MARIA COLLEGE OF ENGINEERING AND TECHNOLOGY ATTOOR

DEPARTMENT OF ECE

2 MARKS & QUESTION- ANSWERS

EC54 –TRANSMISSION LINES AND WAVEGUIDES

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 = Z/Y,where
Z = R + j_L is the series impedance
Y = G + j_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
_ = _ + j _
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 2_ 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 _ 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. How to avoid the frequency distortion that occurs in the line?
In order to reduce frequency distortion occurring in the line,
a) The phase constant _ should be made dependent of frequency.
b) The velocity of propagation is independent of frequency.
c) By using equalizers at the line terminals which minimize the frequency distortion. Equalizers 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 phase is equal for all the frequencies.

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

$$K=V_r/V_i$$

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.What is Impedance matching?
If the load impedance is not equal to the source impedance, then all the power that are transmitted from the source will not reach the load end and hence some power is wasted. This is called impedance mismatch condition. So for proper maximum power transfer, the impedances in the sending and receiving end are matched. This is called impedance matching.

24. Define the term insertion loss

The insertion loss of a line or network is defined as the number of nepers or decibels by which the current in the load is changed by the insertion . Insertion loss=Current flowing in the load without insertion of the network**/**Current flowing in the load with insertion of the network

25.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.

26.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.

UNIT II

27. State the assumptions for the analysis of the performance of the radio frequency line.

1.Due to the skin effect ,the currents are assumed to flow on the surface of the conductor. The internal inductance is zero.

2.The resistance R increases with $\sqrt{f}$ while inductance L increases with f . Hence $\omega L >> R$.

3.The leakage conductance G is zero

28.State the expressions for inductance L of a open wire line and coaxial line.

For open wire line ,

$L=9.21*10^{-7}(\lceil/\lceil r +4\ln d/a)=10^{-7}(\lceil r+9.21\log d/a)$ H/m

For coaxial line,

$L = 4.60*10^{-7}[\log b/a]$H/m

29.State the expressions for the capacitance of a open wire line

For open wire line ,

C=(12.07)/(ln d/a)μμf/m

30.What is dissipationless line?

A line for which the effect of resistance R is completely neglected is called dissipationless line .

31.What is the nature and value of Z0 for the dissipation less line?

For the dissipation less line, the Z0 is purley resistive and given by,

$$Z0=R0 = \sqrt{L/c}$$

32.State the values of α and β for the dissipation less line.

Answer:

$\alpha=0$ and $\beta=\omega\sqrt{LC}$

33.What are nodes and antinodes on a line?

The points along the line where magnitude of voltage or current is zero are called nodes while the the points along the lines where magnitude of voltage or current first maximum are called antinodes or loops.

34.What is standing wave ratio?

The ratio of the maximum to minimum magnitudes of voltage or current on a line having standing waves called standing waves ratio.

$$S = \frac{|E_{max}|}{|E_{min}|} = \frac{|I_{min}|}{|I_{min}|}$$

35.What is the range of values of standing wave ratio?

The range of values of standing wave ratio is theoretically 1 to infinity.

36.State the relation between standing wave ratio and reflection coefficient.

Ans:

$$S = \frac{1+|K|}{1-|K|}$$

37.What are standing waves?

If the transmission is not terminated in its characteristic impedance ,then there will be two waves traveling along the line which gives rise to standing waves having fixed maxima and fixed minima.

38.What is called standing wave ratio?

The ratio of the maximum to minimum magnitudes of current or voltage on a line having standing wave is called the standing-wave ratio S. That is,

$$S= \frac{E_{max}}{E_{min}} = \frac{I_{max}}{I_{min}}$$

39.State the relation between standing were ratio S and reflection co-efficient k.

The relation between standing wave ratio S and reflection co-efficient k is,

$$S = \frac{1+k}{1-k}$$

Also

$$k = \frac{S-1}{S+1}$$

40. How will you make standing wave measurements on coaxial lines?

For coaxial lines it is necessary to use a length of line in which a longitudinal slot, one half wavelength or more long has been cut. A wire probe is inserted into the air dielectric of the line as a pickup device, a vacuum tube voltmeter or other detector being connected between probe and sheath as an indicator. If the meter provides linear indications, S is readily determined. If the indicator is non linear, corrections must be applied to the readings obtained.

41.Give the input impedance of a dissipationless line.

The input impedance of a dissipationless line is given by,

$\mathbf{Z_s = E_s = R_0\, 1+ k < \phi -2\beta s}$

$\mathbf{I_s\, 1- k <\phi -2\beta s}$

42.Give the maximum and minimum input impedance of the dissipationless line.

Maximum input impedance,

$R_{max} = R_0\, 1+ k$

$1- k$

$= SR_o$

Minimum input impedance,

$R_{min} = R_o\, 1+ k$

$1- k$

$= R_o$

S

43.Give the input impedance of open and short circuited lines.

The input impedance of open aned short circuited lines are given by,

$Z_{sc} = jR_o \tan \frac{2\pi s}{\lambda}$

44.Why the point of voltage minimum is measured rather than voltage maximum?

The point of a voltage minimum is measured rather than a voltage maximum because it is usually possible to determine the exact point of minimum voltage with greater accuracy.

45. What is the use of eighth wave line?

An eighth wave line is used to transform any resistance to an impendence with a magnitude equal to Roof the line or to obtain a magnitude match between a resistance of any value and a source of Ro internal resistance.

46. Give the input impendence of eighth wave line terminated in a pure resistance Rr.

The input impendence of eighth wave line terminated in a pure resistance Rr. Is given by

$Zs = (Z_R+jRo/Ro+jZ_R)$

From the above equation it is seen that

$|Zs| = Ro.$

47. Why is a quarter wave line called as impendence inverter?

A quater wave line may be considered as an impendence inverter because it can transform a low impendence in to ahigh impendence and vice versa.

48. What is the application of the quarter wave matching section ?

An important application of the quarter wave matching sectionis to a couple a transmission line to a resistive load such as an antenna .The quarter –wave matching section then must be designed to have a characteristic impendence Ro so chosen that the antenna resistance Ra is transformed to a value equal to the characteristic impendence Ra of the transmission line.The characteristic impendence Ro of the matching section then should be

$Ro' = \sqrt{Ra\, Ro}$

49. What do you mean by copper insulators?
An application of the short circuited quarter wave line is an insulator to support an open wire line or the center conductor of a coaxial line .This application makes se of the fact that the input impendence of a quarter –wave shorted line is very high ,Such lines are sometimes referred to as copper insulators.
50. Bring out the significance of a half wavelength line.
A half wavelength line may be considered as a one- to – one transformer. It has its greatest utility in connecting load to a source in cases where the load source cannot be made adjacent.
51. Give some of the impendence –matching devices.
The quarter – wave line or transformer and the tapered line are some of the impendence –matching devices.
52. Explain impendence matching using stub.
In the method of impendence matching using stub ,an open or closed stub line of suitable length is used as a reactance shunted across the transmission line at a designated distance from the load ,to tune the length of the line and the load to resonance with an antiresonant resistance equal to Ro.
53.Give reasons for preferring a short- circuited stub when compared to an open circuited stub.
A short circuited stub is preferred to an open circuited stub because of greater ease in constructions and because of the inability to maintain high enough insulation resistance at the open –circuit point to ensure that the stub is really opencircuited .A shorted stub also has a lower loss of energy due to radiation ,since the short – circuit can be definitely established with a large metal plate ,effectively stopping all field propagation.
54.What are the two independent measurements that must be made to find the location and length of the stub.
The standing wave ratio S and the position of a voltage minimum are the independent measurements that must be made to find the location and length of the stub.
55.Give the formula to calculate the distance of the point from the load at which the stub is to be connected.
The formula to calculate the distance of the point from the load at which the stub is to be connected is, S1 = (ϕ +_-$\cos^{-1}$|K|)/(2_)
56. Give the formula to calculate the distance d from the voltage minimum to the point stub be connection.
The formula to calculate the distance d from the voltage minimum to the point of stub be connection is, d= $\cos^{-1}$|K| / (2_)
57. Give the formula to calculate the length of the short circuited stub.
The formula to calculate the length of the short circuited stub is,
L=_/2_ $\tan^{-1}$(s/(s-1))
This is the length of the short – circuited stub to be placed d meters towards the load from a point at which a voltage minimum existed before attachment of the stub.
58. What is the input impendence equation of a dissipation less line ?
The input impendence equation of a dissipation less line is given by
(Zs/Ro)=(1+|K|(-2_s)/ (1-|K|(-2_s)

59.Give the equation for the radius of a circle diagram.
The equation for the radius of a circle diagram is
$R=(S_2-1)/2S$ and
$C = (S_2+1)/2S$
Where C is the shift of the center of the circle on the positive Ra axis.
60.What is the use of a circle diagram?
The circle diagram may be used to find the input impendence of a line mof any chosen length.