Husni Harb 09/17/2013

TCET2220 Chapter 1

1. Calculate the free-space wavelength in meters for the following frequencies:

2 kHz

2000 kHz

20 MHz

2 GHz

2. Calculate the free-space wavelength in meters for the following frequencies:

80 kHz

8 MHz

800 MHz

8 GHz

3. Calculate the free-space wavelength in miles for a frequency of 400 Hz.

4. Calculate the free-space wavelength in miles for a frequency of 1.5 kHz.

5. A sinusoidal signal has a free-space wavelength of 80 m. Calculate the frequency.

6. A sinusoidal signal has a free-space wavelength of 6 m. Calculate the frequency.

7. A digital signal utilizes pulse whose minimum widths are about 3 ns. Assuming the speed of light, determine the longest lengths of wire-pairs that can be allowed based on the 10% rule.

t = 0.1 x 3 ns =300 ps

d= cx t 1 = (3 x 108 ) x (300 ps) = 9 cm

8. The longest connecting wires in a digital system are about 20 cm. Assuming the speed of light, determine the shortest acceptable pulse width based on the 10% rule.

t == 6.67 x10-10

pulse width= = 6.67 x 109 s

9. A communication system operates at a frequency of 800 MHz. Assuming the speed of light, determine the length of connecting line that could be used without considering frequency-domain effects based on the 10% rule.

10. The length of a connecting cable between two points in a radio-frequency system is 50 cm. Assuming the speed of light, determine the highest operating frequency that should be used without considering frequency-domain effects based on the 10% rule.

11. In a coil, a current of 100 mA results in a magnetic flux of 50 Determine the inductance.

12. A current of 4 mA is flowing in a 20- H coil. Determine the magnetic flux.

= Current x Inductance = (4 mA x20 H) = 8x 10-8 H

13. In a capacitor, a voltage of 20 V results in charge storage of 5 C. Determine the capacitance.

14. A capacitance of 40 F is charged to a voltage of 12 V. Determine the electric charge.

15. A lossless transmission line has an inductance of 320 nH/m and a capacitance of 57 pF/m. Determine the characteristic impedance.

16. A lossless transmission line has an inductance of 1.2 H/m and a capacitance of 15 pF/m. Determine the characteristic impedance.

17. The dielectric constant of mica is 6. Determine the permittivity.

ε=εrxε0= 6x8.842 = 53.02 x10-12 F/m

18. The permittivity of a material is 14 x10 -12 F/m. Determine the dielectric constant.

εr = = =1.58

19. The relative permeability of nickel is 800. Determine the actual permeability.

**=**0

1.05 mH/m= (800x ()

20. The permeability of a ferromagnetic material is 10-4 H/m. Determine the relative permeability.

**= = =79.58**

21. Determine the velocity of propagation of the transmission line of Problem 1-15.

=2.34x108 m/s

22. Determine the velocity of propagation of the transmission line of Problem 1-16.

=2.36x108m/s

23. The dielectric constant in a transmission line is 4.7, and =0. Determine the velocity of propagation.

**V**= = =1.38 x 108 m/s

24. The dielectric constant in a certain transmission line is 3, and =0.  Determine the velocity of propagation.

**V**= = =1.73x 108 m/s

25. A coaxial cable has the following specifications: R0 = 73, and velocity of propagation =2.1 x108 m/s. Determine L and C.

= =347 x10-9

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26. A coaxial cable has the following specifications: R0 = 150, and velocity factor =0.8. Determine L and C.

= =625

= = 8

27. The lower end of the commercial amplitude-modulation (AM) band is about 550 kHz. AM stations use “quarter-wave” vertical antennas whose lengths are .25. Determine he length in meters of a vertical antenna operating at the lower end.

=545.45

.25 =.25x545.45 = 136.36 m

28. The upper end of a commercial AM band to in Problem 1-27 is about 1610 kHz. Determine the length in meters of a vertical antenna operating at the upper end.

=186.34 x 103 m

29. One popular simple antenna is the “half-wave” horizontal antenna whose theoretical length is .5λ at the operating frequency. In practice, however, the antenna is usually shortened by about 5% due to end effects. Determine the practical length in meters for a half-wave antenna to provide optimum reception at the lower end of the commercial FM band, which is about 88 MHz.

=3.409 m

.5x3.409 = 1.705 m

1.705-(1.7045x.05) =1.6193 m

30. Based on the discussion of problem 1-29, determine the practical length in meters for a half-wave antenna to provide optimum reception at the upper end of the FM band, which is about 108 MHz.

=2.78 m

.5x 2.78 = 1.4 m

1.4-(1.4x.05) =1.33 m