Hall Ticket No | | | | | | | | | | | Question Paper Code: AECB13

INSTITUTE OF AERONAUTICAL ENGINEERING

(Autonomous)

B.Tech IV Semester End Examinations (Regular/Supplementary) - July, 2021

Regulation: R18

ELECTROMAGNETIC WAVES AND TRANSMISSION LINES

Time: 3 Hours **(ECE)** **Max Marks: 70**

Answer FIVE Questions choosing ONE question from each module
(NOTE: Provision is given to answer TWO questions from any ONE module)
All Questions Carry Equal Marks
All parts of the question must be answered in one place only

MODULE – I

1. (a) Derive the electric flux density by using Gauss's law for the following charge distributions.
   i) Point charge
   ii) Infinite line charge **[7M]**
   (b) Given point P (-2, 6, 3) and vector.$\vec{A} = y\,\hat{a}_x + (x+z)\,\hat{a}_y$ Translate P and in cylindrical co-ordinates.
   Given vectors $\vec{A} = 3\,\hat{a}_x + 4\,\hat{a}_y + \hat{a}_z$ and $\vec{B} = 2\,\hat{a}_y + 4\,\hat{a}_z$ Find the angle between A and B. **[7M]**

2. (a) Derive the boundary conditions for the tangential and normal components of electrostatic fields at the boundary between two dielectrics. **[7M]**
   (b) Verify Stokes's theorem for $\vec{A} = \rho\cos\phi\,\hat{a}_\rho + \sin\phi\,\hat{a}_\phi$ around the path shown in the Figure 1. **[7M]**

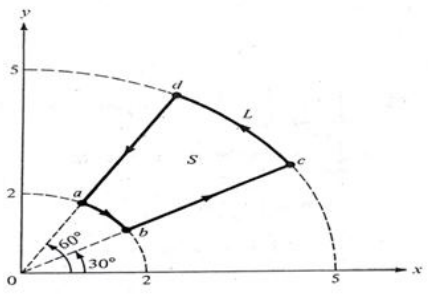

Figure 1

MODULE – II

3. (a) State and explain Biot-Savart's law and Ampere's circuit law. **[7M]**
   (b) Given the magnetic vector potential $\vec{A} = -\frac{\rho}{4}\hat{a}_z$ Wb/m, calculate the total magnetic flux crossing the surface $\varphi = \pi/2$, $1 \leq \rho \leq 2$m, and $0 \leq z \leq 5$m. **[7M]**

4. (a) Write down the Maxwell's equations in integral form and differential form for time varying fields. **[7M]**

(b) A charged particle of mass 2 kg and charge 3 C starts at point (1, -2, 0) with velocity $4\hat{a}_x + 3\hat{a}_z$ m/s in an electric field $12\hat{a}_x + 10\hat{a}_y$ V/m. At time t = 2 s, calculate the acceleration of the particle and its velocity. **[7M]**

MODULE – III

5. (a) Write short notes on the following i) Brewster angle ii) Total internal reflection and iii) Uniform plane wave. **[7M]**

   (b) The electric field in free space is given by $\vec{E} = 50\ \cos\left(10^8 t + \beta x\right)\ \hat{a}_y$ V/m. Find the direction of wave propagation and calculate the time it takes to travel $\lambda/2$. **[7M]**

6. (a) Give the expression for transmission coefficient for horizontal polarization with oblique incidence. **[7M]**

   (b) In a lossless dielectric for which η= 60 π, μ_r= 1 and H = −0.1 cos (ωt −z) a_x+ 0.5 sin (ωt − z) a_y A/m. Calculate ϵ_r, ω and E. **[7M]**

MODULE – IV

7. (a) Draw the equivalent circuit for an open wire transmission line and also obtain transmission line equations of voltage and current. **[7M]**

   (b) Calculate the characteristic impedance of a quarter wave transformer if a 120 ohm load is to be matched to a 75 ohm line. **[7M]**

8. (a) Discuss the condition for loss less and distortion less transmission lines. **[7M]**

   (b) A transmission line operating at 500 MHz has Z_o = 80 Ω, α= 0.04 Np/m, β=1.5 rad/m. Find the line parameters R, L, G, and C. **[7M]**

MODULE – V

9. (a) Briefly describe about quarter-wave transformer and explain how it can be made use of any impedance matching. **[7M]**

   (b) A lossless 50Ω transmission line is terminated in a load with Z_L = (50+ j25)Ω. Find the following: (i) The reflection coefficient Γ. (ii) The standing-wave ratio.
   (iii) The input impedance at 0.35λ from the load. **[7M]**

10. (a) Write short notes on i) Sing stub matching ii) Double stub matching. **[7M]**

    (b) The 0.1λ length line shown in Figure 2 has a characteristics impedance of 50Ω and terminated by a load impedance of Z_L = 5+ j25 Ω. Find:
    i) VSWR;
    ii) Impedance for l =0.1λ;
    iii) Reflection coefficient at load. **[7M]**

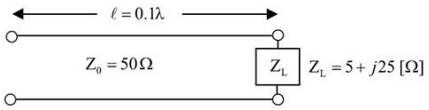

Figure 2