BACHELOR OF TECHNOLOGY (C.B.C.S.) (2020 COURSE)
B.Tech.Sem - IV Electronic & Communication : WINTER- 2022
SUBJECT : EM WAVES & PROPAGATION

Day : Monday | Time : 02:30 PM-05:30 PM

Date : 28-11-2022 | W-24603-2022 | Max. Marks : 60

N.B.

1) All questions are **COMPULSORY.**
2) Figures to the right indicate **FULL** marks.
3) Use on non – programmable **CALCULATOR** is allowed.
4) Assume suitable data and standard notations **WHEREVER** applicable.
5) Bold letters are **VECTORS.**

Q.1 Point charges 5 nC and -2 nC are located at (2, 0, 4) and (-3, 0, 5), respectively.

(a) Determine the force on a 1 nC point charge located at (1, -3, 7). **(05)**

(b) Find the electric field $\boldsymbol{E}$ at (1, -3, 7) **(05)**

OR

Apply Gauss's Law to determine the electric flux density, $\boldsymbol{D}$, and electric field intensity $\boldsymbol{E}$ due to

(a) Point Charge **(05)**

(b) Infinite Line Charge **(05)**

Q.2 State Biot-Savart's law and determine direction using Maxwell's right-hand thumb rule. Derive the necessary mathematical relations to find out the magnetic field intensity, $\boldsymbol{H}$ at any point P due to a line of current. **(10)**

OR

A current distribution give rise to the vector magnetic potential $A = x^2y\,a_x + y^2x\,a_y - 4xyz\,a_z$ wb/m. Calculate

(a) $\boldsymbol{B}$ at (-1, 2, 5) **(05)**

(b) The flux through the surface defined by $z=1$, $0 \le x \le 1$, $-1 \le y \le 4$. **(05)**

Q.3 Apply Faraday's law to determine transform *emf* and motional *emf*. Analyze induced *emf* due to a moving closed loop in a time-varying field. **(10)**

OR

Analyze all four Maxwell's equations in a time-varying field in integral as well as differential form with necessary statements of laws involved. **(10)**

P.T.O.

Q.4 (a) Characterize briefly the four different media applicable for EM-wave propagation with necessary parameters like σ, ε, and μ. (05)

(b) An electric field in free space is given by $E = 50 \cos(10^8 t + \beta x)\, a_y$ V/m

(i) Find the direction of wave propagation (02)

(ii) Calculate β and the time it takes to travel a distance of $\lambda/2$. (03)

OR

(a) Derive the necessary parameters like propagation constant, γ; attenuation constant, α ; phase constant, β; intrinsic impedance, η; and wave velocity, u; when the wave is propagating in lossy dielectrics. Assuming the medium to be linear, isotropic, homogeneous and charge free. (10)

Q.5 Derive the transmission line characteristics like propagation constant, γ; characteristic impedance, z_0; and wave velocity, u; in a lossless line and distortionless line using general transmission line equation. (10)

OR

A lossless transmission line with $Z_0 = 50\ \Omega$ is 30m long and operates at 2 MHz. The line is terminated with a load $Z_l = 60 + j40\ \Omega$. If u=0.06c on the line where, c is the speed of light in vacuum. Evaluate using SMITH CHART.

(a) The reflection coefficient (Γ) & SWR (s) (05)

(b) The input impedance (Z_{in}) (05)

Q.6 Discuss the necessary parameters like η, f_c, λ_c, β & u_p in *TE* and *TM* modes of rectangular waveguides. Also mention dominant modes in both *TE* and *TM* modes. (10)

OR

A rectangular waveguide with dimensions a=2.5 cm, b=1 cm is to operate below 15.1 GHz. How many TM modes can the waveguide transmit if the guide is filled with a medium characterized by $\sigma=0$, $\varepsilon=4\varepsilon_0$, $\mu_r=1$? Calculate their cut-off frequencies. (10)

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The Complete Smith Chart

Black Magic Design