of amplitude **10 V/m** is propagating in the +ve x- direction of medium characterized by ε_r **= 16,** μ_r **= 25,** σ **=0 S/m**. If the frequency of the wave is **10 MHz**, Calculate:
   - **a)** The **propagation constant** of the medium.
   - **b)** The **phase velocity** of the wave, and the **wavelength**.
   - **c)** The **intrinsic impedance**.
   - **d)** If the wave is propagating in the +ve z-direction, write down an expression for the **electric field** and the **magnetic field** vectors in this medium and evaluate it at **z =10 m, and t = 5 ns.**
   - **e)** Find P_{av} at the transmitter.
   - **f)** Re-solve problem for σ **= 0.01 S/m and** σ **= 100 S/m**.

2. A wave propagating in a lossless dielectric has the components **Re (E) = 500 cos (**10^7**t-**β**z)** a_x **V/m** and **Re (H) =1.1 cos (**10^7**t-**β**z)** a_y **A/m**. If the wave is travelling at **v = 0.5 c**. Find ϵ_r, μ_r, β, and λ.

3. A wave has an amplitude Ex_0 **= 600V/m** is propagating in the +ve z- direction of a medium characterized by $\varepsilon = 2 \times 10^{-11}$**F/m**, $\mu = 2 \times 10^{-6}$**H/m**, and σ **=0.1S/m**. If $\omega = 10^{10}$**rad/sec**, find:
   - **a)** E_x and H_y at (**0, 0, 2cm, 0.1ns**).
   - **b)** The **loss tangent**.
   - **c)** How **far** can a wave propagate before its amplitude is **halved**, and when its **phase shift =** 180^o.

4. A uniform plane wave propagating in the +ve z- direction through a lossy material with γ **= 0.2 + j 1.4** and η **= 200 + j300**. Let E_{ox} **= 100 V/m** at **z = 0**, find:
   - **a)** P_{av} at the transmitter.
   - **b)** **Total power dissipated** at the area **2×3 m**.

5. A uniform plane wave has a magnetic field vector given by:
Re (H) = 0.5 exp (0.7x) cos ($5\pi \times 10^6$ t + 0.7x - 0.25π) j A/m. If the accompanying electric field is of amplitude **25V/m**.

- **a)** Calculate the **phase velocity** of the wave, and its **wavelength**.
- **b)** Calculate the **skin depth**.
- **c)** Find $\mathbf{P_{av}}$ at **x = 100m**.
- **d)** The **intrinsic impedance**.
- **e)** Write down an expression of **E(t)**.
- **f)** Calculate ϵ_r, μ_r, and **σ** of the medium.