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TCET 2220

Chapter 3

3-1. A traveling wave of current in milliamperes is given by i=8 cos( 2π \*106t- 0.025x) with t in seconds and x in meters. Determine the following :

1. Direction of propagation:

Positive

1. Peak value

8

1. Angular frequency:

2\*π\*f= 2π\*106= 6.28 \*106

1. Phase constant:

β=.025

1. Cyclic frequency:

f= 1\*106

1. Period:

T== =1\*10-6

1. Wavelength:

λ== =251.327 m

1. Velocity of propagation:

V=f \*λ= 106 \*251.327 =2.51 \*108

3-2. A traveling wave of voltage in volts in given by v= 15 cos(108t+0.35x) with t in seconds and x in meters. Determine the following:

1. Direction of propagation:

Negative

1. Peak value:

15

1. Angular frequency:

108

1. Phase constant

β=.35

1. Cyclic frequency:

f=== 1.59 \*107

1. Period:

T== =6.289 \*10-8

1. Wavelength:

λ= = =17.952

1. Velocity of propagation:

V=f \*λ= 1.59 \*107 \*17.952=2.86 \*108

3-3. A sinusoidal current with a peak value of 2 A and a frequency of 50 MHz is traveling in the positive x-direction with a velocity of 2 x 108 m/s. Determine the following:

1. Period

T===

1. Angular frequency

ω= 2\*π\*f= 2\*π\*= 3.14 \*108

1. Phase constant

== 1.57

1. Wavelength

λ===4.00203

1. An equation for the current

= 2\* cos (3.14 \*108 t-1.57x)

3-4. A sinusoidal voltage with a peak value of 25 V and a radian frequency of 20 Mrad/s is traveling in the negative x-direction with a velocity of 3 x 108 m/s. Determine the following:

1. Cylic frequency:

f= = = 3.18 \*106

1. Period:

T=== 3.14 \*10-7

1. Phase constant:

= .06667

1. Wavelength:

λ= =94.2

1. An equation for the voltage:

= 25\*cos ()

3-5. Consider the current traveling wave of Problem 3-1. Determine the following:

i=8 cos( 2π \*106t- 0.025x)

1. a fixed phasor representation in peak units as either + or - ( You decide which label is appropriate.)

+ = 8 \*e0 = 8∠0

1. the corresponding distance-varying phasor (x) in peak units

(x) =+ = 8 \*e0 \*ejβx

=8 \*e0 \*ej-0.025

= (8∠0)\*(1∠-.0025x)

=(8∠-.0025x)

1. the value of the distance-varying phasor at x=100 m.

=(8∠-.0025x)

=(8∠-.0025\*100)

=8∠-2.5

3-6. Consider the voltage traveling wave of Problem 3-2. Determine the following:

15 cos(108t+0.35x)

1. a fixed phasor representation in peak units as either + or - ( You decide which label is appropriate.)

- =15\*ej0 =15∠0

1. the corresponding distance-varying phasor (x) in peak units

(x)=- \* ejβx

=15\*ej0\* ej0.35

=15∠-0.35\*x

1. the value of the distance-varying phasor at x=4 m.

(4)= 15∠-0.35\*x

(4)= 15∠-0.35\*4

(4)= 15∠-1.20

3-7. Repeat the analysis of Problem 3-5 if the current of Problem 3-1 has a fixed phase shift such that it is described by

i=8 cos( 2π \*106t- 0.025x +1.5)

1. += 8\*e1.5 =8∠1.5
2. = + \* ej-0.025

= 8\*e1.5 \* ej-0.025

= 8∠1.5-0.25\*x

1. 8∠1.5-0.25\*100

=8∠1.5-0.25\*100

=8∠-1

3-8. Repeat the analysis of Problem 3-5 if the current of Problem 3-1 has a fixed phase shift such that it is described by

v= 15 cos(108t+0.35x-)

a)- =15 \*e j-

b)=15 \*e j- \* ej0.35x

=15∠- +0.35x

c)(4)= 15∠ + 0.35\*4

=15∠-58.6

3-9. Redefine the fixed phasor of Problem 3-5 so that the phasor magnitude is expressed in rms units, and determine the average power dissipated in 50-Ω resistance.

a)Irms=

=

= 5.65

b)Power dissipated= (I)2\* R= (5.65)2 \* 50 =1600 watts

3-10. Redefine the fixed phasor of Problem 3-6 so that the phasor magnitude is expressed in rms units, and determine the average power dissipated in75-Ω resistance.

a)Vrms=

=

= 10.610

b)Power dissipated= = =1.501 watts

3-11. Redefine the fixed phasor of Problem 3-7 so that the phasor magnitude is expressed in rms units. Would the power dissipated in a 50-Ω resistance be the same as in Problem 3-9?

1. Irms=

=

=5.56<1.5

b) Power dissipated= (I)2\* R= (5.56)2 \* 75 =1600 watts

3-12. Redefine the fixed phasor of Problem 3-8 so that the phasor magnitude is expressed in rms units. Would the power dissipated in a 75-Ω resistance be the same as in Problem 3-10?

a)Vrms=

=

=10.61

b)Power dissipated= = =1.501 watts ; same as Problem 3-10

3-13. Under steady-state ac conditions, the forward current wave on a certain lossless 50-Ω line is + =2 A. Determine the voltage forward wave.

1. + =2 A.
2. + = R0 \*+

=2 A \* 50

+ =1000

3-14. Under steady-state ac conditions, the forward voltage wave in a 300-Ω lossless line is +=15A. Determine the current forward wave.

+ = = = .05A

3-15. Under steady-state ac conditions, the reverse voltage wave on a lossless 50-Ω line is - =200A. Determine the reverse current wave.

- = = = - 4A

3-16. Under steady-state ac conditions, the reverse current wave on a lossless 75-Ω line is - =.5. Determine the reverse voltage wave.

= \* - = -75 \*(.5A)= -37.52

3-17. A table of specifications for one version of RG-8/U 50-Ω coaxial cable indicates that the attenuation per 100 ft at 50MHz is 1.2 dB. At this frequency, determine the following:

1. attenuation factor in decibels per foot.

α= =.012

1. attenuation factor in nepers per foot.

LNP = =1.382\* 10-3

For a length of 300 ft, determine the following:

1. total attenuation in decibels.

300 ft \* .012 =3.6 dB

1. total attenuation in nepers

LNP = (1.382\* 10-3 )\* 300 =.4146

1. ratio using both decibels and nepers for a single wave

= e-L = e –( 1.382 \* ) =.999

10\* =.661

3-18. A transmission line has an attenuation of 0.05 dB/m. Determine the following:

1. attenuation factor in nepers/m

For a length of 400 m, determine the following:

= = 5.76 \*10-4

1. total attenuation in decibels.

Ldb =.05 \*400 =20

1. total attenuation in nepers

5.76 \* 10-3 \*400 =2.304

1. ratio using both decibels and nepers for a single wave.

10\* =.1

3-19. A single frequency wave is propagating in one direction on a transmission line of length of 200 m. With an input rms voltage of 50 V, the output rms voltage is measured as 20 V. Determine the following:

1. total attenuation in decibels.
2. =20 log 10

8 Ldb =20 log 10 )

1. α === .004511
2. αdb =8.686 \*.004511 =.039991
3. Ldb =.039991\*200= 7.9982
4. total attenuation in nepers.

LNP =α \*d = .004511 \*200 =.9022

1. attenuation factor in decibels/meter

αdb =8.686 \*.004511 =.039991

1. attenuation factor in nepers/meter

αNp =4.511 \* 10 -3

3-20. A single frequency wave is propagating in one direction on a transmission line of length 400 m. The input power to the line is 40 W, and the output power is 12 W. Determine the following:

1. total attenuation in decibels.
2. Ldb =10 log 10 )

Ldb =10 log 10 ) = 5.228

1. α === .00334= 3.34 \*10-3
2. αdb =8.686 \*.00334 =.029011
3. .029011 \*400=11.6044
4. total attenuation in nepers.

LNP=α \*d=.00334 \*400= 1.34

1. attenuation constant in decibels/meters

αdb =8.686 \*.004511 =.039991

1. attenuation factor in nepers/meter

α === .00334= 3.34 \*10-3

3-21. A transmission line has the following parameters at 50 MHz: L=1.2 μH/m, R= 15 Ω/m, C= 10 pF/m, and G= 4 μS/m. Determine the following:

1. Z =R +jωL= 15 + j (( 2\*π\*50\*106) \*1.2 \* 10-6))= 15 +j (376.991)

= 377

1. Y= G +jωC= 4\* 10 -6+ j (( 2\*π\*50\*106) \*10 \* 10-12))= .000004 +j (.003142)

= .003142

1. γ,α, and β

γ == = .0223341 +j (1.08855)

=.0223341

β = 1.08855

1. attenuation in dB/m

αdb =8.686 \*.0223341 =.193994

1. v= = = 2.885 \* 108
2. Z0 = = =346.46 –j(6.67) = 346.525 -.02

3-22. A lossy audio-frequency line has the following parameters at 2 kHz: L= 0.1 µH/ft, R= 0.2 Ω/ft, C= 2 pF/ft, and G is negligible. Determine the following:

1. Z = R +jωL= .2 +j((2\*π\*2000) \*.1 \* 10-6 = .2 +j(0.12566) = .200394 .0627
2. Y= G +jωC= j (( 2\*π\*2000) \*2 \* 10-12))= j (2.513\*10-8)=

= 2.513\*10-8

1. γ,α, and β
2. γ,α, and β

γ == = .000049 +j (.000052)

=.000049

β = .000052

1. attenuation in dB/ft

αdb =8.686 \*.000049 =.000426

1. v== 2.42 \* 108
2. Z0 = = 2823.88 -.754

3-23. A coaxial cable has the following parameters at a frequency of 1 MHz:

series resistance= 0.3 Ω/m

series reactance = 2 Ω/m

shunt conductance = 0.5 µS/m

shunt susceptance =0.6 mS/m

Determine the following:

1. Z =R +jL= .3 + j 2= 2.022
2. Y= G +jC= .5\*10-6 + j (( .6\* 10-3))= . 5\*10-6  + j.0006

= .00061.57

1. γ,α, and β

γ == = .002985 +j (.034703)

=.002985

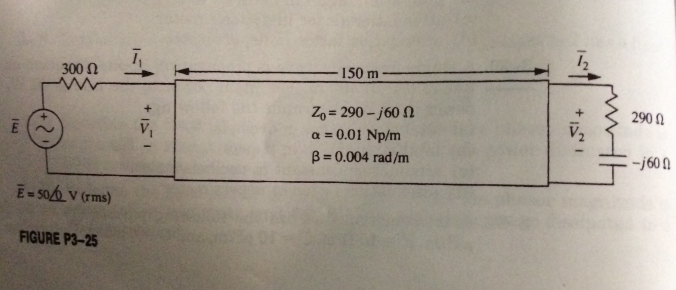
β = .034703

1. attenuation in dB/ft

αdb =8.686 \*.002985 =.025928

1. v= = = 1.81 \* 108
2. Z0=  = =333.337 –j(490972) = 337.062 -.14

3-24. For the coaxial cable of Problem 3-23, repeat the analysis at 100 MHz if the series resistance increases to 1 Ω/m, but the shunt conductance remains essentially the same. ( *Note* : You must apply basic ac circuit theory to determine the new values for the reactance and susceptance.) (Not Answered)

3-25. For the circuit of Fig. P3-25, determine the following: 

α \*d =.001 \*150 =1.5

β\*d =.004 \*150=.6

1. input current 1

1 = == .799903+j.081066 = .084 .101

1. input voltage 1

1 =  \* 1 = (290-j60) \* (.799903+j.081066) =236.836-j24.485 = 238.098-.103

1. input power P1

P1 = (1)2 \*R0 = (.084)2 \*290=2.04 w

1. load current 2

2 =1 \*e –α \*d \* e –jβ\*d = (.084 .101) \* e –1.5 \* e –j.6 = .01794 -.499

1. load voltage 2

2 = 1 \*e –α \*d \* e –jβ\*d = (238.098-.103) \* e –1.5 \* e –j.6 =555-.703

1. load power P2

P2 = (2)2 \*R0 = (.01794)2 \*290=.0933 w

1. line loss in dB

Ldb =10 log 10 ) = 10 log 10 ) =13.41

3-26. For the circuit of Fig. P3-26, determine the following: (Not sure )

α ===.077

α \*d =.077 \*6 =.462

β\*d =.5\*6=.6

1. input current 1

1 = == .0649- j.010806 =.0658-.165

1. input voltage 1

1 =  \* 1 = (600+j100) \*( .0649- j.010806) =606.484+j38.94= 607.732.064118

1. input power P1

l P1 = (1)2 \*R0 = (.0658)2 \*290=1.2556 w

1. load current 2
2. load voltage 2
3. load power P2
4. line loss in nepers

