# Questions and Answers – Transmission lines and Waveguides

1. Maxwell's equation for electromagnetic waves in a waveguide is
a) $\nabla\times E = -j\omega\mu$(vector H)
b) $\nabla\times E = -j\omega\mu$(vector E)
c) $\nabla\times H = -j\omega\mu$(vector H)
d) $\nabla\times H = j\omega\mu$(vector H)

Answer: a
Explanation: Maxwell's equation governs the propagation of waves in a waveguide. This equation describes the relation between electric field and magnetic field inside the waveguide.

2. If the wavelength of a signal is 10 mm, then the wavenumber of the material when a waveguide is filled with that material is:
a) 628
b) 345
c) 123
d) None of the mentioned

Answer: a
Explanation: The wave number is given by the expression $2\pi/\lambda$. Substituting the given wavelength, wave number is 628.

3. If a waveguide is filled with a lossy material then the expression for $\in$ for that material is
a) $\in=\in\in_r(1-j\tan\delta)$
b) $\in=\in_o \in_r (1/ j \tan\delta)$
c) $\in=\in_o \in_r/(1+ j \tan\delta)$
d) $\in=\in_o \in_r/(1-j \tan\delta)$

Answer: a
Explanation: When a waveguide is filled with a dielectric of or any lossy material, the relative permittivity is given by $\in=\in\in_r(1-j\tan\delta)$.

4. If a waveguide is filled with a lossless material of relative permeability 2, then the wave impedance in the TEM mode is:
a) 188.5 Ω
b) 170 Ω
c) 123 Ω
d) 345 Ω

Answer: a
Explanation: The wave impedance is given by the expression$\sqrt{\mu}/\sqrt{\in}$ is the intrinsic impedance of the medium substituting the given values in the above expression, wave impedance is 188.5 Ω.

5. If the wave impedance of a medium is 200 Ω, then what is the relative permittivity of that medium?
a) 1.885
b) 2
c) 2.2
d) 2.5
Answer: a

Explanation: The wave impedance is given by the expression /√∈. is the intrinsic impedance of the medium substituting the given values in the above expression, the relative permittivity is 1.885.

6. If p=0.3 and the wave number of air in TM mode is 16, then the intrinsic impedance of air in TM mode given wave number is 125 is:
a) 1 Ω
b) 0.9 Ω
c) 0.8 Ω
d) 2 Ω
Answer: b
Explanation: Intrinsic impedance for TM mode of propagation is given by β/k. substituting the given values in the above equation; the intrinsic impedance is 0.9 Ω.

7. If the intrinsic impedance of a medium is 0.8 Ω, with wave number 125 and β being 0.2, then the relative permeability of the medium is:
a) 1.326
b) 2.34
c) 4.5
d) 6.7

Answer: a
Explanation: Intrinsic impedance for TM mode of propagation is given by β/k. substituting the given values in the above equation; the permeability of the medium is 1.326.

8. The losses that occur in a transmission line is:
a) Conduction losses
b) Di-electric loss
c) Both of the mentioned
d) None of the mentioned

Answer: c
Explanation: Both conductor loss and dielectric loss occur in a transmission medium. Conductor loss is due to the property of the transmission line while dielectric loss is due to the medium inside the transmission line.

9. Which of the following is true regarding attenuation?
a) Conductor loss
b) Di-electric loss
c) Sum of both conductor loss and dielectric loss
d) Attenuation is different from the losses

Answer: c
Explanation: Attenuation of a propagating wave is due to both the irregularities in the waveguide and as the property of the dielectric material. Hence attenuation of a propagating wave is due to both conductor loss and dielectric loss.

10. If the wave number of a medium is 20 and loss tangent is 0.4 , then the dielectric loss caused by the medium is:
a) 4
b) 2
c) 3

d) 6

Answer: a

Explanation: Dielectric loss in a medium is given by the expression k tan δ/2. Substituting the given value of loss tangent and wave number dielectric loss is 4 Np/m.

11. When a lossless line is terminated with an arbitrary load impedance $Z_L$, then it :

a) causes wave reflection on transmission lines

b) transmits the entire supplied power

c) causes loss in transmission line

d) none of the mentioned

Answer: a

Explanation: When a line is terminated with a impedance other the characteristic impedance of the transmission line, It results in reflection of waves from the load end of the transmission line hence resulting in wave reflection in the transmission line.

12. We say a transmission line is matched when:

a) $Z_L=Z_0$

b) $Z_L=\sqrt{Z_0}$

c) $Z_L=Z_0/2$

d) $Z_L=2Z_0$

Answer: a

Explanation: We say a line is matched only when the characteristic impedance of the transmission line is equal to the terminating load impedance. Hence condition for a line to be matched is $Z_L=Z_0$.

13. Voltage reflection coefficient can be defined as:

a) ratio of amplitude of reflected voltage wave to the transmitted voltage wave

b) ratio of amplitude of reflected voltage to the incident voltage wave

c) ratio of load impedance to the characteristic impedance of the transmission line

d) none of the mention

Answer: b

Explanation: From transmission line theory, reflection co-efficient of a transmission line is defined as the ratio of amplitude of reflected voltage to the incident voltage wave.

14. Expression for a voltage reflection co-efficient in terms of load impedance and characteristics impedance is:

a) $(Z_L- Z_0)/(Z_L+ Z_0)$

b) $(Z_L+ Z_0)/(Z_L- Z_0)$

c) $Z_L. Z_0/( Z_L+ Z_0)( Z_L-Z_0)$

d) $(Z_L+ Z_0)( Z_L-Z_0)/ Z_L. Z_0$

Answer: a

Explanation: The amplitude of the reflected voltage wave at the load end is equal to the difference between the load and the characteristic impedance, incident voltage is proportional to the sum of the load and characteristic impedance.

15. If a transmission line of a characteristics impedance 50 Ω is terminated with a load impedance of 100 Ω, then the reflection co efficient is
a) 0.3334
b) 0.6667
c) 1.6
d) 1.333
Answer: a
Explanation: Expression for reflection co-efficient of a transmission line is $(Z_L - Z_0)/(Z_L + Z_0)$ .substituting the given values of load and characteristic impedance, we get reflection co-efficient equal to 0.3334.

16. Return loss for a transmission line in terms of its reflection co efficient is given by
a) -20logl ┌l in dB where ┌ is the reflection coefficient.
b) -10logl ┌l in dB where ┌ is the reflection coefficient
c) -10log (1/l ┌l) in dB where ┌ is the reflection coefficient
d) -20log (1/l ┌l) in dB where ┌ is the reflection coefficient
Answer: a
Explanation: Return loss signifies the amount of energy reflected back from the load which is proportional to the reflection co-efficient of the line. Return loss in dB is given by the logarithm of the reflection co-efficient.

17. If the reflection coefficient for transmission line is 0.24, then the return lossin dB is
a) 12.39dB
b) 15dB
c) -12.39dB
d) -15.2dB
Answer: a
Explanation: The return loss of a transmission line, given the reflection co-efficient is -20logl ┌l in dB where ┌ is the reflection co-efficient. Substituting for reflection co-efficient in the above equation, return loss is 12.39dB.

18. Expression for VSWR in terms of reflection co-efficient is:
a) (1+│┌│)/(1-│┌│)
b) (1-│┌│)/(1+│┌│)
c) 1/│┌│
d) 1/1+│┌│

Answer: a
Explanation: VSWR is the ratio of maximum amplitude of the standing wave formed to the minimum amplitude of the standing wave, when these voltages are expressed in terms of reflection co-efficient, we get the expression (1+│┌│)/(1-│┌│).

19. If the reflection co-efficient for a transmission line is 0.3, then the VSWR is
a) 0.5384
b) 1.8571
c) 0.4567

d) 3.6732
Answer: b
Explanation: VSWR (voltage standing wave ratio) in terms of reflection co-efficient is given by $(1+|\Gamma|)/(1-|\Gamma|)$.substituting $\Gamma$=0.3 in this equation we get, VSWR=1.8571.

20. If a transmission line of characteristic impedance 50 Ω is terminated with a load impedance of 150 Ω then VSWR is:
a) 0.75
b) 0.5
c) 2
d) none of the mentioned
Answer: a
Explanation: VSWR (voltage standing wave ratio) in terms of load and characteristic impedance is given by $Z_L - Z_0 /Z_L + Z_0$. Substituting for $Z_L$ and $Z_0$ in the above equation, VSWR is 0.5.

21. Expression for input impedance of a transmission line in terms of load impedance and characteristic impedance is:
a) $Z_0 (Z_L + j Z_0 \tan \beta l)/ (Z_0 + j Z_L \tan \beta l)$
b) $(Z_0 + j Z_L \tan \beta l)/ (Z_L + j Z_0 \tan \beta l)$
c) $Z_0 (Z_L - j Z_0 \tan \beta l)/ (Z_0 - j Z_L \tan \beta l)$
d) $(Z_0 - j Z_L \tan \beta l)/ (Z_L - j Z_0 \tan \beta l)$
Answer: a
Explanation: Representing the input voltage as the ratio of voltage at current, representing voltage and currents in hyperbolic function form and simplifying, we get $Z_0 (Z_L + j Z_0 \tan \beta l)/ (Z_0 + j Z_L \tan \beta l)$.

22. Input impedance of a short circuited transmission line is
a) $-jZ_0\tan\beta l$
b) $jZ_0\tan\beta l$
c) $jZ_0\cot\beta l$
d) $- jZ_0\cot\beta l$
Answer: b
Explanation: Since the load impedance of a short circuited transmission line is zero, substituting ZL=0 in the expression for input impedance of a transmission line $Z_0 (Z_L + j Z_0 \tan \beta l)/ (Z_0 + j Z_L \tan \beta l)$, input impedance of the transmission line comes out to be $jZ_0\tan\beta l$.

23. Input impedance of a transmission line can be represented in terms of this simple trigonometry function.
a) sine function
b) cosine function
c) cotangent function
d) tangent function
Answer: d
Explanation: The input impedance of a transmission line is expressed in the standard form as $Z_0 (Z_L + j Z_0 \tan \beta l)/ (Z_0 + j Z_L \tan \beta l)$ which is represented in terms of a tangent function.

24. If a ƛ /3 transmission line is short circuited that has a characteristic impedance of 50 Ω, then its input impedance is:
a) -j100Ω
b) 50Ω
c) 86.60Ω
d) –j86.60Ω
Answer: d
Explanation: For a short circuited transmission line, the input impedance is given by $jZ_0$tanβl.substituting for characteristic impedance and ‘l’ in the above equation, input impedance is –j86.60Ω.

25. Expression for input impedance of an Open circuited transmission line is:
a) $-jZ_0$tanβl
b) $jZ_0$tanβl
c) $jZ_0$cotβl
d) $-jZ_0$cotβl
Answer: d
Explanation: Since the load impedance of a open circuited transmission line is infinity, substituting ZL=infinity (1/ $Z_L$ =0) in the expression for input impedance of a transmission line $Z_0$ ($Z_L$+j $Z_0$tan βl)/ ($Z_0$+j $Z_L$tan βl), input impedance of the open circuited transmission line comes out to be- $jZ_0$cotβl.

26. Input impedance of a open circuited transmission line is represented using this trigonometric function:
a) sine function
b) cosine function
c) cotangent function
d) tangent function
Answer: c
Explanation: The input impedance of a transmission line is expressed in the standard form as $Z_0$ ($Z_L$+j $Z_0$tan βl)/ ($Z_0$+j $Z_L$tan βl). With $Z_L$ equal to infinity for open circuit termination, 1/ $Z_L$ equal to 0, substituting this, we get input impedance in terms of a cotangent function.

27. For a λ/2 transmission line, if the characteristic impedance of the line is 50 Ω and the terminated with a load of 100 Ω, then its input impedance is:
a) 100Ω
b) 50Ω
c) 88.86Ω
d) none of the mentioned
Answer: a
Explanation: Input impedance of a transmission line is given by $Z_0$ ($Z_L$+j $Z_0$tan βl)/ ($Z_0$+j $Z_L$tan βl). Substituting β=2π/λ, and l=λ/2, we get input impedance of the transmission line equal to the load impedance or the terminated load.

28. If a λ/3 transmission line is open circuited and has characteristic impedance of 50 Ω then the input impedance is:
a) j28.86Ω
b) 50Ω

c) j50Ω
d) 28.86Ω
Answer: a
Explanation: Input impedance of an open circuited transmission line is given by – $jZ_0 \cot\beta l$. Substituting $l=\lambda/3$ and $\beta=2\pi/\lambda$ in the above equation, input impedance is j28.86Ω.

29. Expression for a transmission co-efficient of a transmission line is :
a) $2Z_L/ ( Z_L+Z_0)$
b) $(Z_L-Z_0)/ (Z_L+Z_0)$
c) $2Z_0/( Z_L+Z_0)$
d) $(Z_L+Z_0)/ (Z_L-Z_0)$
Answer: a
Explanation: T= ┌+1, where T is the transmission co-efficient and ┌ is the reflection co-efficient substituting ┌= $(Z_L-Z_0)/ (Z_L+Z_0)$ in the equation for transmission co-efficient, we get $2Z_L/ ( Z_L+Z_0)$.

30. For a transmission line, if the reflection coefficient is 0.4, then the transmission coefficient is:
a) 0.4
b) 1.4
c) 0.8
d) 2.8
Answer: b
Explanation: T= ┌+1, where T is the transmission co-efficient and ┌ is the reflection co-efficient substituting ┌=0.4 in the above equation, transmission co-efficient is equal to 1.4.

31. If the transmission coefficient of a transmission line is 1.6, then the reflection co efficient is:
a) 0.8
b) 0.6
c) 0.4
d) 0.3

Answer: b
Explanation: T= ┌+1, where T is the transmission co-efficient and ┌ is the reflection co-efficient substituting T=1.6, we get ┌=0.6.

32. For a transmission line, if the transmission coefficient is 1.4, then the insertion loss in dB is:
a) -2.922dB
b) 29dB
c) 1.46dB
d) -29dB
Answer: a
Explanation: Insertion loss for a transmission line is given by the expression -20loglTl in dB. Substituting T=1.4 and taking logarithm to base 10, insertion loss is -2.922dB.

33. The relation between nepers and decibels is
a) 1 Np= 8.686 dB

b) 1 dB=8.868 dB
c) Np≥dB
d) dB≥Np
Answer: a
Explanation: 1 Np=10log $e^2$ dB. Substituting e=2.718 in the above equation , 1Np=8.686 dB.

34. In a two wire transmission line, if the distance between the lines is 20 mm and the radii is 5 mm then the inductance of the line is:
a) 0.1 μH
b) 0.526 μH
c) 0.9 μH
d) 1 μH
Answer: b
Explanation: The inductance of a two wire transmission line is given by the equation μ*ln(b/a)/2π. Substituting the given values in the above equation, inductance is 0.526 μH.

35. In a two wire transmission line , if the distance between the lines is 60mm and the radii is 10 mm , then the capacitive reactance of the line when operated at 12.5 GHz is
a) 20 pF
b) 21.13 pF
c) 23 pF
d) 12 pF
Answer: b
Explanation: The capacitive reactance of a two wire transmission line is $\pi\in/\cosh^{-1}(D/2a)$. substituting the given values in the above expression, the capacitive reactance is 21.13 pF.

36. For a parallel plate type of a transmission line, then expression for conductance of the line is:
a) ∈(ω)w/d
b) $2R_x/x$
c) μ/2π ln(w/d)
d) $\mu/\pi \cosh^{-1}(w/2d)$
Answer: a
Explanation: The conductance of a parallel plate waveguide is dependent on the complex value of the permittivity, width of the waveguide and the distance between the waveguide plates.

37. One of the Maxwell‘s curl equation that is satisfied inside a coaxial line is:
a) ∇×E =-jωμ (vector H)
b) ∇×E =-jωμ(vector E)
c) ∇×H=-jωμ(vector H)
d) ∇×H=jωμ(vector H)
Answer: a
Explanation: ∇×E = -jωμ (vector H).This is the Maxwell’s equation satisfied by the electric and magnetic fields inside a waveguide.

38. The wave impedance of air for a wave propagating in it is:
a) 377 Ω

b) 345 Ω
c) Insufficient data
d) None of the mentioned
Answer: a
Explanation: Intrinsic impedance is the impedance offered by air for a wave propagating in it. This is a standard value and is 377 Ω.

39. Wave impedance of a wave travelling in a medium of a relative permittivity 2 and permeability 4 is
a) 188.5 Ω
b) 200 Ω
c) 300 Ω
d) None of the mentioned
Answer: a
Explanation: Intrinsic impedance of a medium is given by the expression $\sqrt{\mu/\epsilon}$ . Substituting the given values in the above expression, the wave impedance is 188.5 Ω.

40. For a parallel plate transmission line, if w= 12 mm and the distance between the plates is 2 mm, then the inductance of the transmission line is:
a) 0.2 μH
b) 0.1 μH
c) 0.3 μH
d) 0.4 μH

Answer: a
Explanation: The inductance of a parallel plate transmission line is given by μd/W. substituting the given values in the above expression, the inductance is 0.2 μH.

41. Expression for capacitance of a two wire transmission line is
a) $\in*\pi/\cosh^{-1}(D/2a)$
b) $\mu/\pi*\cosh^{-1}(D/2a)$
c) $2\pi\in/\ln(D/2a)$
d) $\in*\pi\omega/\cosh^{-1}(D/2a)$
Answer: a
Explanation: The expression for capacitance of a two wire transmission line is $\in \pi/\cosh^{-1}(D/2a)$. Capacitance of a two wire transmission line is dependent on the distance between the two lines and the radius of the line.

42. If the distance between the 2 wires in a 2 wire transmission line is 10 mm and the radii 2 mm, then the inductance of the transmission line is:
a) 0.62 μH
b) 1 μH
c) 2 μH
d) None of the mentioned
Answer: a

Explanation: The inductance of a two wire transmission line is given by the expression $\mu\cosh^{-1}(D/2a)/\pi$. Substituting the given values in the above expression, the inductance is 0.62 μH.

43. For a parallel plate transmission line, if the complex part of permittivity is 2.5, if the width is 100 mm and the distance between the plates is 10 mm, then the conductance of the transmission line is:
a) 25 Ʊ
b) 30 Ʊ
c) 45 Ʊ
d) None of the mentioned
Answer: a
Explanation: Conductance of a parallel plate transmission line is ∈W/d. substituting the given values in the above expression, the conductance of the transmission line is 25 Ʊ.

44. If the dielectric loss of a medium is 0.2 Np/m with a wave number of 12, then the value of loss tangent is
a) 0.0334
b) 0.05
c) 0.08
d) 0.09
Answer: a
Explanation: Dielectric loss in a medium is given by the expression k tan $\delta/2$. Substituting the given values, the loss tangent of the medium is 0.0334

45. The key difference between circuit theory and transmission line theory is
a) circuit elements
b) voltage
c) current
d) electrical size
Answer: d
Explanation: Circuit theory assumes physical dimensions of the network smaller than electrical wavelength, while transmission lines may be considerable fraction of wavelength.

46. Transmission line is a _________ parameter network.
a) Lumped
b) distributed
c) active
d) none of the mentioned
Answer: b
Explanation: Since no lumped elements like resistors, capacitors are used at microwave frequencies, only transmission lines are used. Hence they are called distributed parameter network.

47. For transverse electromagnetic wave propagation, we need a minimum of
a) 1 conductor
b) 2 conductors
c) 3 conductors
d) bunch of conductors

Answer: b

Explanation: With a single conductor, transverse electromagnetic wave propagation is not possible. Hence we need a minimum of 2 conductors.

48. To model a transmission line of infinitesimal length $\Delta z$, the lumped element that is not used is

a) resistor
b) inductor
c) capacitor
d) transistor

Answer: d

Explanation: In the lumped element circuit model of a transmission line, we use only resistor, capacitor and inductor. Hence no transistor is used.

49. _________ and __________ contribute to the impedance of a transmission line in the lumped element representation.

a) resistor, inductor
b) resistor, capacitor
c) capacitor, inductor
d) transistor, capacitor

Answer: a

Explanation: $Z=R+j\omega L$. Hence, both resistor and inductor contribute to the impedance of the transmission line.

50. _________ and __________ contribute to the admittance of a transmission line in the lumped element representation.

a) conductance G, capacitor
b) conductance, inductor
c) resistor, capacitor
d) resistor, inductor

Answer: a

Explanation:$Y=G+j\omega C$. Hence, both conductance and capacitance contribute to the admittance of the transmission line.

51. Characteristic impedance of a transmission line is:

a) impedance Z of a transmission line
b) impedance which is a constant at any point on the transmission line
c) reciprocal of admittance of a transmission line
d) none of the mentioned

Answer: b

Explanation: Characteristic impedance is defined as that impedance of a line which is a constant when measured at any point on the line, Hence B.

52. Propagation constant $\gamma$ is a :

a) real value
b) none of the mentioned
c) imaginary value

d) complex value
Answer: c
Explanation: Since propagation constant is a complex value, containing attenuation constant α, phase constant β respectively as their real and imaginary parts.

53. Attenuation constant α signifies:
a) real part of propagation constant
b) loss that the transmission line causes
c) none of the mentioned
d) all of the mentioned
Answer: d
Explanation: α is the real value of propagation constant, also signifies the loss that the transmission line causes and hence the total amount of energy transmitted. Hence all of the mentioned.

54. Propagation constant γ is given by
a) α+jβ
b) α-jβ
c) α/jβ
d) α.jβ
Answer: a
Explanation: Propagation constant is a complex sum of α and β, α being the real value and β being the complex part.

55. Characteristic impedance $Z_o$ is given by:
a) √Z/Y
b) √ZY
c) √Z+√Y
d) √Z-√Y
Answer: a
Explanation: Characteristic impedance $Z_o$ is the square root of ratio of impedance and admittance of the transmission line.

56. Propagation constant γ in terms of admittance and impedance of the transmission line is
a) √Z/Y
b) √ZY
c) ZY
d) ZY*
Answer: b
Explanation: Propagation constant is the root of product of impedance and admittance of the transmission line.

57. The value of 'α' for a lossless line is
a) 0
b) 1
c) Infinity
d) Data insufficient

Answer: a
Explanation: α-for a transmission line signifies the attenuation constant. For a lossless transmission line attenuation constant is zero and the propagation occurs without losses.

58. If propagation constant is 12:60°, then the value of phase constant and attenuation constant is

a) α=6, β=10.39
b) α=61, β=78
c) α=12, β=20.6
d) none of the mentioned
Answer: a
Explanation: The given propagation constant is in polar form .converting from polar form to rectangular form and equating the real and imaginary parts, we get α=6 and β=10.39.

59. If a transmission line with inductive reactance of 41.97 Ω and capacitive reactance of 1132.5Ω is operated at 1 GHz , then its phase constant is:
a) 0.0305
b) 0.3
c) 30.3
d) 0.6
Answer: a
Explanation: From the given inductive reactance and capacitive reactance, L and C are calculated using $X_L = 2\pi fL$ and $X_c = 1/2\pi fC$. $\beta=\omega\sqrt{LC}$, substituting the calculated L and C, we get β=0.0305.

60. The expression for a phase velocity of a transmission line is:
a) $\sqrt{LC}$
b) $1/\sqrt{LC}$
c) $X_L+X_c$
d) $X_L/X_c$
Answer: b
Explanation: The expression for phase velocity is derived from known basic transmission line equations and the derived equation comes out to be $1/\sqrt{LC}$ .

61. If the admittance and the impedance of a transmission line are 100 Ω and 50 Ω of a respectively, then value of phase constant β is:
a) 0
b) 20
c) 132
d) 50
Answer: a
Explanation: $\beta=\omega\sqrt{LC}$. Since both the line impedance and line admittance are both real, there is no phase difference caused and hence substituting in the above equation, we get β=0.

62. For a lossless line, which of the following is true?
a) γ=jβ
b) γ=α

c) $\gamma=\alpha+j\beta$
d) $\gamma=\alpha*j\beta$
Answer: a
Explanation: For a lossless line, attenuation constant $\alpha$ is 0. Hence substituting $\alpha=0$ in $\gamma=\alpha+j\beta$, we get $\gamma=j\beta$.

63. Expression for phase constant $\beta$ is
a) $\sqrt{LC}$
b) $\omega \sqrt{LC}$
c) $1/ (\omega \sqrt{LC})$
d) None of the mentioned
Answer: b
Explanation: From the equation of $\gamma$ in terms of Z and Y(impedance and admittance of the transmission line respectively), expanding the equation and making certain approximations, $\beta= \omega \sqrt{LC}$.

64. A microwave generator at 1.2 GHz supplies power to a microwave transmission line having the parameters $R=0.8\Omega/m$, G=O.8millisiemen/m, $L=0.01\mu H/m$ and C=0.4PF/m. Propagation constant of the transmission line is:
a) 0.0654 +j0.48
b) 0.064+j4.8
c) 6.4+j4.8
d) none of the mentioned

Answer: a
Explanation: $Z=R+j\omega L$ and $Y=G+j\omega C$, hence finding out Z and Y from these equations, substituting in $\gamma=\sqrt{ZY}$, value of $\gamma$ is found out to be 0.0654+j0.48.

65. In a certain microwave transmission line, the characteristic impedance was found to be 210 10°Ω and propagation constant 0.2 78°.What is the impedance Z of the line, if the frequency of operation is 1 GHz?
a) 0.035+j41.97
b) 0.35+j4.97
c) 35.6+j4.28
d) 9.254+j4.6

Answer: a
Explanation: Impedance Z of a transmission line is given by the product of propagation constant $\gamma$ and characteristic $Z_o$ , $Z= \gamma Z_o$ , we get Z=0.035+j41.97.

66. For a transmission line, L=1.8mh/m C=0.01pF/m, then the phase constant of the line when operated at a frequency of 1 GHz is:
a) 4.2426
b) 2.2
c) 0.3
d) 1

Answer: a
Explanation: Formula to calculate the phase constant $\beta$ is $\beta=\omega\sqrt{LC}$. substituting the given values of L,C and f, the value of $\beta$ is 4.2426.

67. For a low loss line when both conductor and di-electric loss is small, the assumption that could be made is

a) $R << \omega L$ and $G << \omega C$

b) $R >> \omega L$ and $G >> \omega C$

c) $R << \omega C$ and $G << \omega L$

d) $R >> \omega C$ and $G >> \omega L$

Answer: A

Explanation: For a low loss line, the real part of impedance and admittance, that is resistance and conductance must be very small compared to the complex part of admittance and impedance for maximum power transfer. Hence $R << \omega L$ and $G << \omega C$.

68. Expression for α(attenuation constant) in terms of R , G, L and C of a transmission line is:

a) $(R\sqrt{(C/L)}+G\sqrt{(L/C)})0.5$

b) $(R\sqrt{(C/L)}+G\sqrt{(L/C)})$

c) $(R\sqrt{(L/C)}+G\sqrt{(C/L)})$

d) $(R\sqrt{(L/C)}+G\sqrt{(C/L)})0.5$

Answer: A

Explanation: For a low loss line, the real part of impedance and admittance, that is resistance and conductance must be very small compared to the complex part of admittance and impedance for maximum power transfer. Hence $R << \omega L$ and $G << \omega C$, with this assumption, modifying the expression for propagation constant, the simplified expression for attenuation constant α is $(R\sqrt{(C/L)}+G\sqrt{(L/C)})0.5$.

69. Expression for characteristic impedance $Z_o$ of a transmission line in terms of L and C the transmission line is

a) $\sqrt{(C/L)}$

b) $\sqrt{(CL)}$

c) $\sqrt{(L/C)}$

d) $1/\sqrt{(LC)}$

Answer: C

Explanation: For a low loss line, the real part of impedance and admittance, that is resistance and conductance must be very small compared to the complex part of admittance and impedance for maximum power transfer. HenceR $<< \omega L$ and $G << \omega C$, with this assumption, modifying the expression for characteristic impedance$\sqrt{(((R+j\omega L))}/\sqrt{(G+j\omega C))}$, the ratio reduces to $\sqrt{(L/c)}$.

70. If the inductance and capacitance of a loss line transmission line are 45 mH/m and10 μF/m, the characteristic impedance of the transmission line is:

a) 50Ω

b) 67.08Ω

c) 100Ω

d) none of the mentioned

Answer: B

Explanation: The expression for characteristic impedance of a transmission line in terms of inductance and capacitance of a transmission line is$\sqrt{((L)/C)}$. Substituting the given values in this equation, the characteristic impedance of the transmission line is 67.08Ω.

71. If the characteristic impedance of a transmission line is 50 Ω, and the inductance of the transmission line being 25 mH/m, the capacitance of the lossy transmission line is
a) 1μF
b) 10 μF
c) 0.1 μF
d) 50 μF
Answer: B
Explanation: The expression for characteristic impedance of a transmission line in terms of inductance and capacitance of a transmission line is $\sqrt{((L)/C)}$. Substituting the given values in this equation, and solving for C, value of C is 10μF.

72. If R = 1.5Ω/m, G = 0.2 mseimens/m, L = 2.5 nH/m, C = 0.1 pF/m for a low loss transmission line, then the attenuation constant of the transmission line is:
a) 0.0.158
b) 0.0523
c) 0.0216
d) 0.0745
Answer: A
Explanation: The expression for attenuation constant of a low loss transmission line is $(R\sqrt{(C/L)}+G\sqrt{(L/C)})0.5$. Substituting the given values in the above expression, the value of attenuation constant is 0.0158.

73. A lossy line that has a linear phase factor as a function of frequency is called
a) distortion less line
b) terminated lossy line
c) loss less line
d) lossy line
Answer: A
Explanation: A distortion less transmission line is a type of a lossy transmission line that has a linear phase factor as a function of frequency. That is, as the frequency of operation changes, the phase variation is linearly dependent.

74. The condition for a distortion less line is:
a) R/L=G/C
b) R/C=G/L
c) R=G
d) C=L
Answer: A
Explanation: The special case of a lossy transmission line that has a linear phase factor as a function of frequency is called distortion less line. The relation between the transmission line constants for such a distortion less line R/L=G/C.

75. For a distortion less line, R= 0.8Ω/m, G= 0.8 msiemens/m, L= 0.01μH/m then C is:
a) 10 pF
b) 1pF

c) 1nF
d) 10nF
Answer: A
Explanation: The special case of a lossy transmission line that has a linear phase factor as a function of frequency is called distortion less line. The relation between the transmission line constants for such a distortion less line R/L=G/C. substituting the given values in the equation, we get 10pF.

76. For a lossy transmission line, γ=0.02+j0.15 and is 20m long. The line is terminated with an impedance of a 400Ω. Then the input impedance of the transmission line given that the characteristic impedance of the transmission line is 156.13+j11.38Ω is
a) 100+j50 Ω
b) 228+j36.8 Ω
c) 50+36.8j Ω
d) none of the mentioned
Answer: B
Explanation: The relation between source impedance, propagation constant and characteristic impedance is given by ZS= Z0 (ZLcosh(γl) + Z0 sinh(γl))/( Z0cosh(γl) + ZL sinh(γl)). Substituting the given values in the above equation, input impedance of the transmission line is 228+j36.8 Ω.

77. The expression for conductance G of a coaxial transmission line with outer radius ‘b’ and inner radius ‘a’ is given by:
a) 2πωε/ (ln b/a)
b) (R/2π)(1/a+1/b)
c) Rb/πa
d) 2Rb/a
Answer: a
Explanation: The conductance G of a coaxial transmission line is 2πωε/ (ln b/a). Conductance of the transmission line is inversely related to the conductance of the transmission line.

78. Expression for resistance R of a coaxial transmission line outer radius b and inner radius a is:
a) $R_s/2\pi$ ( 1/a+1/b)
b) 2πω∈”/ln(b/a)
c) $\mu/\pi \cos^{-1}(b/a)$
d) $\pi\epsilon$ ’/$\cosh^{-1}(b/a)$
Answer: a
Explanation: Resistance R of a coaxial transmission line is $R_s/2\pi$ ( 1/a+1/b). Here a and b are the outer and inner radius of the transmission line. Rs are the series resistance of the coaxial cable.

79. If the outer and the inner diameter of a coaxial transmission line are 20 mm and 10 mm respectively, then the inductance /m of the transmission line is:
a) 0.13 μH
b) 0.2 μH
c) 0.3 μH
d) 0.1 μH
Answer: a

Explanation: Inductance of a coaxial transmission line is $\mu*\ln (b/a)/ 2\pi$. Substituting the given values in the equation for inductance, the inductance is 0.13 μH.

80. If the outer circumference and the inner circumference of a transmission line are $40\pi$ and $25\pi$ units respectively, then the capacitive reactance of the coaxial transmission line is:
a) 0.376 nF
b) 0.45 nF
c) 0.9 nF
d) none of the mentioned
Answer: a
Explanation: Capacitance of a coaxial transmission line is given by the expression $2\pi\in/\ln (b/a)$. Computing the capacitance from this equation and then computing the capacitive reactance, the coaxial line has a capacitive reactance 0.376 nF.

81. For a 2 wire transmission line, if the complex part of permittivity is 2.5, then the given distance between the 2 wires is 10mm and operated at a frequency of 1.2 MHz and the radius of the line being 5mm, then the conductance of the transmission line is:
a) 0.2 μH
b) 0.1 μH
c) 0.5 μH
d) 1 μH
Answer: a
Explanation: For a two wire transmission line, inductance of the line is given by $\pi\in/ \cosh^{-1}(D/ 2a)$. Substituting the given values in the above equation, the conductance of the line is 0.2 μH.

82. Characteristics impedance of a coaxial line with external and inner diameter 5mm is
a) 40 Ω
b) 41.58 Ω
c) 47.78 Ω
d) 54.87 Ω
Answer: b
Explanation: Characteristic impedance of the coaxial line is given by the expression $\ln (b/a)/ 2\pi$. Substituting the given values in the above expression, the characteristic impedance is 41.58 Ω.

83. The characteristic impedance of the transmission line if the outer diameter and inner diameter of the transmission line is 20 mm and 10 mm respectively, given the intrinsic impedance of the medium is 377 Ω, then the characteristic impedance of the transmission line is:
a) 41.58 Ω
b) 50 Ω
c) 377 Ω
d) None of the mentioned
Answer: a
Explanation: Characteristic impedance of the coaxial line is given by the expression $\ln (b/a)/ 2\pi$. Substituting the given values in the above expression, the characteristic impedance 41.58 Ω.

84. Flow of power in transmission line takes place through:
a) Electric field and magnetic field
b) Voltage and current
c) Voltage
d) Electric field
Answer: a
Explanation: In a transmission line, flow of power takes place through propagation of electric field and magnetic field. Alternating electric field and alternating magnetic field propagates EM wave transmitting power.

85. When a transmission line is exited by a source, total power supplied is delivered to the load.
a) True
b) False
Answer: b
Explanation: When a transmission line is excited by the source, entire power is not delivered to the load due to the various types of losses that occur in the transmission line.

86. Expression for propagation constant. $\gamma$ In terms of $\omega$ is:
a) $\sqrt{}\omega^2\mu\in$
b) $\omega^2\mu\in$
c) $-\omega^2\mu\in$
d) None of the mentioned
Answer: a
Explanation: Propagation constant $\gamma$ for a transmission line is dependent on the operating frequency of the transmission line, and the permittivity and permeability of the medium.

Generator And Load Mismatches.

87. When a load is matched to a transmission line, the condition that is satisfied when matched is:
a) $Z_L=Z_0$
b) $Z_L=2Z0_0$
c) $Z_L=Z_{in}$
d) $Z_L=2Z_{in}$
Answer: A
Explanation: In order to deliver the maximum power from source to load, the transmission line has to be matched to the load. Hence for the transmission line to be matched to the load, the condition to be satisfied is $Z_L=Z_0$.

88. When a load $Z_L$ is matched to a line, the value of standing wave ratio is:
a) 1
b) 0
c) infinity
d) insufficient data to calculate SWR
Answer: A
Explanation: When the load is matched to the transmission line, they are said to be matched. Hence standing waves exist on the transmission line. Hence SWR is 1.

89. The value of reflection co efficient when a transmission line is matched to the load is:
a) 1
b) 0
c) 0.707
d) cannot be determined
Answer: B
Explanation: When the transmission line and the load are matched, no reflections occur in the transmission line and hence no voltage wave is reflected back. Hence, the reflection co-efficient for a matched line is 0.

90. The value of transmission co efficient when a transmission line is matched to a load is:
a) 1
b) 0
c) 0.5
d) 0.707
Answer: A
Explanation: Transmission co-efficient is defined as the ratio of the incident power to transmitted power at the load end. When the transmission line is matched, the incident power is completely transmitted. Hence, transmission co-efficient is 1.

91. The expression for power delivered to a load , when a line is matched and supplied with a source of $V_g$ with generator impedance $R_g$ +j$X_g$ is:
a) $0.5*V_g^2/R_g$
b) $0.5*V_g^2R_g/4(R_g^2+ X_g^2)$
c) $R_g/4(R_g^2+ X_g^2)$
d) generator impedance does not cause any losses
Answer: B
Explanation: Due to the generator impedance, there will be some power dissipated and hence the total source power is not transmitted. Hence that power dissipated due to generator impedance is also removed from the total power delivered.

92. If a transmission line is exited from a source of 4V at 1.2GHz frequency with a generator impedance of 4+j3 with a characteristic impedance of the transmission line 50Ω, then the power delivered to the load is:
a) 0.1 watt
b) 0.9 watt
c) 0.8 watt
d) 1watt
Answer: C
Explanation: The expression for total power delivered given the generator impedance is $0.5*V_g^2R_g/4(R_g^2+ X_g^2)$. Substituting the given values in the above equation, the total power delivered is 0.8 watt.

93. If the generator impedance of a source connected to a transmission line is 50+j100Ω, then for conjugate matching to occur, the input impedance must be:
a) 50-j100 Ω

b) 50+100 Ω
c) 50 Ω
d) one of the mentioned
Answer: A
Explanation: The condition for conjugate matching is $Z_{in}$=*$Z_g$, where $Z_{in}$ is the input impedance of the transmission line and $Z_g$ is the generator impedance. For conjugate matching, taking the conjugate of the given impedance, the input impedance must be 50-100j Ω.

94. After conjugate impedance matching the input impedance used for matching after normalization was 1+j with the characteristic impedance of the transmission line being 100Ω, then the generator impedance must have been:
a) 100+100jk
b) 1+j
c) 100-100j
d) 1-j
Answer: C
Explanation: After conjugate matching the input impedance of a transmission line after normalization is 1+j. hence the generator impedance will be the conjugate, that is 1-j. multiplying with the characteristic impedance, we get 100-100j.

95. For a matched transmission line with a generator impedance of 50Ω and the source being 4V,1GHZ,then the maximum power delivered to the line is:
a) 0.4 watt
b) 0.04 watt
c) 0.5 watt
d) no power is delivered
Answer: B
Explanation: The maximum power delivered to the load given the generator impedance is $0.5*V_g^2R_g/4(R_g^2+X_g^2)$. Substituting in the above equation the given values, power delivered is 0.04 watt.

96. If the power delivered to a load is 0.04w, then the normalized generator impedance if the source use is 4V at 2GHz and the generator impedance is real and characteristic impedance of the transmission line is 50Ω is:
a) 1 Ω
b) 1+j Ω
c) 1-j Ω
d) 50 Ω
Answer: A
Explanation: The maximum power delivered to the load given the generator impedance is $0.5*V_g^2R_g/4(R_g^2+X_g^2)$. Rearranging the equation and substituting the given value, $R_g$ is 50Ω. To normalize, dividing the impedance by characteristic impedance, the impedance is 1 Ω.

97.Discontinuities in the matching quarter wave transformer are not of considerable amount and are negligible.
a) True

b) False
Answer: b
Explanation: Discontinuities in the matching network cause reflections which result in considerable attenuation of the transmitted signal. Hence, discontinuities in transformers are not negligible.

98. The overall reflection coefficient of a matching quarter wave transformer cannot be calculated because of physical constraints.
a) True
b) False
Answer: b
Explanation: Though the computation of total reflection is complex, the total reflection can be computed in two ways. They are the impedance method and the multiple reflection method.

99. In the multiple reflections analysis method, the total reflection is
a) An infinite sum of partial reflections
b) An infinite sum of partial reflection and transmissions
c) Constant value
d) Finite sum of partial reflections
Answer: b
Explanation: The number of discontinuities in the matching circuit (quarter wave transmission line) is theoretically infinite since the exact number cannot be practically determined. Hence, the total reflection is an infinite sum of partial reflections and transmission.

100. The expression for total reflection in the simplified form is given by:
a) $\Gamma=\Gamma_1+ \Gamma_3e^{-2j\theta}$
b) $\Gamma=\Gamma 1_1+\Gamma_3$
c) $\Gamma=\Gamma_{12}+ \Gamma_3e^{-2j\theta}$
d) $\Gamma= \Gamma_1+ \Gamma_2e^{-2j\theta}$

Answer: a
Explanation: This expression dictates that the total reflection is dominated by the reflection from the initial discontinuity between Z1 and Z2 ($\Gamma_1$), and the first reflection from the discontinuity between Z2 and ZL ($\Gamma_3e^{-2j\theta}$).