Reg. No. : | | | | | | | | | | | | |

Question Paper Code : 86571

B.E./B.Tech. DEGREE EXAMINATIONS, NOVEMBER/DECEMBER 2021.

Fifth Semester

Electronics and Communication Engineering

EC 1303 — TRANSMISSION LINES AND WAVEGUIDES

(Regulations 2008)

Time : Three hours | Maximum : 100 marks

(Smith Chart is to be provided)

Answer ALL questions.

PART A — ($10 \times 2 = 20$ marks)

1. Determine the characteristics impedance of a coaxial cable operating at extremely high frequencies with L = 483.12 nH/m and C = 24.15 pF/m.

2. Write the equations for the characteristics impedance and propagation constant of a telephone cable.

3. A lossless transmission line has a shunt capacitance of 100 pF/m and a series inductance of 4 μH/m. Determine the characteristic impedance.

4. Give the applications of $\lambda/8$ and $\lambda/4$ lines.

5. Assume a wave is propagates in a parallel plane waveguide. The frequency of the wave is 6000 MHz and the plane separation is 7cm. Calculate the cutoff wavelength of the dominant mode.

6. Define TEM waves.

7. What do you meant by Dominant Mode?

8. Define wave impedance of a wave guide.

9. What are the disadvantages if the resonator is made using lumped elements at high frequencies?

10. Why is TM01 mode preferred to the TE01 mode in a circular waveguide?

PART B — (5 × 16 = 80 marks)

11. (a) (i) Derive the transmission line differential equations and obtain the general solutions for the voltage and current on the transmission line. (10)

(ii) The attenuation on a 50 Ω distortionless line is 0.01 dB/m. The line has a capacitance of 0.1 nF/m. Determine the resistance, inductance and conductance of the line. (6)

Or

(b) (i) Derive expression for the attenuation constant (α) and phase constant (β) of a transmission line in terms of R, L, G and C. (8)

(ii) A transmission line has R = 6 Ω/km, L= 2.2 mH/km, C = 0.005 μF km and G = 0.05 micromho/km. Determine the characteristic impedance, attenuation and phase constants at KHz. (8)

12. (a) (i) Design a single stub matching Network for the following Data (use SMITH CHART)

$Z_L \rightarrow$ load impedance = 400 + j200 Ω

$Z_o \rightarrow$ characteristic impedance = 300 Ω.

Use short circuited shunt stubs. Specify the VSWR values before and after the connection of stubs. (8)

(ii) Sketch the input impedance variation and standing wave pattern when a transmission line is terminated in a (8)

(1) Short circuit

(2) Open circuit.

Or

(b) Design a double stub matching Network for the following data. Normalised value of load admittance $y_l = 1.23 - j0.51$. Distance between the stubs is 0.4λ and distance from load to first stub is 0.1λ. Use shunt stubs which are short circuited at the far end. Indicate the forbidden regions (use SMITH CHART).

13. (a) Explain the transmission of TM waves between parallel planes with necessary equations. Discuss the characteristics of TE and TM waves between parallel planes. (16)

Or

(b) (i) Explain briefly the attenuation of TE and TM waves between parallel planes with necessary expressions and diagrams. (10)

(ii) Discuss the velocity of propagation and wave impedances of different modes propagating between parallel planes (6)

14. (a) Deduce the expressions of electric and magnetic fields of TE waves guided along a rectangular Waveguide.

Or

(b) (i) Write short notes on Wave impedance of TE and TM waves in rectangular wave guides. (10)

(ii) Calculate the cut-off frequency for a $TE_{1,0}$ wave in air in a rectangular waveguide measuring 5 cm by 2.5 cm. Also calculate the phase and group velocities at a frequency of 6 GHz. (6)

15. (a) (i) A copper walled rectangular cavity resonator is structured by $3 \times 1 \times 4$ cm and operates at the dominant modes of TE and TM. Find the resonant frequency and quality factor. The conductivity of copper is 5.8×10^7 mho/m. There is air inside the cavity. (8)

(ii) Derive the expressions for the field components of TM waves in a circular waveguide. (8)

Or

(b) (i) Derive the expressions for the resonant frequencies of TE and TM waves in a circular cavity resonator. (8)

(ii) Determine the size of a circular waveguide required to propagate TE11 mode if $\lambda_c = 8$ cm $(\rho_{11} = 1.841)$. (3)

(iii) Derive an expression for the quality factor Q of microwave cavities. (5)