Roll No											

PRESIDENCY UNIVERSITY
BENGALURU

SCHOOL OF ENGINEERING
MID TERM EXAMINATION - APR 2023

Semester : Semester IV - 2021
Course Code : ECE3009
Course Name : Sem IV - ECE3009 - Transmission Lines and Waveguides
Program : ECE

Date : 13-APR-2023
Time : 9.30AM - 11.00AM
Max Marks : 50
Weightage : 25%

Instructions:
(i) Read all questions carefully and answer accordingly.
(ii) Question paper consists of 3 parts.
(iii) Scientific and non-programmable calculator are permitted.
(iv) Do not write any information on the question paper other than Roll Number.

PART A

ANSWER ALL THE QUESTIONS **(5 X 2 = 10M)**

1. If z_1 and z_2 are two complex numbers such that $z_1 = 20\angle 150^\circ$ and $z_2 = 20\sqrt{3}\angle 60^\circ$, find $z_1 + z_2$.
(CO1) [Knowledge]

2. If $R = 2\ \Omega/m$, $L = 2\ mH/m$ and $C = 1\ \mu F/m$ for a distortionless line, find the value of G.
(CO1) [Knowledge]

3. If $z_1 = 3\left(1 + j\sqrt{3}\right), z_2 = \sqrt{2}\,(1 + j)$ and $z_3 = \dfrac{z_1}{z_2} = r_3 \exp\,(j\theta_3)$, evaluate r_3 and θ_3.
(CO1) [Knowledge]

4. Find the phase-velocity v_p for $\omega = 3000\,\mathrm{rad/s}$ and $\beta = 0.03\,\mathrm{rad/km}$ in connection with a transmission line
(CO1) [Knowledge]

5. What happens if the propagation constant of a transmission line is purely real?
(CO1) [Knowledge]

PART B

ANSWER ALL THE QUESTIONS **(2 X 10 = 20M)**

6. The differential equations for a transmission line in terms of voltage and current yields solutions that contains both the forward as well as the backward (or reflected waves) waves. Since the latter is undesirable in many situations, one such method to eliminate it is to design an infinite transmission line (which is practically impossible). For such a transmission line having a characteristic impedance of $50\,\Omega$
(a) Suggest a more practical method to overcome this problem.
(b) Consider the load impedance to be $100\,\Omega$. Calculate the reflection coefficent for this line

(CO1) [Comprehension]

7. In a transmission line where the attenuation constant α is 0 and the phase constant β is linearly dependent on frequency, the characteristic impedance $Z_0 = 50\ \Omega$ and a phase constant of $3\,\mathrm{rad/m}$ at $10\,MHz$. What will be the inductance and the capacitance per unit length of the line?

(CO1) [Comprehension]

PART C

ANSWER ALL THE QUESTIONS **(2 X 10 = 20M)**

8. In a distortionless transmission line, all frequency components have the same phase velocity and is highly desirable in case of video transmission. For such a distortion-less line,
(a) Write down the relationship between the parameters $R, L, G, \text{ and } C$.
(b) Write down the expression for Z_0.
(c) Consider a distiortion-less line where $R \text{ and } G$ are $6\,\Omega/km$ and $3.2\,\mu\mho/km$ respectively. If the phase-velocity in such a line is $2 * 10^5\ km/s$, find the values of $L \text{ and } C$ for this line.

(CO1) [Application]

9. Transmission lines do not suffer the performance limitations of discrete devices at high frequencies (where their sizes are comparable to the wavelength) and are less expensive. Therefore, exploiting the properties of open- and short-circuited transmission lines makes it possible to implement impedance matching circuits, filters and other devices entirely from transmission lines, with fewer or no discrete inductors or capacitors required. Based on this concept, answer the following questions
(a) Write down the expressions for input impedance in case of open- and short-circuited transmission lines.
(b) For a given transmission line, the values of Z_{SC} and Z_{OC} are $Z_{SC} = 100\angle(-60°)$ and $Z_{OC} = 400\angle\theta$. If this transmission line is distortionless, find the values of Z_0 and θ.

(CO1) [Application]