SRI VIDYA COLLEGE OF ENGINEERING & TECHNOLOGY

DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING

EC6503-TRANSMISSION LINES AND WAVE GUIDES

2 MARKS & 16 MARKS

UNIT 1 TRANSMISSION LINE THEORY

1. Define the line parameters?

The parameters of a transmission line are:
Resistance (R)
Inductance (L)
Capacitance (C)
Conductance (G)
Resistance (R) is defined as the loop resistance per unit length of the wire.
Its unit is ohm/Km
Inductance (L) is defined as the loop inductance per unit length of the wire.
Its unit is Henry/Km
Capacitance (C) is defined as the loop capacitance per unit length of the wire.
Its unit is Farad/Km
Conductance (G) is defined as the loop conductance per unit length of the wire. Its unit is mho/Km

2. What are the secondary constants of a line? Why the line parameters are called distributed elements?

The secondary constants of a line are:
Characteristic Impedance
Propagation Constant
Since the line constants R, L, C, G are distributed through the entire length of the line, they are called as distributed elements. They are also called as primary constants.

3. Define Characteristic impedance

Characteristic impedance is the impedance measured at the sending end of the line. It is given by $Z0 = \Gamma Z/Y$, where
$Z = R + j\omega L$ is the series impedance
$Y = G + j\omega C$ is the shunt admittance

4. Define Propagation constant

Propagation constant is defined as the natural logarithm of the ratio of the sending end current or voltage to the receiving end current or voltage of the line. It gives the manner in the wave is propagated along a line and specifies the variation of voltage and current in the line as a function of distance. Propagation constant is a complex quantity and is expressed as $\gamma = \alpha + j\beta$ The real part is called the attenuation constant whereas the imaginary part of propagation constant is called the phase constant

5. What is a finite line? Write down the significance of this line?

A finite line is a line having a finite length on the line. It is a line, which is terminated, in its characteristic impedance (ZR=Z0), so the input impedance of the finite line is equal to the characteristic impedance (Zs=Z0).

6.What is an infinite line?

An infinite line is a line in which the length of the transmission line is infinite. A finite line, which is terminated in its characteristic impedance, is termed as infinite line. So for an infinite line, the input impedance is equivalent to the characteristic impedance.

7.What is wavelength of a line?

The distance the wave travels along the line while the phase angle is changing through 2π radians is called a wavelength

.

8.What are the types of line distortions?

The distortions occurring in the transmission line are called waveform distortion or line distortion. Waveform distortion is of two types:
a) Frequency distortion
b) Phase or Delay Distortion.

9.How frequency distortion occurs in a line?

When a signal having many frequency components are transmitted along the line, all the frequencies will not have equal attenuation and hence the received end waveform will not be identical with the input waveform at the sending end because each frequency is having different attenuation. This type of distortion is called frequency distortion.

10.How to avoid the frequency distortion that occurs in the line?

In order to reduce frequency distortion occurring in the line,
a) The attenuation constant α should be made independent of frequency.
b) By using equalizers at the line terminals which minimize the frequency distortion. Equalisers are networks whose frequency and phase characteristics are adjusted to be inverse to those of the lines, which result in a uniform frequency response over the desired frequency band, and hence the attenuation is equal for all the frequencies.

11.What is delay distortion?

When a signal having many frequency components are transmitted along the line, all the frequencies will not have same time of transmission, some frequencies being delayed more than others. So the received end waveform will not be identical with the input waveform at the sending end because some frequency components will be delayed more than those of other frequencies. This type of distortion is called phase or delay distortion.

12. **Define Characteristic impedance.**

If an infinite number of identical symmetrical networks are connected one after another. The impedance that, when connected to the output terminals of a transmission.

13.What is a distortion less line? What is the condition for a distortion less line?

A line, which has neither frequency distortion nor phase distortion is called a distortion less line. The condition for a distortion less line is RC=LG. Also,
a) The attenuation constant should be made independent of frequency.
b) The phase constant should be made dependent of frequency.
d) The velocity of propagation is independent of frequency
.

14.What is the drawback of using ordinary telephone cables?

In ordinary telephone cables, the wires are insulated with paper and twisted in pairs, therefore there will not be flux linkage between the wires, which results in negligible inductance, and conductance. If this is the case, the there occurs frequency and phase distortion in the line.

15.How the telephone line can be made a distortion less line?

For the telephone cable to be distortion less line, the inductance value should

be increased by placing lumped inductors along the line.

16.What is Loading?

Loading is the process of increasing the inductance value by placing lumped inductors at specific intervals along the line, which avoids the distortion

17.What are the types of loading?

a) Continuous loading
b) Patch loading
c) Lumped loading

18.What is continuous loading?

Continuous loading is the process of increasing the inductance value by placing a iron core or a magnetic tape over the conductor of the line.

19.What is patch loading?

It is the process of using sections of continuously loaded cables separated by sections of unloaded cables which increases the inductance value

20.What is lumped loading?

Lumped loading is the process of increasing the inductance value by placing lumped inductors at specific intervals along the line, which avoids the distortion

21.Define reflection coefficient

Reflection Coefficient can be defined as the ratio of the reflected voltage to the incident voltage at the receiving end of the line Reflection Coefficient
K=Reflected Voltage at load /Incident voltage at the load
K=Vr/Vi

22. Define reflection loss

Reflection loss is defined as the number of nepers or decibels by which the current in the load under image matched conditions would exceed the current actually flowing in the load

23.When reflection occurs in a line?

Reflection occurs because of the following cases:
1) when the load end is open circuited
2) when the load end is short-circuited
3) when the line is not terminated in its characteristic impedance
When the line is either open or short circuited, then there is not resistance at the receiving end to absorb all the power transmitted from the source end. Hence all the power incident on the load gets completely reflected back to the source causing reflections in the line. When the line is terminated in its characteristic impedance, the load will absorb some power and some will be reflected back thus producing reflections.

24.What are the conditions for a perfect line? What is a smooth line?

For a perfect line, the resistance and the leakage conductance value were neglected. The conditions for a perfect line are R=G=0.
A smooth line is one in which the load is terminated by its characteristic impedance and no reflections occur in such a line. It is also called as flat line.

25. Mention the types of transmission lines.

- Two – wire parallel lines
- Coaxial lines
- Twisted wires
- Parallel plates or planar lines
- Wire above conducting line
- Microstrip lines
- Optical fibres

26. List out the applications of transmission lines.

- They are used to transfer energy from one circuit to another.
- They can be used as a circuit elements such as inductors, capacitors etc.
- They can be used as impedance matching devices.
- They can be used as stubs.

16 MARKS:

1.Define propagation constant and characteristic impedance

2. Obtain the general solution of the transmission line and state its physical significance(or) Develop the differential equations governing the voltage and current at any point on a transmission line solve these to obtain the voltage and current in terms of the load current and voltage.(or) Derive the transmission line equation and obtain the solution of it.

3.Derive the equations of attenuation constant and phase constant of a transmission line in terms of R,L,G and C.

4.The constants of a transmission line are R=6 ohms/km, L=2.2 mH/km, C=0.005x10^{-6} F/km and G=0.25x10^{-6} mbos/km. Determine the characteristic impedance and propagation constant at 1000 Hz.

5.. Explain the different types of distortions in a transmission lines and also Derive the condition for a dissipation less line.

6. Derive the equations for input impedance of transmission lines.

7.A parallel wire transmission line is having the following line parameters at 5kHz.Series resistance (R=2.59X10^{-3} ohms /m),series inductance(L=2 micro henry/m),shunt conductance(G=0 mhos/m) and capacitance between conductors(c=5.56 pF/m).Find the characteristic impedance, attenuation constant(Np/m),phase shift constant(rad/m),velocity of propagation and wavelength

8.Write a brief note on reflection coefficient and its effect an voltage and current equations in transmission lines

9. A distortion less transmission line has attenuation constant ,15x10-3 neper/m and capacitance of 0.1nf/m.The characteristic impedance √ (L/C) =50 ohms. Find the resistance, inductance and conductance per meter of the line.

10. Explain in detail about the reflection on a line not terminated in its characteristic impedance Z_0

11. Explain the following terms:

i)Reflection on transmission lines ii. Reflection coefficient

12. Explain the physical significance of the transmission line general solution equation derived for E and I interms of E_r and I_r

13.Explain in detail Waveform distortion and also derive the condition for distortionless line.

14.A cable has the following parameters:R=48.75ohm/km,L=1.09mH/km,G=38.75µ mho/km,c=0.059 µ F/km.Determine the characteristic impedance,propagation constant and Wavelength for a source of f=1600Hz and Es=1V

15.Derive the expressions for voltage and current along a parallel wire transmission line and obtain its solution.