Indian Institute of Space Science and Technology (IIST)
Quiz II Question Paper, October, 2022
ECE(Avionics), Electromagnetic and Wave Propagation (AV214), 3rd Semester

Marks: 15 Time: 1 Hr.

Answer all the questions. Make suitable assumptions if necessary.
Given: $\mu_0 = 4\pi \times 10^{-7}$ **H/m** $\epsilon_0 = 8.854 \times 10^{-12}$ **F/m**

1. The electric field of a uniform plane wave in free space is given by

$$\overline{E} = 10(\hat{y} + j\hat{z})e^{-j25x}$$

(a) Determine the frequency of the wave, (b) find the corresponding magnetic field, (c) what is the polarization of the wave? **3**

2. The amplitude of a uniform plane wave traveling through a lossy nonmagnetic medium at a frequency of 5.2 MHz reduces by 25% every meter. The electric field of the wave leads the magnetic field by 30°. Under these circumstances, find (a) the complex propagation constant of the wave and (b) the relative permittivity and conductivity of the medium. **3+3**

You may use the following equations:

$$\alpha = \omega\sqrt{\frac{\varepsilon\mu}{2}}\left[\sqrt{1+\left(\frac{\sigma}{\omega\varepsilon}\right)^2} - 1\right]^{\frac{1}{2}} \beta = \omega\sqrt{\frac{\varepsilon\mu}{2}}\left[\sqrt{1+\left(\frac{\sigma}{\omega\varepsilon}\right)^2} + 1\right]^{\frac{1}{2}}$$

3. A uniform plane electromagnetic wave at $f = 300$ MHz propagates in the direction defined by the vector $\hat{x} + \hat{y}$ in a rectangular coordinate system. The complex electric field intensity vector of the wave at the coordinate origin is $\overline{E}_0 = (1+j)\hat{z}$ V/m and the medium is air. Find the expressions of electric and magnetic field vectors. **3**

4. The electric and magnetic fields in a coaxial cable having inner radius a and outer radius b, are given by

$$\overline{E} = \frac{V_0}{\rho \ln\left(\frac{b}{a}\right)} \cos\omega(t - z\sqrt{\mu_0\varepsilon_0})\hat{\rho} \quad \text{for} \quad a \le \rho \le b$$

$$\overline{H} = \frac{I_0}{2\pi\rho \ln\left(\frac{b}{a}\right)} \cos\omega(t - z\sqrt{\mu_0\varepsilon_0})\hat{\phi} \quad \text{for} \quad a \le \rho \le b$$

where V_0 and I_0 are constants and coaxial line is oriented along z direction. Find out the net power flow along the cable. **3**