Scilab Textbook Companion for Electronic Communication Systems by G. Kennedy And B. Davis[1]

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Book Description

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Scilab numbering policy used in this document and the relation to the above book.

Exa Example (Solved example)

Eqn Equation (Particular equation of the above book)

AP Appendix to Example(Scilab Code that is an Appednix to a particular Example of the above book)

For example, Exa 3.51 means solved example 3.51 of this book. Sec 2.3 means a scilab code whose theory is explained in Section 2.3 of the book.

Contents

List of Scilab Codes

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Chapter 1

Introduction To Communication Systems

Scilab code Exa 1.1 Fourier series

```
//Determine the first four terms in the Fourier series for a rectangular waveform

f = 1e+3;
T = 1/f;
pw = 500e-6;
A = 10;
p = pw/T;
ft1 = (A*p);
ft2 = ( (2*A*p) * sin(%pi*p)/(%pi*p) * cos(2e+3*%pi*p) );
ft3 = ( (2*A*p) * sin(%pi)/(%pi) * cos(4e+3*%pi*p) );
ft4 = ( (2*A*p) * sin(1.5*%pi)/(1.5*%pi) * cos(6e+3*%pi*p) );

disp(ft1, ' Fourier transform 1st = ')
disp(ft2, ' Fourier transform 2nd = ')
disp(ft3, ' Fourier transform 3rd = ')
```

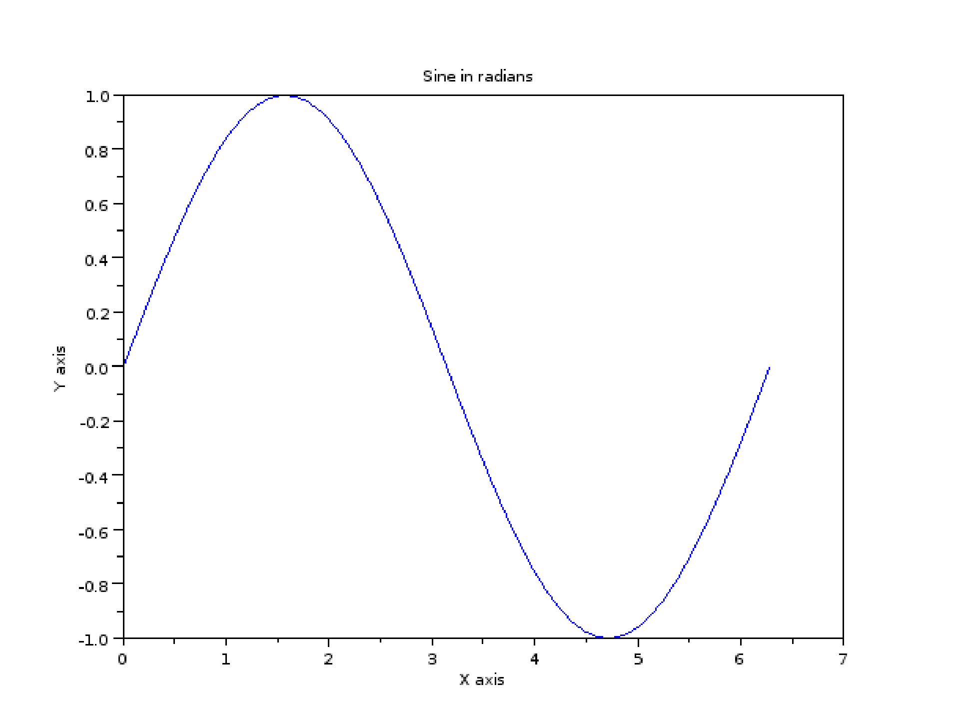

Figure 1.1: Fourier series

```
disp(ft4, ' Fourier transform 4th = ')

//For Plotting graph

xset('window',1);
xtitle("Sine in radians","X axis","Y axis");
x=linspace(0,2*%pi,50);
y=sin(x);
plot(x,y);
```

Scilab code Exa 1.2 Evaluate a single pulse

```
//Evaluate a single pulse

A = 8e-3;
f = 0.5e+3;

w = 2*%pi*f;
pw = 1/f;
w = 2*%pi/pw;

MV = A/pw;    // Maximum voltage

disp(MV, 'Maximum voltage(in V)')

//For plotting graph
xset('window',2);
xtitle("Figure 1.7","X axis","Y axis");
x=linspace(0.1,6*%pi/(pw),50000);
y=(MV*pw*sin(pw)*x)/(pw*x);
plot(x,y);

//As the values on both x and y axis very small, so
    plot in this example is not able to shown the
    variation
```

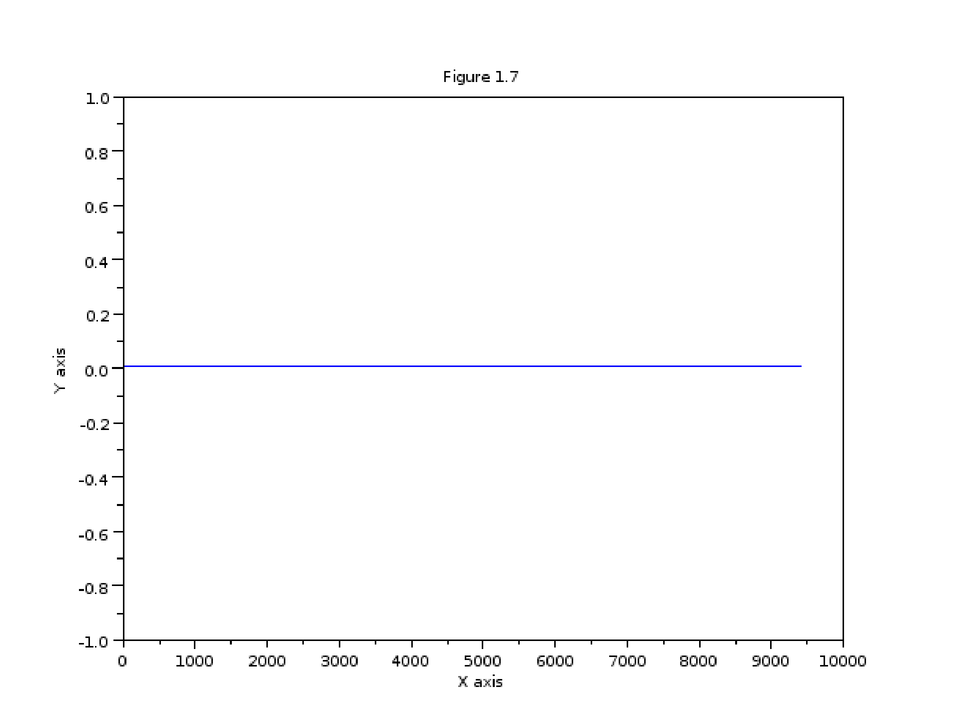

Figure 1.2: Evaluate a single pulse

Chapter 2

Noise

Scilab code Exa 2.1 RMS noise voltage

```
//Determine RMS noise voltage

f1 = 18e+6;
f2 = 20e+6;
R = 10e+3;
T = 27;
k = 1.38e-23;

df = f2-f1;
T = T + 273;

Vn = sqrt(4*k*T*df*R);

disp(Vn, 'RMS noise voltage is (in V)')
```

Scilab code Exa 2.2 Noise voltage

```
//Determine noise voltage
```

```

f = 6e+6;
R1 = 200;
R2 = 300;
T = 17;

R = R1 + R2;
k = 1.38e-23;
T = T + 273;

Vn = sqrt(4*k*T*f*R);

disp(Vn, 'Noise voltage is (in V)')
```

Scilab code Exa 2.3 Input noise resistance

```
//Determine Input−noise Resistance

R1 = 600 + 1600;
R2 = (27e+3*81e+3) / (27e+3+81e+3) + 10e+3;
R3 = 1e+6;

A1 = 10;
A2 = 25;

Req = R1 + R2/A1^2 + R3/(A1^2 * A2^2);

disp(Req, 'Input−noise Resistance is (in ohms)')
```

Scilab code Exa 2.4 Noise figure of amplifier

```
//Determine noise figure of the amplifier of
   previous example
```

```
Ro = 50;
Req = 2518;
Rt = 600;

Req1 = Req - Rt

F = 1 + (Req1/Ro);
F1 =  10*log10(F);

disp(F, 'Noise Figure of amplifier is (in W)')
disp(F1, 'Noise Figure of amplifier is (in dB)')
```

Chapter 3

Amplitude Modulation

Scilab code Exa 3.1 Frequency range by sidebands

```
//Determine frequency range occupied by the
   sidebands

L = 50e-6;
C = 1e-9;

f = 1/(2*%pi*sqrt(L*C));

f1 = f-10000;
f2 = f+10000;

disp(f, 'Frequency range occupied by the sidebands
   is (in Hz)')
disp(f1, 'Frequency range extending from ')
disp(' Hz ', f2, 'to' )
```

Scilab code Exa 3.2 Total power in modulated wave

```
//Calculate total power in the modulated wave

Pc = 400;
m = .75;

Pt = Pc*(1+(m^2/2));

disp(Pt, 'Total power in modulated power is (in W)')
```

Scilab code Exa 3.3 Carrier power

```
//Determine carrier power

Pt = 10;
m = .60;

Pc = Pt/(1+(m^2/2));

disp(Pc, 'Carrier power is (in kW)')
```

Scilab code Exa 3.4 Antenna current

```
//Determine antenna current when percent of
    modulation changes to 0.8

It = 8.93;
Ic = 8;

m = sqrt(2*((It/Ic)^2 - 1));

m1 = .8;
It1 = Ic*sqrt(1 + (m1^2/2))

```

```
disp(It1, 'Antenna current when percent of
    modulation changes to 0.8 is (in A)')
```

Scilab code Exa 3.5 Total radiated power

```
//Determine total radiated power

Pt = 10.125;
Pc = 9;

m1 = sqrt(2*((Pt/Pc) - 1));

m2 = .40;
mt = sqrt(m1^2 + m2^2);

Pt1 = Pc*(1+(mt^2/2));

disp(Pt1, 'Total radiated power is (in kW)')
```

Scilab code Exa 3.6 Modulation index

```
//Determine modulation index due to this second wave

It1 = 11;
m1 = .40;
It2 = 12;

Ic = It1/sqrt(1+(m1^2/2));
mt = sqrt(2*( (It2/Ic)^2 - 1 ));

m = sqrt(mt^2 - m1^2);

disp(m, 'Modulation index due to second wave is')
```

Chapter 4

Single Sideband Techniques

Scilab code Exa 4.1 Power savings

```
//Calculate percentage power savings when carrier
   and one of the sidebands are suppressed in a AM
   wave modulated to a depth of (a) 100% (b) 50%


Pc = 10;
m1 = 1;
m2 = .5;

Pt1 = Pc*(1+(m1^2/2));
Psb1 = Pc*(m1^2/4);
s1 = (Pt1 - Psb1)/Pt1;
s1a = s1 * 100;

Pt2 = Pc*(1+(m2^2/2));
Psb2 = Pc*(m2^2/4);
s2 = (Pt2 - Psb2)/Pt2;
s2a = s2 * 100;

disp(s1a, 'Power savings when modulation index is
   100%')
```

```
disp(s2a, 'Power savings when modulation index is 50
   %')
```

Scilab code Exa 4.2 Frequency

```
//Determine frequency present in the unwanted lower
   sideband

x = 2*(%pi/180);

a = 1/sin(x);

p = 20*log10(a);

disp(p, 'Frequency present in the unwanted lower
   sideband is (in dB)')
```

Chapter 5

Frequency Modulation

Scilab code Exa 5.1 Modulation index

```
//Determine modulation index in each case

de1 = 4.8;
V = 2.4e+3;
fm1 = 0.5;
fm2 = 0.2;

Vm1 = 7.2;
de2 = 2*Vm1;

Vm2 = 10;
de3 = 2*Vm2;

mf1 = de1/fm1;
mf2 = de2/fm1;
mf3 = de3/fm2;

disp(de2, 'Deviation when AF voltage id incresed to
   7.2 V (in kHz)')
disp(de3, 'Deviation when AF voltage id incresed to
   10 V (in kHz)')
```

```
disp(mf1, 'Modulation index in case 1')
disp(mf2, 'Modulation index in case 2')
disp(mf3, 'Modulation index in case 3')
```

Scilab code Exa 5.2 Carrier and modulating frequencies

```
//Find carrier and modulating frequencies, modulation index and max. deviation of FM wave. Also find power dissipated in FM wave

wc = 6e+8;
wm = 1250;
%pi;
mf = 5;
Vrms = 12/sqrt(2);
R = 10;

fc = wc/(2*%pi);
fm = wm/(2*%pi);
del = mf*fm;
P = (Vrms)^2/R;

disp(fc, 'Carrier Frequency (in Hz)')
disp(fm, 'Modulation Frequency (in Hz)')
disp(mf, 'Moduation Index')
disp(del, 'Max. Deviation (in Hz)')
disp(P, 'Power dissipated in FM wave (in W)');
```

Scilab code Exa 5.3 Bandwidth

```
//Determine bandwidth requirement for an FM signal

del = 10;
```

```
fm = 2;
fms = 8;

mf = del/fm;
bw = fm*fms*2;

disp(bw, 'Bandwidth requirement for an FM signal (in
    Khz) ');
```

Scilab code Exa 5.4 Equation of modulated wave

```
//Write equation of modulated wave for (a) FM (b)
   PM and when modulating frequency is changed to 2
   Khz

fc = 25e+6;
fm = 400;
del = 1e+4;

wc = 2*%pi*fc;
wm = 2*%pi*fm;

mf = del/fm;

disp(wc, ' Equation of modulated wave in FM for case
    (a) is V = 4sin( ')
disp(mf,' t + ')
disp(wm, 'sin ')
disp('t (FM)')

disp(wc, ' Equation of modulated wave in PM for case
    (b) is V = 4sin( ')
disp(mf,' t + ')
disp(wm, 'sin ')
disp('t (PM)')
```

```
disp(wc, ' Equation of modulated wave in FM for case
    (c) is V =  4sin(  ')

disp(5*wm, 't + 5sin  ')
disp('t (FM)')

disp(wc, ' Equation of modulated wave in PM for case
    (d) is V =  4sin(  ')
disp(mf,' t +  ')
disp(5*wm, 'sin  ')
disp('t (PM)')
```

Scilab code Exa 5.5 Capacity reactance

```
//Determine value of capacity reactance obtainable
    from a reactance FET

n = 9;
gm = 12e-3;

Xceq = n/gm;

disp(Xceq, 'Value of capacity reactance is (in ohms)
    ');
```

Scilab code Exa 5.6 Total frequency variation

```
//Determine total frequency variation when the
    transconductance of the FET is varied from zero
    to maximum by the modulating voltage

gm = 9e-3;
```

```
fn = 8*5e+7;
f = 50e+6;
C = 50e-12;

Cx = gm/(2*%pi*fn);

F = sqrt(1 + (Cx/C));

del = (0.0352*f)/2.0352;
totaldel = 2*del;

disp(totaldel, 'Total frequency variation is (in Hz)
   ')
```

Scilab code Exa 5.7 RMS value of modulating voltage

```
//Determine (a) The rms value of the required
   modulating voltage (b) The value of the fixed
   capacitance and inductance of the oscillator
   tuned circuit across which the reactance
   modulator is connected

Vgsmin = -2;
Vgsmax = -0.5;
Vm =  Vgsmax - Vgsmin;

Gmmin = 3.2e-4;
Gmmax = 8.3e-4;
f = 8.8e+7;
del = 75e+3;

Vrms = Vm/(2*sqrt(2));

Cn = Gmmin/(2*%pi*f);
Cx = (Cn*Gmmax)/Gmmin;
```

```

C = ( ((Cx - Cn)*f)/(4*del) - Cn);

L = 1/(4*%pi^2*f^2*C);


disp(Vrms, '(A) RMS value of the required modulating
    voltage (in V)')
disp(C, 'Value of the fixed capacitance (in F)')
disp(L, 'Value of the fixed inductance (in H)')
```

Chapter 6

Radio Receivers

Scilab code Exa 6.1 Image frequency and Rejection ratio

```
//Determine (a) Image frequency and its rejection
   ratio at 1000 kHz (b) Image frequency and its
   rejection ratio at 25 Mhz

fa = 1000 + 2*455;
rho_a = fa/1000 - 1000/fa;
alpha_a = sqrt(1 + 100^2 * rho_a^2);

fb = 25 + 2*0.455;
rho_b = fb/25 - 25/fb;
alpha_b = sqrt(1 + 100^2 * rho_b^2);

disp(rho_a, 'Image frequency at 1000 kHz (in Hz)')
disp(alpha_a, 'Rejection Ratio at 1000 kHz')

disp(rho_b, 'Image frequency at 25 MHz (in Hz)')
disp(alpha_b, 'Rejection Ratio at 25 MHz')
```

Scilab code Exa 6.2 Loaded Q and intermediate frequency

```
//Determine (a) Loaded Q which an RF amplifier for
   this receiver would have to have (b) new
   intermediate frequency that would be needed (if
   there is to be no RF amplifier)

//Page 127

alpha_a = 138.6;
alpha_b = 7.22;
rho_b = 0.0715
fa = 25;

alpha = alpha_a/alpha_b;
q = sqrt((alpha^2 - 1))/rho_b;
f1 = ((1.91*fa) - fa)/2;

disp(q, 'Loaded Q which an RF amplifier ')
disp(q/2 , 'Geometric Mean of Loaded Q which an RF
   amplifier ')

disp(f1, 'new intermediate frequency that would be
   needed (in MHz)')
```

Scilab code Exa 6.3 Maximum modulation index

```
//Determine maximum modulation index

R1 = 110;
R2 = 220;
R3 = 470;
R4 = 1000;

Rc = R1 + R2;
Zm = ( (R2*R3*R4)/((R2*R3) + (R3*R4) + (R4*R2)) +
   110);
```

```
Mmax = Zm/Rc;
Mmax1 = Mmax*100;

disp(Mmax1, 'Maximum modulation index (in %)')
```

Chapter 7

Transmission Lines

Scilab code Exa 7.1 Inductance and outer conductor diameter

```
//Determine inductance per meter and outer conductor
    diameter

Z0 = 75;
C = 69e-12;
k = 2.23;
d = 0.584;

L = Z0^2*C;
D = d * 10^(Z0/(138/sqrt(k)));

disp(L, 'Inductance per meter (in H/m)')
disp(D, 'Outer conductor diameter (in mm)')
```

Scilab code Exa 7.2 Minimum value of characteristic impedance

```
//Determine the minimum value that the
   characteristic impedance of an air-dielectric
   parallel-wire line
```

```
Zmin = 276*log10(2*1);

disp(Zmin, 'Min. value that char. impd. of an air-dielectric parallel-wire line is (in ohms)')
```

Scilab code Exa 7.3 Outer conductor diameter

```
//Determine the outer conductor diameter of a coaxial cable

Z0 = 2000;
k = 2.56;
d = 0.025;


D = d * 10^(Z0/(138/sqrt(k)));
D1 = D/1e+6;
D2 = D1/9.44e+12;

disp(D2, 'Outer conductor diameter is (in light years)')
```

Scilab code Exa 7.4 Charactericstic impediance

```
//Determine the charactericstic impediance of the quarter-wave transfomer

Z0 = 200;
Zl = 300;

Z01 = sqrt(Z0*Zl);

```

```
disp(Z01, 'Charactericstic impediance of the quarter-wave transfomer is (in ohms)')
```

Scilab code Exa 7.5 Reactance and characteristic impedance

```
//Determine reactance of the stub and the characteristic impedance of the quater-wave transformer, both connected directly to the load

Z0 = 300;
Zl = 200 + 75*%i;
Bstub = 1.64e-3;

Yl = 1/Zl;
X = -1/Bstub;
Gl = 4.38e-3;
Rl = 1/Gl;

Z01= sqrt(Z0*Rl);

disp(X, 'Reactance of quarter-wave transformer is (in ohms)')
disp(Z01, 'Char. imp. of quarter-wave transformer (in ohms)')
```

Chapter 9

Antennas

Scilab code Exa 9.1 Length of antenna

```
//Determine the length of an antenna

v = 3e+8;
vf = 0.95;
f = 5e+5;

L = (v*vf)/f;
L1 = L*3.9;

disp(L, 'Length of an antenna is (in m)')
disp(L1, 'Length of an antenna is (in feet)')
```

Scilab code Exa 9.2 Power delivered to isotropic antenna

```
//Determine how much power must be delivered to the
    isotropic antenna

A = 2.15;
```

```
P1 = 1000;

P2 = P1*10^(0.1*A);

disp(P2, 'Power must be delivered to the isotropic
   antenna is (in W)')
```

Scilab code Exa 9.3 ERP

```
//Determine the ERP
P0 = 500;
Fgain = 2;

erp = P0*(Fgain^2);

disp(erp, 'Erp (in W)')
```

Scilab code Exa 9.4 Beamwidth

```
//Determine the beamwidth between nulls of a 2-m
   paraboloid reflector

D = 2;
lambda = 0.05;

Phi0 = 2*70*(lambda/D);

disp(Phi0, 'Beamwidth between nulls of a 2-m
   paraboloid reflector (in degres)')
```

Scilab code Exa 9.5 Gain of antenna

```
//Determine the gain of the antenna in previous
   example

D = 200;
lambda = 5;

Ap = 6*((D/lambda)^2);

disp(Ap , 'Gain of the antenna is (in W)')
```

Chapter 10

Waveguides Resonators And Components

Scilab code Exa 10.1 Cutoff frequency of dominant mode

```
//Determine the cutoff frequency of the dominant
   mode

m = 1;
n = 0;
a = 0.051;
b = 0.024;

fc = (1.5e+8)*sqrt((m/a)^2 + (n/b)^2);

disp(fc, 'Cutoff Frequency of the dominant mode is (
   in Hz)')
```

Scilab code Exa 10.2 Lowest frequency

```
//Determine the lowest frequency and also the mode
```

```
closest to the dominant mode for the waveguide in
 previous example

m1 = 0;
n1 = 1;
a1 = 0.051;
b1 = 0.024;

fc1 = (1.5e+8)*sqrt((m1/a1)^2 + (n1/b1)^2);

disp(fc1, 'Cutoff Frequency of the TE10 mode is (in
   Hz)')



m2 = 2;
n2 = 0;
a2 = 0.051;
b2 = 0.024;

fc2 = (1.5e+8)*sqrt((m2/a2)^2 + (n2/b2)^2);

disp(fc2, 'Cutoff Frequency of the TE20 mode is (in
   Hz)')



m3 = 0;
n3 = 2;
a3 = 0.051;
b3 = 0.024;

fc3 = (1.5e+8)*sqrt((m3/a3)^2 + (n3/b3)^2);

disp(fc1, 'Cutoff Frequency of the TE02 mode is (in
   Hz)')
```

Scilab code Exa 10.3 Cutoff wavelength for dominant mode

```
//Determine (a) The cutoff wavelength for the
   dominant mode (b) The wavelength in a waveguide,
   also for the dominant mode (c) The corresponding
   ground and phase velocities

a = 3;
m = 1;
vc = 3e+10;
f = 6e+9;

lambda0 = (2*a)/m;
lambda = vc/f;

rho = sqrt(1 - (lambda/lambda0)^2);

lambdap = lambda/rho;

vg = vc*rho;
vp = vc/rho;

disp(lambda0, 'Cutoff wavelength for the dominant
   mode is (in cm) ')
disp(lambdap, 'Wavelength in a waveguide for the
   dominant mode (in cm) ')
disp(vg, 'Group Velocities (in m/s) ')
disp(vp, 'Phase Velocities (in m/s) ')
```

Scilab code Exa 10.4 Greatest number of half waves

```
//Determine the greatest number of half-waves of electric intensity which it will be possible to establish between the two walls and also determine the guide wavelength for this mode of propagation
vc = 3e+10;
f = 10e+9;
d = 6;
m1 = 1;
m2 = 2;
m3 = 3;
m4 = 4;

lambda = vc/f;

lambda01 = (2*d)/m1;
lambda02 = (2*d)/m2;
lambda03 = (2*d)/m3;
lambda04 = (2*d)/m4;

lambdap = lambda/sqrt(1 - (lambda/lambda03)^2);

disp(lambda, 'Wave which will propagate in the WG (in cm)');
disp(lambda01, 'This mode will propagate (in cm)')
disp(lambda02, 'This mode will propagate (in cm)')
disp(lambda03, 'This mode will propagate (in cm)')
disp(lambda04, 'This mode will not propagate (in cm)')
disp(lambdap, 'Guide wavelength for this mode of propagation (in cm)')
```

Scilab code Exa 10.5 Formula for cutoff wavelength

```
//Determine the formula for the cutoff wavelength in
```

```
a standard rectangular waveguide for the TM11 mode

m = 1;
n = 1;
a = 1;
b = a/2;

lambda0 = 2/sqrt((m/a)^2 + (n/b)^2);

disp('*a', lambda0, 'Formula for the cutoff wavelength in a standard rectangular waveguide for the TM11 mode',)
```

Scilab code Exa 10.6 Characteristic wave impediance

```
//Determine the characteristic wave impediance for the data of Example 10.3 and 10.4

L = 120*%pi;
rho1 = 0.553;
rho2 = 0.661;

Z0a = L/rho1;
Z0b = L/rho2;

disp(Z0a, 'Char. Wave impediance for the data for Ex 10.3 (in ohms)')
disp(Z0b, 'Char. Wave impediance for the data for Ex 10.4 (in ohms)')
```

Scilab code Exa 10.7 Various parameters for TE10 and TM11

```
//Determine the cut-off wavelength, the guide wavelength, the group and phase velocities and the char. wave impediance for (a) the TE10 mode and (b) the TM11 mode

vc = 3e+10;
f = 9e+9;
a = 4.5;
b = 3;
m = 1;
n = 1;
L = 120*%pi;

lambda = vc/f;
lambda0 = (2*a)/m;
rho = sqrt(1 - (lambda/lambda0)^2);
lambdap = lambda/rho;
vga = vc*rho;
vpa = vc/rho;
Z0 = L/rho;

lambda0b = 2/sqrt((m/a)^2 + (n/b)^2);
rhob = sqrt(1 - (lambda/lambda0b)^2);
lambdapb = lambda/rhob;
vgb = vc*rhob;
vpb = vc/rhob;
Z0b = L*rhob;

disp(lambda0, 'Cut-off wavelength for TE10 mode (in cm)')
disp(lambdap, 'Guide wavelength for TE10 mode (in cm)')
disp(vga, 'Group Velocitiy for TE10 mode (in m/s)')
disp(vpa, 'Phase Velocitiy for TE10 mode (in m/s)')
disp(Z0, 'Char. Impediance for TE10 mode (in ohms)')

disp(lambda0b, 'Cut-off wavelength for TM11 mode (in cm)')
```

```
disp(lambdapb, 'Guide wavelength for TM11 mode (in cm)')
disp(vgb, 'Group Velocitiy for TM11 mode (in m/s)')
disp(vpb, 'Phase Velocitiy for TM11 mode (in m/s)')
disp(Z0b, 'Char. Impediance for TM11 mode (in ohms)')
```

Scilab code Exa 10.8 Frequency

```
//Determine the frequency
a = 3;
m = 1;
vc = 3e+10;
L = 120*%pi;
Z0 = 500;

lambda0 = (2*a)/m;
lambda = lambda0*sqrt(1 - (L/Z0)^2);
f = vc/lambda;

disp(f, 'Frequency is (in Hz)')
```

Scilab code Exa 10.9 Various parameters of circular waveguide

```
//Determine the cutoff wavelength, the guide wavelength and the char. wave impediance of a circular waveguide

vc = 3e+10;
f = 10e+9;
r = 2;
kr = 1.84;
L = 120*%pi;
```

```

lambda = vc/f;
lambda0 = (2*%pi*r)/kr;
lambdap = lambda/sqrt(1 - (lambda/lambda0)^2);
Z0 = L/sqrt(1 - (lambda/lambda0)^2);

disp(lambda0 , 'Cutoff wavelength (in cm)')
disp(lambdap , 'Guide wavelength (in cm)')
disp(Z0, 'Char. wave impediance (in ohms)')
```

Scilab code Exa 10.10 Ratio of cross section

```
//Determine the ratio of the cross section of a
   circular waveguide to that of a rectangle

r = 1;
kr = 1.84;


lambda0 = (2*%pi*r)/kr;
a = (3.41*r)/2;
b = a/2;

Ac = %pi*(r)^2;
Ar = a*b;

R = Ac/Ar;

disp(R, 'Ratio of the cross section of a circular
   waveguide to that of a reactangle')
```

Scilab code Exa 10.11 Voltage attenuation

```
//Determine the voltage attenuation provided by a 25
    cm length of waveguide

a = 1;
m = 1;
vc = 3e+10;
f = 1e+9;
A = 25
L0 = 2;

lambda0 = (2*a)/m;
lambda = vc/f;

lambdaDB = 54.5*(A/L0);

disp(lambdaDB, 'Volatage attenuation is (in dB)')
```

Chapter 13

Pulse Communications

Scilab code Exa 13.1 Capacity of 4 Khz telephone channel

```
//Determine the capacity of a standard 4-Khz
   telephone channel

SNR = 10^(32/10);
df = 3400-300;

C = df*log2(1 + SNR);

disp(C, 'capacity of a standard 4-Khz telephone
   channel is (in bits/sec)')
```

Scilab code Exa 13.2 Information carrying capacity

```
//Determine (a) the information-carrying capacity (b
   ) the capacity of the channel if its bandwidth is
    doubled, while the transmitted signal power
   remains constant

```

```
SNR = 10^(28/10);
BW1 = 4000;
BW2 = 8000;

C1 = BW1*log2(1+SNR);
C2 = BW2*log2(1+(SNR/2));

C = C2/C1;

disp(C1, 'Information-carrying capacity is (in bits/sec)');
disp(C2, 'Capacity of the channel if its bandwidth is doubled is (in bits/sec)');
```

Chapter 16

Radar Systems

Scilab code Exa 16.1 Duty cycle of radar

```
//Determine the duty cycle of a radar

PW = 3e-6;
PRT = 6e-3;

Duty = PW/PRT;

disp(Duty, 'Duty cycle of a radar is')
```

Scilab code Exa 16.2 Average power

```
//Determine the average power

PeakP = 100e+3;
Duty = 5e-4;

AvgP = PeakP * Duty;

disp(AvgP, 'Average power is (in W)')
```

Scilab code Exa 16.3 Minimum receivable signal

```
//Determine the minimum receivable signal in a radar receiver

F = 10^(9/10);
k = 1.38e-23;
T0 = 290;
dF = 1.5e+6;

Pmin = k*T0*dF*(F-1);

disp(Pmin, 'Minimum receivable signal in a radar receiver is (in W)')
```

Scilab code Exa 16.4 Maximum range of radar

```
//Determine the maximum range of a radar system

P1 = 5e+5;
A0 = 5;
S = 20;
lambda = 0.03;
Pmin = 1e-13;

Rmax = sqrt(sqrt((P1*A0^2*S)/(4*%pi*lambda^2*Pmin)))
;
Rmax1 = Rmax/1000;

disp(Rmax1, 'Maximum range of a radar system is (in Km)')
```

Scilab code Exa 16.5 Peak transmitted pulse power

```
//Determine the peak transmitted pulse power

dF = 5e+5;
lambda = 3.75e-2;
F = 3;
D = 1;
S = 5;

Pt = (dF*lambda^2*(F-1))/(256*D^4*S);

disp(Pt, 'Peak transmitted pulse power is (in W)')
```

Scilab code Exa 16.6 Maximum range of deep space radar

```
//Determine the maximum range of a deep-space radar

lambda1 = 30/2.5;
lambda = lambda1/100;
Pt = 2.5e+7;
D = 64;
S = 1;
dF = 5e+3;
F = 1.1;

Rmax = 48*sqrt(sqrt(((Pt*D^4*S)/(dF*lambda^2*(F-1)))
   ));

disp(Rmax, 'Maximum range of a deep-space radar is (
   in Km)')
```

Scilab code Exa 16.7 Lowest three blind speeds of radar

```
//Determine the lowest three blind speeds of this
   radar

vc = 3e+8;
f = 5e+9;
PRF = 800;
n = 1;

lambda = vc/f;

vb = PRF*n*lambda;
vb1 = vb*60*60*1e-3;
vb2 = vb1*2;
vb3 = vb1*3;

disp(vb3, vb2, vb1,  'The lowest three blind speeds
   of this radar are (in Km/h)')
```

Scilab code Exa 16.8 Maximum active tracking range

```
//Determine the maximum active tracking range of a
   deep space radar

A0t = 2.09e+3;
PtT = 5e+5;
A0b = 5.1e-1;

lambda = 0.12;
k = 1.38e-23;
T0 = 2.9e+2;;
```

```
dF = 5e+3;
Fb = 20;

RmaxT = sqrt((A0t*PtT*A0b)/(lambda^2*k*T0*dF*(Fb-1))
    );


A0b = 5.1e-3;
Ptb = 50;
A0t = 2.09e+3;

lambda = 0.12;
k = 1.38e-23;
T0 = 2.9e+2;;
dF = 5e+3;
Ft = 1.1;

RmaxR = sqrt((A0b*Ptb*A0t)/(lambda^2*k*T0*dF*(Ft-1))
    );


disp(RmaxT, 'Active tracking range of a deep space
    radar is (in m)')
disp(RmaxR, 'Active tracking range of a deep space
    radar is (in m)')
disp(RmaxR, 'Maximum Active tracking range of a deep
     space radar is (in m)')
```

Scilab code Exa 16.9 Doppler frequency

```
//Determine the Doppler frequency seen by a
    stationary radar

vc = 3e+8;
f = 5e+9;
```

```
lambda = vc/f;
vr = 100e+3/(60*60);

fd = (2*vr)/lambda;

disp(fd, 'Doppler frequency is (in Hz)')
```

Chapter 18

Introduction To Fiber Optic Technology

Scilab code Exa 18.1 Critical angle

```
//Determine the critical angle of incidence between
   two substances with different refractive indexes

n1 = 1.5;
n2 = 1.46;

thetaC = asind((1.46*n2)/(1.5*n1));

disp(thetaC, 'Critical angle is (in degrees)')
```

Scilab code Exa 18.2 Bandwidth

```
//Determine the bandwidth

Tr = 2;

```

```
BW = 0.35/Tr;

disp(BW, 'Bandwidth is (in Ghz)');
```

Scilab code Exa 18.3 Responsivity

```
//Determine the responsivity

uA = 40;
uW = 80;

R = uA / uW;

disp(R, 'Responsivity is (in A/W)')
```