**NEW YORK COLLEGE OF TECHNOLOGY**

**TCET 2220**

**FALL 2013**

1.-C**alculate the free-space wavelength in meters for the following frequencies:**

1. 2 kHz
2. 200 kHz
3. 20 MHz
4. 2 GHz

λ =C/F

λ =C/F =3 x 10 **8** / 2x 10 **3** = **15.0 km**

λ =C/F = 3 x 10 **8** / 200 x 10 **5**  =**15km**

λ =C/F 3 x 10 **8** / 20 x 10 **7 =15m**

λ =C/F 3 x 10 **8**  / 2 x 10 **9= 15cm**

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

1. 80 kHz
2. 8 MHz
3. 800 MHz
4. 8 GHz

λ =C/F =3 x 108/ 8x103 = **37.5 km**

λ =C/F =3 x 108 / 8 x 106 = **37.5m**

λ =C/F =3 x 108 / 800 x 108 = **0.37m**

λ =C/F =3 x 108 / 8 x 109 = **3.75 cm**

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

λ =C/F = 186,000 / 400 = **465mi**

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

λ =C/F =3 x 108 / 8 x 1010 = λ =3 x 108 / 1.5 x 103 = 186,00/ 1.5x103=**124mi**

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

λ =C/F C=λ.F F= C/ λ = 3x108 /80 **= 3.75 Mhz**

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

λ =C/F F=C/ λ = F=3x108 /6=  **50Mhz**

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

T1 = 0.1 x 3ns =.3ns

D=c.t d= (3x108) x (3 x10 -9)=0.0090 m = **9cm**

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

\*\* T1 = 0.1 x 6.676ns =**0.6667ns**

D=c.t t=d/c t=20cm / (3 x10 8)=6.6ns = 20x10-2/3x108=0.6667ns

**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 use d without considering frequency-domain effects based on the 10% rule.**

λ = C/F λ= (3x108)/ 800x 106 = **0.375 m**

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

λ = C/F f=(3x108)/ 50= 600Mhz f=(3x108)/ 5= 60Mhz

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

H= Flux (wb)/ Current (A) L=ɸ/ I

H=(50x10-6 ) (100x10-3)= **500µH**

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

H= Flux / Current Flux= H/A L=ɸ/ I Flux =20µm/ 4mA Flux = 20x10-6 / 4x10-3= **80 n wb**

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

F= charge/voltage C= Q/V

f= 5µc/20v=5x10-6 c/20= 250x10-9F **= 0.25µf**

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

F=charge/voltage c=f/v c=40µf/12v = 3.33x10-6 c Q=C.V = 40x10-6 (12)= **480 µC**

**15-A lossless transmission line has an inductance of 320 Nh/M and a capacitance of 57 Pf/m. Determine the characteristic impedance**.

R0 = \sqrt{\ }L/C = \sqrt{\ }(320nH/m) / 57PF/m R0 = \sqrt{\ }(320/10-9 H/m) / 57 x 10-12  F/m = **74.9266 Ω**

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

R0 = \sqrt{\ }L/C = 1.2 x 10 -6 / (15 x 10-12) = **282.84Ω**

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

Є = Є r Є 0  Є = 6 x (1 / 36 Л x 10-9 f/m) = **53.05 x 10-12 F/m**

**18-The permittivity of a material is 14X10¯12 F/m. Determine the dielectric constant.**

Є = Є r Є 0  Є r =Є/ Є 0

Є = 14 x 10-12  (1 / 36 Л x 10-9 f/m) = **1.583**

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

µ 0  = 4 Л x 10 -7 H/m

µ = µ R µ 0  µ = 800 x 4 Л x 10 -7 H/m = **1.0053 x 10 – 3 H/m**

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

µ 0  = 4 Л x 10 -7 H/m

µ = µ R µ 0  µ r = µ / µ 0 µ r = 10 – 4 H/m / ( 4 Л x 10 -7 H/m ) = **79.57**

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

V = 1/ Lc

V= 1/ 320 nH x 57 PF/m = 1/(320 x 10 -9 hm) (57 x 10 -12 f/m) = **2.342x108 m/s**

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

V = 1/ Lc

V= 1/ 1.2 µ H x 15 PF/m = 1/(1.2 x 10 -6 hm) (15 x 10-12 f/m) = **2.3570 x 10 8 m/s**

**23-The dielectric constant in a transmission line is 4.7, and µ = µ₀. Determine the velocity of propagation**

V = C/ µЄ v=1/Є t  = 1/ 4.7 **= 461.26 x 10-3 m/s**

V = C/ µ r Єr = 3x108 /  (1) (4.7)= **1.384x108m/s**

**24-The dielectric constant in a certain transmission line is 3, and µ = µ₀. Determine the velocity of propagation**

v=1/Є t  = 1/3 = 577.3 x 10-3 m/s

V = C/ µ r Єr = 3x108 /  (1) (3)= **1.732x108m/s**

**25-A coaxial cable has the following specifications: R₀ = 73 Ω, and velocity of propagation = 2.1X10 8 m/s. Determine L and C.**

L = R0 / v = 73 Ω / 2.1 x 10 8 = **0.3476µf/m**

C= 1/R0v = 1/(73Ω) (2.1 x 10 8) = **65.2310 p F**

**26-A transmission line has the following specifications: R₀ = 150 Ω, and velocity factor = 0.8. Determine L and C.**

V=0.8c v=o.8c x (3 x 108) v=**2.4 x 10 8 m/s**

L = R0 / v = 150 Ω / 2.4 x 10 8 **= 0.625 µf/m**

C= 1/R0v = 1/(150 Ω) (2.4 x 10 8 ) = **27.78 P F/m**

**27-The lower end of the commercial amplitude-modulation (AM) band is about 550kHz. AM stations use “quarter-wave” vertical antennas whose lengths are 0.25 λ. Determine the length in meters of a vertical antenna operating at the lower end.**

λ/4= ¼ x C/f = ¼ x (3x108 )/ (550x103 **)= 136.4m**

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

λ/4= ¼ x C/f = ¼ x (3x108 )/ 1610x103 )= **46.58m**

**29-One popular simple antenna is the “half-wave” horizontal antenna whose theoretical length is 0.5 λ at the operating frequency. In practice, however, the antenna is usually 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.**

∫= 0.95 x 0.5 λ

∫=0.475

0.475 x C/f = (0.475)(3x108 )/ (88x106 )= **1.619 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.**

∫= 0.95 x 0.5 λ

∫=0.475

0.475 x C/f = (0.475)(3x108 )/ (108x106 )= **1.319 m**

**31-Show that the free-space velocity of light in feet/second is very close to c = 982 X 10 6 ft/s.**

C=300x 106 m/s

300x 3.2808feet/meter x106  = **984x106  feet/sec**

32-Show that the free-space wavelength in feet can be expressed as

λ (ft) = 984

f(MHz)

You may use the result of Problem 1-31

Sinces velocity of light is 984x106  feet/sec

Frequency is f(MHZ)x 106 the 106 will cancel

λ (ft) = 982/ f(MHz) = 984x106 / (MHz) x 106 = **984**