DBX-003-1152002 Seat No. _____

M. Sc. (Electronics) (Sem. II) Examination

July - 2022

Advance Electromagnetics : Paper-6

Faculty Code : 003

Subject Code : 1152002

Time : $2\frac{1}{2}$ Hours] [Total Marks : **70**

1 Answer any seven from the following : **14**

(1) For sea water $\sigma = 4\frac{mho}{m}$, $\mu_r = 1$ and $\in_r = 81$. Find the intrinsic impedance experienced by an EM wave having frequency of 4 MHz.

(2) The magnitude filed H of a plane wave is 5 mA/m in a medium defined by $\mu_r = 1$ and $\in_r = 4$. Determine the average power flow.

(3) Define surface impedance. Draw the graph of surface impedance versus linear current density.

(4) A copper walled resonant cavity is operating at $f = 6.25$ GHz and has $\sigma_c = 5.8 \times 10^7\ mho/m$. Find the skin depth of the wall.

(5) The cut-off frequency for the dominant mode in a rectangular waveguide is $f_c = 4\ GHz$. Calculate the dimension of the broad wall along x-axis.

(6) Which components of electric and magnetic field exist in the parallel plate waveguide? Draw the field pattens for resultant fields using arrow convention.

(7) A 100 Km long transmission line has an inductance of 27 mH. Calculate its distributed inductance. A 50Ω transmission line is connected to a load impedance yielding a VSWR of unity. Calculate the load impedance.

(8) A parallel transmission line is shorted at the load end. Mention the equivalent circuits for the following cases.

$l < \frac{\lambda}{4}$, $l = \frac{\lambda}{4}$, $\frac{\lambda}{4} < l < \frac{\lambda}{4}$, $l = \frac{\lambda}{2}$

(9) Write the functions of an antenna.

(10) What do you understand by the far field and induction field?

2 Answer any two from the following :

(A) Draw an Electromagnetic wave travelling in X-direction. Write its characteristics. Prove that for this wave $E_x = H_x = 0$. **7**

(B) Prove that the ratio of the magnitudes of electric and magnetic field is $120\pi\Omega$. **7**

(C) Solve the following : **7**

(1) If a wave with a frequency of 100 MHz propagates in free space, find propagation constant.

(2) If the H field is given by $H(z,t) = 48\cos(10^8 t + 40z)\, a_y, A/m$, identify the amplitude, frequency and phase constant. Find the wavelength.

(3) If a wave is propagating in a medium with a velocity of $v = \frac{1}{3} \times 10^{10}\ cm/s$, $\mu = \mu_0$ $\sigma = 0$, find $\in_r$ and intrinsic impedance.

3 Answer the following :

(A) Derive the expressions for α and β fo rconducting medium for EM wave. **7**

(B) A medium like copper conductor which is characterized by the parameters $\sigma = 5.8 \times 10^7\ mho/m$, $\in_r = 1$, $\mu_r = 1$ supports a uniform plane wave of frequency 60 Hz. Find the attenuation constant, propagation constant, intrinsic impedance, wavelength and phase velocity of the wave. **7**

OR

3 Answer the following.

(A) Derive the expressions for α, β and v for good dielectric. Define depth of penetration. Find the depth of penetration of an EM wave in copper at $f = 60\ Hz$ if $\sigma = 5.8 \times 10^7\ mho/m$, $\epsilon_r = 1$, $\mu_r = 1$. **7**

(B) Discuss the oblique incidence of an EM wave on perfect conductor for Parallel polarization. **7**

4 Answer the following.

(A) Write on Smith chart with necessary mathematical derivations. **7**

(B) With proper diagram discuss half-wave dipole. Derive expressions for total radiated power and radiation resistance for the same. **7**

5 Answer any two from the following.

(A) Solve the following : **7**

(1) The magnetic field H of a plane wave has a magnitude of 5 mA/m in a medium defined by $\epsilon_r = 4$, $\mu_r = 1$. Determine the average power flow and maximum energy density in the plane wave.

(2) The conductivity of sea water is $\sigma = 5\ mho/m$ and $\epsilon_r = 8$. What is the distance, an EM wave can be transmitted at 25 KHz and 25 MHz when the range corresponds to 90% of attenuation?

(B) Solve the following : **7**

(1) If a wave of 6 GHz is propagating between two parallel conducting plates separated by 30 mmm find the cut-off wavelength, guide wavelength for TE_1 mode.

(2) A hollow rectangular waveguide operates at $f = 1\ GHz$ and it has the dimensions of 5 × 2 cm. Check whether TE_{21} mode propagates or not.

(C) Solve the following : 7

(1) For a transmission line which is terminated in a normalized impedance Z_n, VSWR=2. Find the normalized impedance magnitude.

(2) A transmission line is lossless and is 25 m long. It is terminated in a load of $Z_L = 40 + j30\Omega$ at a frequency of 10 MHz. The inductance and capacitance of the line are L=300nH/m, C=4p F/m. Find the input impedance at the source and at the mod-point of the line.

(D) Solve the following : 7

(1) Find the directivity of a half-wave dipole.

(2) Find the directivity, efficiency and effective area of an antenna if its $R_r = 80\Omega$, $R_l = 10\Omega$. The power gain is 10 dB and antenna operates at a frequency of 100 MHz.