# Scilab Textbook Companion for Electronics Communication by D. Roddy[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

# Chapter 1

# Passive Circuits

**Scilab code Exa 1.2.2** example 2

```
clc;
// page no 5
// prob no 1_2_2
//T-type attenuator provide 6-dB insertion loss
//All resistance are in ohm
Ro=50
ILdB=6
IL=10^-(ILdB/20)
//Determination of R
R=Ro*(1-IL)/(1+IL)
disp('ohm',R,+'The value of resistance R is')
//Determination of R3
R3=(2*Ro*IL)/(1-(0.5)^2)
disp('ohm',R3,+'The value of resistance R3 is')
```

**Scilab code Exa 1.2.3** example 3

```
clc;
```

```
// page no 7
// prob no 1_2_3
//pi-attenuator with 6 dB insertion loss
//output resistance is Ro=50 ohm
//All resistance are in ohm
Ro=50
ILdB=6
IL=10^-(ILdB/20)
//Determination of RA and RB
RA=Ro*(1+IL)/(1-IL);
disp('ohm',RA,+'The value of resistance RA and RB is
    ')
//Determination of RC
RC=Ro*(1-(IL)^2)/(2*IL);
disp('ohm',RC,+'The value of resistance RC is')
```

**Scilab code Exa 1.2.4** example 4

```
clc;
// page no 9
// prob no 1_2_4
//As given in fig. 1.2.4 L-attenuator with source
    resistance Rs=75 ohm and load resistance Rl=50
    ohm
Rs=75; Rl=50;
//Determination of R1
R1=(Rs*(Rs-Rl))^(1/2);
disp('ohm',R1,+'The value of resistance R1 is');
//Determination of R3
R3=((Rs^2)-(R1^2))/R1;
disp('ohm',R3,+'The value of resistance R3 is');
//Determination of insertion loss
IL=(R3*(Rs+R1))/((Rs+R1+R3)*(R3+R1)-(R3)^2)
ILdB=-20*log10(IL);//convertion of power in decibels
disp('dB',ILdB,+'The value of insertion loss is');
```

**Scilab code Exa 1.2.5** example 5

```
clc;
// page no 10
// prob no 1_2_5
//As given in fig. 1.2.4 L-attenuator with source resistance Rs=10 ohm and load resistance Rl=50 ohm
Rs=10; Rl=50;
//Determination of R2
R2=(Rl*(Rl-Rs))^(1/2);
disp('ohm',R2,+'The value of resistance R2 is');
//Determination of R3
R3=((Rl^2)-(R2^2))/R2;
disp('ohm',R3,+'The value of resistance R3 is');
//Determination of insertion loss
IL=(R3*(Rs+Rl))/((Rs+R3)*(R3+R2+Rl)-(R3)^2)
ILdB=-20*log10(IL);//convertion of power in decibels
disp('dB',ILdB,+'The value of insertion loss is');
```

**Scilab code Exa 1.5.1** example 6

```
clc;
// page no 21
// prob no 1_5_1
//Series tuned resonant ckt is given which is tuned at 25 MHz with
//series resistance 5 ohm self capacitance 7 pF and inductance 1 uH
C=7*10^-12;R=5;L=10^-6;f=25*10^6;
//Determination of self resonant freq of coil denoted as Fsr
```

```
Fsr=1/(2*3.14*(L*C)^0.5);
disp('MHz',Fsr/(10^6),+'The value of self resonant freq is');
//Determination of Q-factor of coil,excluding self-capacitive effects
Q=(2*3.14*f*L)/R;
disp(Q,'The value of Q-factor is');
//Determination of effective inductance
Leff=L/(1-(f/Fsr)^2);
disp('uH',Leff*(10^6),+'The value of effective inductance is');
//Determination of effective Q-factor
Qeff=Q*(1-(f/Fsr)^2);
disp(Qeff,'The value of effective Q-factor is');
```

**Scilab code Exa 1.8.1** example 7

```
clc;
// page no 26
// prob no 1_8_1
//High frequency transformer with identical primary and secondary circuits
Lp=150*10^-6;
Ls=150*10^-6;
Cp=470*10^-12;
Cs=470*10^-12;
//Lp=Ls=150 uH,Cp=Cs=470 pF
Q=85//Q-factor for each ckt is 85
c=0.01//Coeff of coupling is 0.01
Rl=5000//Load resistance Rl=5000 ohm
r=75000//Constant current source with internal resistance r=75 kohm
//Determination of common resonant frequency
wo=1/((Lp*Cp)^(1/2));
//disp('Mrad/sec',wo/(10^6),+'The value of common
```

```
    resonant freq is');
p=3.77*10^6;
Z2=Rl/(1+(p*%i*Cs*Rl));
Z1=r/(1+(p*%i*Cp*r));
// At resonance Zs=Zp=Z
Z=wo*Ls*(1/Q +%i);
Zm=%i*p*c*Lp;
// Determination of denominator
Dr=((Z+Z1)*(Z+Z2))-(Zm^2)
// Hence transfer impedance is given as
Zr= (Z1*Z2*Zm)/Dr;
disp('ohm',Zr,'The transfer impedance is');
```

**Scilab code Exa 1.10.1** example 8

```
clc;
// page no 34
// prob no 1_10_1
//From the ckt of fig. 1.10.1(a)
C1=70*10^-12
C2=150*10^-12
Rl=200
Q=150
f=27*10^6
r=40000
//Determination of common resonant freq
wo=2*3.14*f;
disp('Mrad/sec',wo/(10^6),+'The value of common
    resonant freq is');
//Determination of Gl
Gl=1/Rl;
disp('mSec',Gl*(10^3),+'The value of Gl is');
//Checking the approxiamtion in denominator
ap=((wo*(C1+C2))/(Gl))^2
alpha=(C1+C2)/C1;
```

```
disp(alpha,'The value of alpha is ')
//Determination of effective load
Reff=((alpha)^2)*Rl;
disp('kohm',Reff/(10^3),+'The value of effective load is');
//If effective load is much less than internal resistance hence tuning capacitance then
Cs=C1*C2/(C1+C2);
disp('pF',Cs*(10^12),+'The value of tuning capacitance is');
//Determination of Rd
Rd=Q/(wo*Cs);
disp('kohm',Rd/(10^3),+'The value of Rd is');
//If Rd is much greater than Reff then -3dB bandwidth is given by
B=1/(2*3.14*C2*alpha*Rl);
disp('MHz',B/(10^6),+'The value of -3dB BW is');
```

# Chapter 2

# WAVEFORM SPECTRA

**Scilab code Exa 2.13.1** example 1

```
clc;
//page no 74
//prob no. 2.13.1
//A rectangular pulse with h=3V and width=2ms across
    10 ohm resistor
V=3;t=2*10^-3;R=10;
//Determination of average energy
P=(V^2)/R;//Instantaneous power
U=P*t;
disp('J',U,'The average energy is');
```

# Chapter 4

# Noise

**Scilab code Exa 4.2.1** example 1

```
clc;
// page no 120
// prob no 4_2_1
//Resistor at room temp T=290 K with BW=1MHz and R=50 ohm
T=290
BW=1*10^6// Noise bandwidth in hertz
k=1.38*10^-23 //Boltzman constant in J/K
R=50
//Determination of thermal noise power Pn
Pn=k*T*BW;
disp('W',Pn,+'The value of thernal noise power is');
//Determination of RMS noise voltage
En=(4*R*k*T*BW)^(1/2);
disp('uV',En*(10^6),+'The value of RMS noise voltage is');
```

---

**Scilab code Exa 4.2.2** example 2

```
clc;
// page no 122
// prob no 4_2_2
//Two resistor at room temp are given with BW=100KHz
R1=20000
R2=50000
k=1.38*10^-23 //Boltzman constant in J/K
T=290
BW=100*10^3
//Determination of thermal noise voltage for 20Kohm resistor
En1=(4*R1*k*T*BW)^(1/2);
disp('uV',En1*(10^6),+'a)i)The value of RMS noise voltage is');
//Determination of thermal noise voltage for 50 kohm resistor
En2=En1*(R2/R1)^(1/2);
disp('uV',En2*(10^6),+'a)ii)The value of RMS noise voltage is');
//Determination of thermal noise voltage for 20K & 50k resistor in series
Rser=R1+R2// Series combination of R1 & R2
En3=En1*(Rser/R1)^(1/2);
disp('uV',En3*(10^6),+'b)The value of RMS noise voltage is');
//Determination of thermal noise voltage for 20K & 50k resistor in parellel
Rpar=(R1*R2)/(R1+R2)// parallel combination of R1 & R2
En4=En1*(Rpar/R1)^(1/2);
disp('uV',En4*(10^6),+'c)The value of RMS noise voltage is');
```

**Scilab code Exa 4.2.3** example 3

```
clc;
// page no 128
// prob no 4_2_3
//Parallel tuned ckt tuned at resonant freq f=120
    MHz
f=120*10^6;
c=25*10^-12;//capacitance of 12 pF
Q=30;//Q-factor of the ckt is 30
BW=10*10^3;//cahnnel BW of the receiver is 10 KHz
k=1.38*10^-23 //Boltzman constant in J/K
T=290;//Room temp
//Determination of effective noise voltage Rd
    apearing at i/p at room temp
 Rd=Q/(2*%pi*f*c);
 disp('kohm',Rd/1000,'The value of Rd is ');
 Vn=(4*Rd*k*T*BW)^(1/2);
disp('uV',Vn*(10^6),'The value of effective noise
    voltage is');
```

**Scilab code Exa 4.3.1** example 4

```
clc;
// page no 131
// prob no 4_3_1
//Direct current of 1 mA flowing across
    semiconductor junctn
Idc=10^-3;
Bn=10^6;//Effective noise BW=1 MHz
q=1.6*10^-19;//Charge on electron in coulombs
//Determination of noise component current In in DC
    current of Idc=1 mA
In=(2*Idc*q*Bn)^(1/2);
disp('nA',In*(10^9)','The value of noise current In
    is ')
```

**Scilab code Exa 4.11.1** example 5

```
clc;
// page no 135
// prob no 4_11_1
//An amplifier is given
Rn=300;//Equivalent noise resistance
Ieq=5*10^-6;//Equivalent noise current is 5 uA
Rs=150;//Amplifier fed from 150 ohm,10 uV rms sinusoidal source
Vs=10*10^-6;
Bn=10*10^6;//Noise BW is 10 MHz
//Assume the following
kT=4*10^-21;//k is Boltzman constant in J/K & T is room temp
q=1.6*10^-19;//Charge on electron in coulombs
//Determination of shot noise current
Ina=(2*q*Ieq*Bn)^(1/2);
disp('nA',Ina*(10^9)','The value of shot noise current Ina is ');
//Noise voltage developed by this across source resistance is
V=Ina*Rs;
disp('uV',Vs*(10^6)','The value of noise voltage across Rs is ');
//Noise voltage developed across Rn resistance is
Vna=(4*Rn*kT*Bn)^(1/2);
disp('uV',Vna*(10^6)','The value of noise voltage across Rn is ');
//Determination of thermal noise voltage from source
Vns=(4*Rs*kT*Bn)^(1/2);
disp('uV',Vns*(10^6)','The value of thermal noise voltage at Rs is');
//Determination of total noise voltage at input
```

```
Vn=(((V)^2)+((Vna)^2)+((Vns)^2))^(1/2)
disp('uV',Vn*(10^6)','The value of total noise voltage Vn is ');
//Determination of signal to noise ratio in dB
SNR=20*(log10(Vs/Vn));
disp('dB',SNR,'The value of signal to noise ratio is ');
```

**Scilab code Exa 4.12.1** example 6

```
clc;
// page no 136
// prob no 4_12_1
//As shown in fig 4.12.1
//Three identical links are given with for 1 link is SNR=60 dB
SNR1=60;
l=3;
//Determination of output signal to noise ratio
SNR=(SNR1)-10*log10(l);
disp('dB',SNR,'The value of output signal to noise ratio is ');
```

**Scilab code Exa 4.12.2** example 7

```
clc;
// page no 137
// prob no 4_12_2
//SNR for three links is given in which Ist two have SNR 60 db & IInd 40 dB
SNRdB(1)=60;//SNR is 60 dB for Ist link
SNRdB(2)=60;//SNR is 60 dB for IInd link
SNRdB(3)=40;//SNR is 40 dB for IIIrd link
```

```
//Determination of power in watt
for i=1:3
snr(i)=10^(-SNRdB(i)/10);
end;
//Determination of overall SNR
for i=1:3
SNR=snr(i);
end;
//Determination of total SNR in dB
SNRdB=10*(-log10(SNR));
disp('dB',SNRdB,'The value of output signal to noise ratio is ');
```

**Scilab code Exa 4.13.1** example 8

```
clc;
// page no 139
// prob no 4_13_1
//Noise fig. of an amplifier is 7 dB with input SNR =35 dB
SNRin=35;//SNR at i/p of amplifier
F=7;//Noise figure of an amplifier
//Determination of output SNR
SNRout=SNRin-F;
disp('dB',SNRout,'The value of output signal to noise ratio is ');
```

**Scilab code Exa 4.14.1** example 9

```
clc;
// page no 140
// prob no 4_14_1
//Noise fig. of an amplifier is 13 dB with BW=1MHz
```

```
f=13;//Noise figure of an amplifier
Bn=1*10^6;
kT=4*10^-21;//k is Boltzman constant in J/K & T is
    room temp
F=10^(f/10);
//Determination of equivalent amplifier input noise
Pna=(F-1)*kT*Bn;
disp('pW',Pna*10^12,'The value of input noise is');
```

**Scilab code Exa 4.15.1** example 10

```
clc;
// page no 141
// prob no 4_15_1
//mixer with noise fig. 20dB preceded by amplifier
    with noise fig. 9dB is given
f1=9;//Noise fig for amplifier
f2=20;//Noise fig for mixer
g=15;//power gain
//Converting dB in power ratio
F1=10^(f1/10);
F2=10^(f2/10);
G=10^(g/10);
//Determination of overall noise fig. reffered at i/
    p
F=F1+(F2-1)/G;
//converting in dB
FdB=10*log10(F);
disp('dB',FdB,'The overall noise fig is');
```

**Scilab code Exa 4.17.1** example 11

```
clc;
```

```
// page no 143
// prob no 4_17_1
//An attenuator is given with insertion loss of 6 dB
//Noise fig is equivalent to insertion loss
F=6;//Noise fig.=6 dB
//Determination of noise factor
Fn=10^(6/10);
disp(Fn,'The value of noise factor is ');
```

**Scilab code Exa 4.18.1** example 12

```
clc;
// page no 144
// prob no 4_18_1
//A receiver with noise fig. 12dB fed by low noise
   amplr with gain  50 dB with noise temp of 90 k
f=12;
Tm=290;//Room temp value
T=90;
g=50;
//calculating power ratio
F=10^(f/10);
G=10^(g/10);
//Determination of equivalent noise at room temp
Tem=(F-1)*Tm;
disp('K',Tem,'The value of equivalent noise at room
   temp is');
//Determination of equivalent noise at 90 k temp
Te=T+(Tem/G);
disp('K',Te,'The value of equivalent noise at noise
   temp=90 is');
```

**Scilab code Exa 4.19.1** example 13

```
clc;
// page no 146
// prob no 4_19_1
//An avalanche diode source is given with excess
   noise ratio is 14 dB
enr=14;
To=290;//Room temp in K
y=9;//Y-factor  is 9 dB
//converting dB in power ratio
ENR=10^(enr/10);
Y=10^(y/10);
//From def of ENR the hot temp is
Th=To*(ENR+1);
disp('K',Th,'The value of hot temp Th is ');
//Determination of equivalent noise temp
Te=(Th-(Y*To))/(Y-1);
disp('K',Te,'The value of equivalent noise temp Te
   is ');
```

# Chapter 5

# TUNED SMALL SIGNAL AMPLIFIERS MIXERS AND ACTIVE FILTERS

**Scilab code Exa 5.4.1** example 1

```
//page no 162
// problem no 5.4.1
//Resonating freq of a tuned ckt of a CE amplifier
   is 5MHz
f=5*10^6;
c=100*10^-12;//tuning capacitance in F
Q=150;// Q-factor of the ckt
Rl=5*10^3;//load resistance in ohm
Rc=40*10^3;//o/p reistance of transistor
Ic=500*10^-6;//transister collector current in A
C=0.6*10^-12;//collector to base capacitance in F
Vt=26*10^-3;//thermal voltage in V
//transe conductance is given as
gm=Ic/Vt;
RD2=Q/(2*%pi*f*c);
// At resonance the output admittance is purely
   conductive and is given as
```

```
Yo=(1/Rc)+(1/RD2)+(1/Rl);
//The voltage gain is given as
Av=-(gm/Yo);
disp(Av,'The voltage gain is');
//The Millar capacitance is given as
Cm=(1-Av)*C;
disp('pF',Cm*10^12,'The Millar capacitance is');
```

**Scilab code Exa 5.4.2** example 2

```
clc;
//page no 163
// problem no 5.4.2
//Resonating freq of a tuned ckt of a CE amplifier
   is 5MHz
f=5*10^6;//in Hz
w0=2*%pi*f;
Q=100;//Q-factor of the ckt
L=2*10^-6;//inductance expressed in H
Rs=1000;//source resistance in ohm
Ic=500*10^-6;//transister collector current in A
Vt=26*10^-3;//thermal voltage in V
hfe=200;
C_be=10*10^-12;//in pF
// refer to problem 5.4.1
Av=78;
Cm=47;
gm=Ic/Vt;
r_be=hfe/gm;
// The dynamic resistance of the tuned ckt is
RD1=Q*w0*L;
//The effective dynamic conductance is
RD1eff_1=(1/Rs)+(1/RD1)+(1/r_be);
RD1_eff=1/RD1eff_1
// Tha effective Q-factor is
```

```
Qeff=RD1_eff/(w0*L);
disp(Qeff,'The effective Q-factor is');
// The voltage gain refered to source is
Avs=RD1_eff*Av/Rs;
disp(Avs,'The voltage gain is');
```

# Chapter 6

# Oscillators

**Scilab code Exa 6.3.1** example 1

```
clc;
//page no 199
// prob no 6.3.1
// RC phase shift scillator
// In the given problem small-signal o/p resistance
    Rc=40kohm
// collector bias resistor , rc=10kohm,f=400 Hz;
// all resistances are in Kohm and freq in Hz
f=400;rc= 10; Rc= 40;
// Minimum value of beta is given by Bomin= 23+(4*Ro
    /R)+(29*R/Ro)
// For minimum beta Ro/R=2.7, we represent Ro/R=b
b=2.7;
Bomin=23+(4*b)+(29*1/b);
disp(Bomin,'1.The minimum value of beta is');
//Determination of R and C components
//R0 is given by (rc*Rc)/(rc+Rc)
R0=(rc*Rc)/(rc+Rc);
R=2.7* R0;
disp('Kohm',R,+'2.The value of resistor R=');
c=1/(2*%pi*f*R*sqrt(6+(4*b))*10^9;
```

```
disp('pF',c,+'3.The value of capacitor is ');
```

**Scilab code Exa 6.3.2** example 2

```
clc;
// page no 200
// prob no 6.3.2
// RC phase shift oscillator
// all resistors are in Kohm
f=800;R0=18;
// R>>Ro should be chosen to minimize the effect of Ro on frequency. A number of values for R can be tried , and it will be found that R=100Kohm is reasonable.
R=100;
c=1/(2*%pi*f*R*sqrt(6+(4*R0/R)))*10^9;// C in pF
disp('pF',c,+'The value of capacitor is ');
```

**Scilab code Exa 6.3.3** example 3

```
clc;
// page no 201
// prob no 6_3_3
// RC pase shift oscillator
// All resistors are in Kohm
f=1000; Ro=5;
//Choose R>> R0 to minimize the effects of R0 on frequency. Select R=100kohm
R=100;
c=1/(2*%pi*f*R*sqrt(6+(4*R0/R)))*10^9;
disp('pF',c,+'The value of capacitor is ');
// The required open -circuit voltage gain is
Ao= 29+23*(Ro/R)+4*(Ro/R)^2;
```

```
disp(Ao,'1.The required open -circuit voltage gain
    is');
gm=Ao/Ro;
disp('mS',gm,+'2.The value of gm is');
```

**Scilab code Exa 6.4.1** example 4

```
clc;
// page no 205
// prob no 6_4_1
// colpitt's oscillator
L=400*10^-6;// in H
c1= 100;// in pF
c2= 300;// in pF
Q=200;
Ro= 5*10^3;
Bo=100;//beta value
// The tuning capacitance is
Cs=(c1*c2/(c1+c2));
disp('pF',Cs,+'1.The value of capacitor is ');
//  the frequency of oscillation is obtained as
f=1/(2*%pi*sqrt(L*Cs*10^-12));
disp('Hz',f,'2.The frequency of oscillation is');
// The dynamic impedence of the tuned circuit
wo= 2*%pi *f;
Rd=Q/(wo*Cs*10^-12);
disp('ohm',Rd,+'3.The dynamic impedence of the tuned
     circuit');
// The coil series resistance is
r=wo*L/Q;
disp('ohm',r,+'4.The coil series resistance is ');
//The capacitor raio c= c1/c2=1/3, and therefore 1-
    c2/B0*c1 = 1 .
// The starting value of gm is therefore given by
c= c1/c2;
```

```
gm=(1/Ro)*c +(c+3+2)*(1/Rd);
disp('sec',gm,+'5.The value of gm is');
// Assuming the input resistance is that of the
    transistor alone,
R1=Bo/gm;
disp('ohm',R1,+'6.The input resistance is');
//The actual starting frequency is obtained from wo
    ^2=(1/LCs)+(1/R1R2C1C2)
wo2=1/((L*Cs*10^-12)+(1/R1*Ro*c1*c2*10^-12*10^-12));
wo=sqrt(wo2);
// Hence the frequency is
f=wo/(2*%pi);
disp('Hz',f,'7.The frequency of oscillation is');
```

**Scilab code Exa 6.6.1** example 5

```
clc;
// page no 211
// prob no 6.6.1
//In given problem zero bias capacitance co is 20pF
Co=20;// in pF
Vd=-7;// reverse bias voltage in volt
//constant pottential of junction is 0.5
a=0.5;// for abrupt junction
Cd=Co/(1-(Vd/0.5))^a;
disp('pF',Cd,+'The value of capacitor is ');
```

**Scilab code Exa 6.6.2** example 6

```
clc;
// page no 212
// prob no 6.6.2
//Voltage controlled Clapp oscillator
```

```
// Capacitor is in pF and inductor in uH
C1=300; C2=300; Cc=20; L=100;
// A) With zero applied bias ,the total tuning
    capacitor is
Vd1=0;a=0.5;Co=20;
Cd1=Co/(1-(Vd1/0.5))^a;
Cs1=1/((1/C1)+(1/C2)+(1/Cc)+(1/Cd1));
disp('pF',Cs1, +'1.The total tuning capacitor is');
// The frequency of oscillation is
f=1/(2*%pi*sqrt(L*10^-6*Cs1*10^-12));
disp('Hz',f,'2.The frequency of oscillation is');
// B) With a reverse bias of -7 v, the tuning
    capacitance becomes
Vd2=-7;
Cd2=Co/(1-(Vd2/0.5))^a;
Cs2=1/((1/C1)+(1/C2)+(1/Cc)+(1/Cd2));
disp('pF',Cs2, +'3.The total tuning capacitor is');
// The frequency of oscillation is
f=1/(2*%pi*sqrt(L*10^-6*Cs2*10^-12));
disp('Hz',f,'4.The frequency of oscillation is');
```

# Chapter 7

# RECEIVERS

**Scilab code Exa 7.3.1** example 1

```
clc;
//page no 227
//prob no. 7.3.1
//An RF receiver tunes signal in 550-1600kHz with IF
    =455kHz
fs_min=550*10^3;fs_max=1600*10^3;IF=455*10^3;
//Determination of freq tuning ranges
fo_min=fs_min+IF;
fo_max=fs_max+IF;
disp('Hz',fo_max,'fo_max=','Hz',fo_min,'fo_min=','
    The freq tuning range is');
Rf=(fo_max)/(fo_min);//calculation of freq tuning
    range ratio
disp(Rf,'Rf=','The tuning range ratio of oscillator
    is');
Rc=Rf^2;//calculation of capacitance tuning range
    ratio
disp(Rc,'Rc=','The capacitor tuning range ratio of
    oscillator is');
//For RF section
Rf1=fs_max/fs_min;
```

```
disp(Rf1,'Rf=','The tuning range ratio of RF-ckt is'
    );
Rc1=Rf1^2;
disp(Rc1,'Rc','The capacitor tuning range ratio of
    RF-ckt is');
```

**Scilab code Exa 7.4.1** example 2

```
clc;
//page no 230
//prob no. 7.4.1
//Refer example 7.3.1
//2-tuning capacitor with max 350pF/section ^
    capacitance ratio in eg. 7.3.1
Rco=8.463;Rfo=2.909;Rcs=4.182;Rfo=2.045;fo_max
    =2055*10^3;fo_min=1005*10^3;
Cs_max=350*10^-12;
//For the RF section
Cs_min=Cs_max/Rcs;
disp('F',Cs_min,'The Cs_min is');
```

**Scilab code Exa 7.6.1** example 3

```
clc;
//page no 234
//prob no. 7.6.1
// An AM broadcast receiver with following
    specifications is given
IF=465;//IF in KHz
fs=1000;//Tuning freq in KHz
Q=50;//Quality factor
// Oscillator freq fo is given as
fo=fs+IF;
```

```
// a) Image freq is given as
fi=fo+IF;
disp('KHz',fi,'Image freq is');
y=fi/fs - fs/fi;
// b) image rejection is given as
Ar=1/sqrt(1+(y*Q)^2);
Ar_dB=20*log10(Ar);
disp('dB',Ar_dB,'Image rejection is');
```

**Scilab code Exa 7.7.1** example 4

```
clc;
//page no 236
//prob no. 7.7.1
// refer to example 7.3.1
// A broadcast receiver is tuned to a signal with
fs=950;//in KHz
IF=455;//in KHz
m=[1,2];
n=[1,2];
f0=fs+IF;
disp('The sum of frequencies are');
for i=1:1:2
    for j=1:1:2
fu1=n(j)/m(i) *f0 + 1/m(i) *IF;
disp(fu1);
end
end
disp('The difference of frequencies are');
for i=1:1:2
    for j=1:1:2
fu2=n(j)/m(i) *f0 - 1/m(i) *IF;
disp(fu2);
end
end
```

# Chapter 8

# AMPLITUDE MODULATION

**Scilab code Exa 8.3.1** example 1

```
clc;
//page no 257
//prob no. 8.3.1
//A modulating signal with zero dc component & vpp
   =11,vcp=10 carrier peak voltage
vpp=11;//peak to peak voltage of modulating signal
vcp=10;//carrier peak voltage
//Determination of modulation index
E_max=vcp+(vpp/2);
E_min=vcp-(vpp/2);
m=(E_max-E_min)/(E_max+E_min);
disp(m,'The modulation index is');
//determination of kratio of side lengths
L1_L2=E_max/E_min;
disp(L1_L2,'The ratio of side lengths L1/L2 is');
```

**Scilab code Exa 8.5.1** example 2

```
clc;
//page no 260
//prob no. 8.5.1
//A carrier with fc=10MHz & vp=10V modulated with fm=5kHz & Vm=6V
fc=10*10^6;//Carrier freq
fm=5*10^3;//Modullating freq
vp=10;vm=6;
//Determination of modulation index
m=vm/vp;
disp(m,'The modulation index is');
```

**Scilab code Exa 8.7.1** example 3

```
clc;
//page no 263
//prob no. 8.7.1
//AM radio Tx=10A when unmodulated & 12A when modulated
I=12;Ic=10;
//Determination of modulation index
m=sqrt(2*(((I/Ic)^2)-1));
disp(m,'The modulation index is');
```

**Scilab code Exa 8.11.1** exampple 4

```
clc;
//page no 274
//prob no. 8.11.1
//RC load ckt for diode detector with c=1000pF in paralel with R=10Kohm
fm=10*10^3;//modulation freq
c=1000*10^-12;R=10*10^3;
```

```
Yp=(1/R)+((%i)*2*(%pi)*fm*c);//admittance of RC load
disp(Yp);
Zp=1/sqrt((real(Yp)^2)+(imag(Yp)^2));
disp(Zp);
//Determination of max modulation index
m=Zp/R;
disp(m,'The max modulation index is');
```

# Chapter 9

# SINGLE SIDEBAND MODULATION

**Scilab code Exa 9.2** example 1

```
clc;
// page no 349
// prob no 9.2
Nd=7; N_start=1; N_stop=1; N_parity=1;
Nt= Nd + N_start+ N_stop + N_parity;
efficiency=Nd/Nt *100;
disp('%',efficiency,'The efficiency is');
```

**Scilab code Exa 9.6** example 2

```
clc;
// page no 358
// prob no 9.6
m=21;
// The correct number of check bits is the smallest
   number that satisfy the equation 2^n >= m+n+1;
```

```
for n=1:1:10 // we choose range of 1 to 10
    a=m+n+1;
    b=2^n;
    if(b>=a)
        disp(n,'hammming bits are required')
        break;
    end
end
```

# Chapter 10

# Angle Modulation

**Scilab code Exa 10.12.1** example 1

```
clc;
//page no 343
//problem no 10.12.1
p=10;t=0.3*10^-6;gm=2*10^-3;
q=1/p;f_max=q/(2*%pi*t);
Z2=p/gm;
R2=Z2;//Z2 is resistance
//Determination of equivalent tuning capacitance
C1=t/R2;
Ceq=gm*t;
disp('f',Ceq,'The equivaent tuning capacitance is');
```

**Scilab code Exa 10.13.1** example 2

```
clc;
//page no 349
//problem no 10.13.1
del_phi_d=12;f_min=100;del_f_max_allow=15000;
```

```
del_phi_rad=(12*%pi)/180;
del_f_max=del_phi_rad*f_min;
//Determination of freq deviation
N=del_f_max_allow/del_f_max;
l=del_f_max*729;//using six tripler
f=0.1*729;
//Determination of signal oscillator signal
fo=152-f;
disp('MHz',fo,'fo is best obtained by using two
    tripler');
```

# Chapter 11

# PULSE MODULATION

**Scilab code Exa 11.3.1** example 1

```
clc;
//page no 392
//prob no. 11.3.1
//PCM system with SNR=40dB & rms peak ratio=-10
SNR=40;
//a)Determination of no. of bits/code
n=(SNR-(10*log10(3))-(-10))/(20*log10(2));
disp(n,'The no. of bits per code word is');
disp('Rounded off ','=8');
```

**Scilab code Exa 11.3.2** example 2

```
clc;
//page no 393
//prob no. 11.3.2
//A telephone signal wih cut off freq=4kHz digitzed
   into 8-bit at nyquist sampling rate fs=2W
q=1;W=4*10^3;n=8;
```

```
//a)Determination of Tx Bandwidth
B=(1+q)*W*n;
disp('Hz',B,'a)The transmission BW is');
//b)Determination of quantization S/N ratio
SN_dB=6*n;
disp('dB',SN_dB,'b)The quantization S/N ration is');
```

# Chapter 12

# DIGITAL COMMUNICATIONS

**Scilab code Exa 12.4.1** example 1

```
clc;
//page no 419
// problem no 12.4.1
//a binary polar waveform with following
   specifications are given
Vs_Vn=4;//SNVR
a=erf(4/sqrt(2));
b=erfc(4/sqrt(2));
Pbe=1/2 * b;// bit error probability
disp(a);
disp(b);
disp(Pbe,'The bit error probability');
```

**Scilab code Exa 12.4.2** example 2

```
clc;
```

```
//page no 420
//problem no 12.4.2
//a binary unipolar waveform with following
    specifications are given
A=4;//max value of received signal voltage
Vn=0.5;//rms noise voltage
Vth=2;//Threshold voltage for the comparator
Pbe=1/2 * b;// bit error probability
disp(Pbe,'The bit error probability');
```

**Scilab code Exa 12.4.3** example 3

```
clc;
//page no 421
//problem no 12.4.3
SNR=9;//SNR in dB
//conversion of dB to power ratio
p=10^(9/10);
// for Polar
Pbe1=1/2 * erfc(sqrt(7.94/2));
disp(Pbe1);
// for Unipolar
Pbe2=1/2 * erfc(sqrt(7.94)/2);
disp(Pbe2);
```

**Scilab code Exa 12.5.1** exampple 4

```
clc;
//page no 423
//problem no 12.5.1
// binary unipolar signal is given
Pavg=6*10^-12;//in W
d=0.02*10^-6;//pulse duration in sec
```

```
T=550;//equivalent noise temp in K
Eb=Pavg*d;//avg energy per pulse
No=1.38*10^-23 *T;
r=Eb/No;
//Bit error probability is
Pbe=1/2 * erfc(sqrt(r/2));
disp(Pbe,'The bit error probability');
```

**Scilab code Exa 12.9.1** example 5

```
clc;
//page no 435
//problem no 12.9.1
ENR=10;// energy to noise density ratio
Pbe1=1/2 * erfc(sqrt(ENR/2));
disp(Pbe1,'a)The bit error probability');
Pbe2=1/2 * %e^-(ENR/2);
disp(Pbe2,'b)The bit error probability');
```

**Scilab code Exa 12.13.1** example 7

```
clc;
//page no 451
//problem no 12.13.1
//A 8 bit codewords
Pbec=0.01;n=8;i=3;
Pi=(Pbec^i)*((1-(Pbec))^(n-i));
Cin=(factorial(n))/(factorial(i)*factorial(n-i));
Pin=Cin*Pi;
P_in=Cin*Pbec^i
disp(Pin,'Pin=','The probability of a received
    codeword');
disp(P_in,'P_in');
```

**Scilab code Exa 12.13.3** example 6

```
clc;
//page no 454
//problem no 12.13.3
SN_dB=9;
SNR=10^(SN_dB/10);
PbeU=1/2 * (1-erf(sqrt(SNR)));
BERu=PbeU;
disp(BERu,'a)The bit error probability');
n=10;k=n-1;
r=k/n;
SNR1=r*SNR;
PbeC=1/2 * (1-erf(sqrt(SNR1)));
BERc=(n-1)*PbeC^2;
disp(BERc,'b)The bit error probability');
```

**Scilab code Exa 12.13.4** example 9

```
clc;
//page no 457
//problem no 12.13.4
//Tx link
SN_dB=8;
SNR=10^(SN_dB/10);
//a)Determination of bit error rate
PbeU=0.5*(1-erf(sqrt(SNR)));
BER_U=PbeU;
disp(BER_U,'a)The bit-error rate is');
//b)new bit error rate
n=15;k=11;t=1;r=k/n;
```

```
SNR_n=r*SNR;
PbeC=0.5*(1-erf(sqrt(SNR_n)));
BER_C=((factorial(n-1))*PbeC^(t+1))/((factorial(t))
    *(factorial(n-t-1)));
disp(BER_C,'The new bit error rate is');
```

# Chapter 13

# TRANSMISSION LINES AND CABLES

**Scilab code Exa 13.5.2** example 1

```
clc;
//page no 475
//prob no. 13.5.2
// The attenuation coeff is 0.0006 N/m
a=0.0006;//The attenuation coeff in N/m
//a)Determinaion of the attenuation coeff in dB/m
a_dB=8.686*a;
disp('dB/m',a_dB,'The attenuation coeff is');
//b) Determination of attenuation coeff in dB/mile
k=1609;//conversion coeff for meter to mile
a_dB_mile=k*a_dB;
disp('dB/mile',a_dB_mile,'The attenuation coeff is')
    ;
```

**Scilab code Exa 13.10.1** example 2

```
clc;
//page no 485
//prob no. 13.10.1
// Measurements on a 50 ohm slotted line gave
Z0=50;//measured in ohm
VSWR=2.0;
d=0.2;//distance from load to first minimum
T=(VSWR-1)/(VSWR+1);
pi=180;
Ql=pi*(4*0.2-1);
// using Euler's identity
e=cosd(Ql)+%i*sind(Ql);// expansion for e^(jQl);
a=T*e;
//Load impedance is given as
ZL=Z0*(1+a)/(1-a);
disp('ohm',real(ZL),'a) The equivalent  series resistance is');
disp('ohm',imag(ZL),'The equivalent  series reactance is');
disp('The minus sign indicate the capacitive reactance');
Yl=1/ZL;
disp('ohm',1/real(Yl),'b) The equivalent  parallel resistance is');
disp('ohm',1/imag(Yl),'The equivalent  parallel reactance is');
```

**Scilab code Exa 13.11.1** example 3

```
clc;
//page no 488
//prob no. 13.11.1
d=0.1;//length of 50ohm short-circuited line
Z0=50;//in ohm
f=500*10^6;//freq in Hz
```

```
pi=180;
Bl=2*pi*d;
//a)Determination of equivalent inductive reactance
Z=%i*Z0*tand(Bl);
disp('ohm','i',Z,'The equivalent inductive reactance
    is');
//b)Determination of equivalent inductance
L_eq=Z/(2*%pi*f);
disp('nH',L_eq*10^9,'The equivalent inductance is');
```

**Scilab code Exa 13.17.1** example 4

```
clc;
//page no 513
//prob no. 13.17.1
VSWR=2;l_min=0.2;Z0=50;
Ql=((4*l_min )- 1)*%pi;
tl=(VSWR-1)/(VSWR+1);
Tl=tl*%e^(%i*Ql);
Zl=Z0*(1+Tl)/(1-Tl);
disp('ohm',real(Zl),'a) The equivalent  series
   resistance is');
disp('ohm',imag(Zl),'The equivalent  series
   reactance is');
disp('The minus sign indicate the capacitive
   reactance');
Yl=1/Zl;
disp('ohm',1/real(Yl),'b) The equivalent  parallel
   resistance is');
disp('ohm',1/imag(Yl),'The equivalent  parallel
   reactance is');
```

**Scilab code Exa 13.17.2** example 5

```
clc;
//page no 514
//prob no. 13.17.2
// A transmission line is terminated with
ZL=30-(%i*23);
l=0.5;//// length of line in m
Z0=50;//characteristic impedance in ohm
wl=0.45;//wavelength on the line in m
B=2*%pi/wl;
Tl=(ZL-Z0)/(ZL+Z0)
VI=1;//reference voltage in volt
VR=VI*Tl;
Vi=VI*%e^(%i*B*l);
Vr=VR*%e^-(%i*B*l);
V=Vi+Vr;
I=(Vi-Vr)/Z0;
Z=V/I;
disp('ohm',Z,'The input impedance is');
```

**Scilab code Exa 13.17.3** example 6

```
clc;
//page no 515
//prob no. 13.17.3
Z0=600;Zl=73;//in ohm
F=0.9;
QF=(2*%pi*F)/4;
//For matching, the effective load impedance on the
   main line must equal the characteristic impedance
    of the mail line
Zl1=Zl;
Z01=sqrt(Zl1*Zl);
Tl=(Zl-Z01)/(Zl+Z01);
VI=1;//reference voltage
Vi=VI*%e^(%i*QF);
```

```
Vr=Tl*VI*%e^-(%i*QF);
V_in=Vi+Vr;
I_in=(Vi-Vr)/Z01;
Z_in=V_in/I_in;
disp('ohm',Z_in,'The input impedance is');
//the voltage reflection coeff is
TL_F=(Z_in-Z0)/(Z_in+Z0);
//the VSWr is given as
VSWR_F=(1+TL_F)/(1-TL_F);
disp(VSWR_F,'The VSWR is');
```

# Chapter 14

# WAVEGUIDES

**Scilab code Exa 14.2.1** example 1

```
clc;
//page no 524
//prob no. 14.2.1
// A rectangular waveguide has a broad wall
   dimension as a=0.900 in. Therefore
a=2.286;//in cm
wl_c=2*a*10^-2;//in m
c=3*10^8;
wl=c/10^10;//in m
if(wl_c >wl)
    disp('i)TE10 wave will propogate');
else
    disp('i)TE10 wave will not propogate');
end
//determination of gide wl
wl_g=wl/(sqrt(1-(wl/wl_c)^2));
disp('cm',wl_g*10^2,'Guide wavelength is');
//determination of phase velocity
vp=c*wl_g/wl;
disp('m/s',vp,'Phase velocity is');
//determination of group velocity
```

```
vg=c*wl/wl_g;
disp('m/s',vg,'Group velocity is');
```

# Chapter 15

# RADIO WAVE PROPOGATION

**Scilab code Exa 15.2.1** example 1

```
clc;
//page no 538
//prob no. 15.2.1
// satellite communication system is given
ht=36000;//height of satellite in km
f=4000;//freq used in MHz
Gt=15;//transmitting antenna gain
Gr=45;//receiving antenna gain
// A) Determination of free-space transmission loss
L=32.5+20*log10(ht)+20*log10(f);
disp('dB',L,'The free-space transmission loss is');
// B) Determination of received power Pr
Pt=200;//transmitted power in watt
Pr_Pt=Gt+Gr-L;//power ration in dB
Pr_Pt_watt=10^(Pr_Pt/10);//power ratio in watts
//Therefore
Pr=Pt*Pr_Pt_watt;
disp('watts',Pr,'The received power');
```

**Scilab code Exa 15.2.2** example 2

```
clc;
//page no 539
//prob no. 15.2.2
// In the given problemhalf dipole antenna is given
Pr=10;//radiated power in watt
f=150;//freq used in MHz
d2=50;//distance of dipole in km
//we know for the half dipole the maximum gain is
   1.64:1,and the effectie length is wl/pi.
   Therefore open-ckt voltage induced is given as
Vs=sqrt(30*Pr*1.64)/(d2*10^3)*2/%pi;
disp('uV',Vs*10^6,'The open-ckt voltage induced is '
   );
```

---

**Scilab code Exa 15.3.1** example 3

```
clc;
//page no 545
//prob no. 15.3.1
// VHF mobile radio system is given
Pt=100;//transmitted power
f=150;//freq used in MHz
d1=20;//height of transmitting antenna in m
Gt=1.64;//transmitting antenna gain
ht=2;//height of receiving antenna in m
d2=40;// distance in km
wl=c/(f*10^6);
E0=sqrt(30*Pt*Gt)
// Field strength at a receiving antenna is
ER=(E0*4*%pi*d1*ht)/(wl*(d2*10^3)^2);
```

```
disp('uV/m',ER*10^6,'Field strength at a receiving
    antenna is');
```

**Scilab code Exa 15.3.2** example 4

```
clc;
//page no 548
//prob no. 15.3.2
ht1=100;ht2=60;//antenna heights in ft
dmax_miles=sqrt(2*ht1)+sqrt(2*ht2);
disp('miles',dmax_miles,'The maximum range is');
```

**Scilab code Exa 15.4.1** example 5

```
clc;
//page no 560
//prob no. 15.4.1
ht=200;//virtual height in km
a=6370;//in km
B_degree=20;
B_rad=20*%pi/180;//angle of elevation in degree
// The flat-earth approximation gives
d=2*ht/tand(B_degree);
disp('km',d,'d=');
// By using radian measures for all angles
d=2*a*(((%pi/2)-B_rad)-(asin(a*cosd(B_degree)/(a+ht)
    )));
disp('km',d,'d=');
```

**Scilab code Exa 15.7.1** example 6

```
clc;
//page no 574
//prob no. 15.7.1
// In this problem data regarding the sea water is given
conductivity = 4;//measured in S/m
rel_permittivity =80;
u=4*%pi*10^-7;
f1=100;//measured in Hz
f2=10^6;//measured in Hz
// A) first it is necessary to evaluate the ratio of conductivity/w*rel_permittivity
w1=2*%pi*f1;
r=conductivity/w1*rel_permittivity;
//after the calculation this ratio is much greater than unity. Therefore we have to use following eq to calculate the attenuation coeff as
a=sqrt(w1*conductivity*u/2);
disp('N/m',a,'The attenuation coeff is');
// By using the conversion factor 1N=8.686 dB
a_dB=a*8.686;
disp('dB/m',a_dB,'The attenuation coeff in dB/m is');
// B)
w2=2*%pi*f2;
r=conductivity/w2*rel_permittivity;
//after the calculation this ratio is much greater than unity. Therefore we have to use following eq to calculate the attenuation coeff as
a=sqrt(w2*conductivity*u/2);
disp('N/m',a,'The attenuation coeff is');
// By using the conversion factor 1N=8.686 dB
a_dB=a*8.686;
disp('dB/m',a_dB,'The attenuation coeff in dB/m is');
```

# Chapter 16

# ANTENNAS

**Scilab code Exa 16.7.2** example 1

```
clc;
//page no 590
//prob no. 16.7.2
//For the Hertzian dipole, the radiation pattern is
   described by g(x)=sin^2(x) and g(y)=1
// Determination of -3dB beamwidth
// from the polar diagram shown we have
g_x=0.5;
x=asind(sqrt(g_x));
g_y=0.5;
y1=asind(sqrt(g_y));
y=y1+90;
//Therefore
z=y-x;
disp('degree',z,'The -3dB beamwidth is');
```

**Scilab code Exa 16.9.1** example 2

```
clc;
//prob no. 16.9.1
//Half dipole antenna is given with I=Io*cos(Bl)
   where l=0
//The physical length of the antenna is wl/2
//consider wl=unity and current Io=unity
Io=1;
wl=1;
phy_length=wl/2;
I_av=2*Io/%pi;
//Thus area is given as
Area=I_av*phy_length;
// From the above eq l_effective is given as
disp('l_eff= wl/pi');
```

**Scilab code Exa 16.19.1** example 3

```
clc;
//prob no. 16.19.1
// Paraboloida reflector antenna is given with
D=6;//reflector diameter in m
n=0.65;//illumination effeciency
f=10^10;//frequency of operation in Hz
c=3*10^8;//velo of light in m/s
wl=c/f;
A=(%pi*D^2)/4;
A_eff=n*A;
disp('m^2',A_eff,'Effective area is');
D0=4*%pi*A_eff/wl^2;
disp(D0,'The directivity is');
BW_dB=70*wl/D;
disp('degree',BW_dB,'The -3dB beamwidth is');
BW_null=2*BW_dB;
disp('degree',BW_null,'The null beamwidth is');
```

# Chapter 17

# Telephone Systems

**Scilab code Exa 17.1.1** example 1

```
clc;
//page no 641
//problem no 17.1.1
//a)Determination of max gain1
FTL=50;M=12;
NFL=2*FTL;NFLG=(NFL-M);
G_max1=NFLG/2;
disp('dB',G_max1,'a)The max gain is');
//b)Determination of max gain2
IL=3;RLW=20;RLE=40;
NL=(4*IL)+RLW+RLE;
NLG=(NL-M);
G_max2=NLG/2;
disp('dB',G_max2,'The max gain is');
//c)Determination of amplr gain
LT=15;OM=6;
OLW=(RLW-LT)/2;
OLE=(RLE-LT)/2;
A=OM+OLW+OLE+(2*IL);
disp('dB',A,'The amplr gain is');
```

# Chapter 18

# FACSIMILE AND TELEVISION

**Scilab code Exa 18.2.1** example 1

```
clc;
// page no 671
// prob no 18_2_1
//A drum of facsimile machine with diameter=70.4mm &
    scanning pitch=0.2mm/scan
D=70.4;P=0.2;
//Determination of index of co-operation
IOC_CCITT=D/P;
IOC_IEEE=IOC_CCITT*(%pi);
disp(IOC_IEEE,'The index of co-operation is');
```

**Scilab code Exa 18.2.2** example 2

```
clc;
// page no 676
// prob no 18_2_2
```

```
//A drum scanner in eg.18.2.1 with pitch=0.26mm/line
    & diameter=68.4mm & drum rotate at 120rpm &
    scans lines=1075
D=68.4;P=0.26;rpm=120;n=1075;
//Determination of no. of pixels scan
Npx=(%pi)*(D/P);
disp('pixels/line',Npx,'The no. of pixels in scan
    line is');
//Determination of scan rate
Rs=rpm/60;
disp('lines/sec',Rs,'The scan rate is');
//Determination of pixel rate is
Rpx=Npx*Rs;
disp('pixels/sec',Rpx,'The pixel rate is');
f_max=Rpx/2;
//Determination of document Tx time
td=n/(60*Rs);
disp('min',td,'The document Transmission time is');
```

**Scilab code Exa 18.3.1** example 3

```
clc;
//page no 693
//prob no. 18.3.1
a=(4/3);//aspect ratio
N=525;//no. of line periods per frame
Ns=40;//no. of suppressed lines
//Determination of no. of pixel periods in line
    period
Nv=N-Ns;
disp('lines',Nv,'The no. of pixel periods in line
    period is ');
//Determination of picture height and width
Nh=a*Nv;
disp('pixels',Nh,'The picture height is');
```

```
Nl=(Nh/0.835);
disp('pixels',Nl,'The picture length is');
```

**Scilab code Exa 18.3.2** example 4

```
clc;
//page no 694
//prob no. 18.3.2
//A TV system with
N=525;P=30;
//Determination of horizontal and vertical
   synchhronization freq.
fh=N*P;
disp('Hz',fh,'the horizontal freq. is ');
fv=2*P;
disp('Hz',fv,'the vertical freq. is ');
//Determination of time reqd to scan one line
Th=(1/fh);
disp('sec',Th,'the time reqd to scan one line is ');
```

**Scilab code Exa 18.3.3** example 5

```
clc;
//page no 695
//prob no. 18.3.3
//U.S. NTSC is given
//refer example 18.3.2
fh=15750;Nl=775;
//Determination of video bandwidth
Bv=0.35*fh*Nl;
disp('Hz',Bv,'the band width is');
```

**Scilab code Exa 18.7.1** example 6

```
clc;
//page no 706
//prob no. 18.7.1
//refer example 18.3.1
a=4/3;//aspect ratio
D=48.26*10^-2;//CRT tube diagonal
Nh=647;
H=sqrt((a^2)*(D^2)/(1+a^2));
//Determination of viewing angle & minimum dist.
w=H/Nh;
theta=Nh*(1/60);//As each pixel subtend 1 minute of arc
disp('degree',theta,'The viewing angle is');
X=H/(2*tand(theta/2));
disp('m',X,'The min. viewing dist is');
```

---

**Scilab code Exa 18.7.2** example 7

```
clc;
//page no 707
//prob no. 18.7.2
//HDTV system is given
//Refer example 18.7.1
a=16/9;D=1.40;Nh=1840;//Assuming square pixel
H=sqrt((a^2)*(D^2)/(1+a^2));
//Determination of viewing angle
theta=Nh*(1/60);
disp('degree',theta,'The viewing angle is');
//Determination of viewing dist
X=H/(2*tand(theta/2));
```

```
disp('m',X,'The viewing dist is');
```

# Chapter 19

# SATELLITE COMMUNICATIONS

**Scilab code Exa 19.14.1** example 2

```
clc;
//page no 737
//problem no 19.14.1
//A high power amplr
P_HPA=600;TFL_dB=1.5;G_dB_ES=50;RFL_dB=1;GTR_dB_SAT
    =-8;FSL_dB=200;AML_dB=0.5;PL_dB=0.5;AA_dB=1;
//Determination of carrier to noise ratio
P_dB_HPA=10*log10(P_HPA/1);
EIRP_dB=P_dB_HPA-TFL_dB+G_dB_ES;
TPL_dB=FSL_dB+AML_dB+PL_dB+AA_dB;
CNoR_dB=EIRP_dB-TPL_dB-RFL_dB+GTR_dB_SAT+228.6;
disp(CNoR_dB,'The carrier to noise ratio in dB is');
```

**Scilab code Exa 19.14.2** example 3

```
clc;
```

```
//page no 739
//problem no 19.14.2
f=14*10^9;BO_dB=10;GTR_dB_SAT=3;RFL_dB=1;phi_dB=-98;
    c=3*10^8;
//Determination of carrier to noise ratio
wav=c/f;
Ao_dB=10*log10((wav^2)/(4*(%pi)*1));
CNo_dB=phi_dB-BO_dB+GTR_dB_SAT-RFL_dB+Ao_dB+228.6;
disp(CNo_dB,'The carrier to noise ratio is');
```

**Scilab code Exa 19.16.1** example 4

```
clc;
//page no
//problem no 19.16.1
//Determination of overall C/N
CNo_dB_U=88;CNo_dB_D=78;
NoC_U=10^(-CNo_dB_U/10);
NoC_D=10^(-CNo_dB_D/10);
NoC=NoC_U+NoC_D;
CNo_dB=10*log10(1/NoC);
disp(CNo_dB,'The overall carrier to noise ratio is')
    ;
```

**Scilab code Exa 19.17.1** example 6

```
clc;
// page no 742
// prob no 19.17.1
// A digital satellite link is given with following
    specification
Eb_N0=9.6;//ratio expessed in dB
Rb=1.544*10^6;//bit rate expessed in bps
```

```
// The bit rate in dB relative to 1bps is
R_dB_b=10*log10(Rb) ;
//The required CN0 ratio is
CNo_db=Eb_N0+R_dB_b;
disp(CNo_db,'The ratio C/No is');
```

# Chapter 20

# Fiber Optic Communication

**Scilab code Exa 20.2.1** example 1

```
clc;
// page no 753
// prob no 20.2.1
// An optic fiber is made of glass with following
   details
n1=1.55;//RI of glass
n2=1.51;//RI of clad
// NA of the fibe is given as
NA=n1*sqrt(2*(n1-n2)/n1);
disp(NA,'The numerical aperture is');
// Acceptance angle is given as
acc_angle=asind(NA);
disp(acc_angle,'The acceptance angle is');
```

**Scilab code Exa 20.2.2** example 2

```
clc;
//page no 761
```

```
//prob no. 20.2.2
//refer example 20.2.1
d=50*10^-6;wav=0.8*10^-6;NA=0.352;
//Determination of V number
V=(%pi)*d*NA/wav
disp(V,'the V no. is');
//Determination of approximate number of modes
N=(V^2)/2;
disp(N,'the approximate no. of modes are ');
```

**Scilab code Exa 20.2.3** example 3

```
clc;
//page no 763
//prob no. 20.2.3
d=5*10^-6;wave=1.3*10^-6;NA=0.35;
//Determination of V no.
V=(%pi)*d*NA/wave;
disp(V,'the v no. is' );
disp('from the table it is seen that 6 modes have
    cut off v less than 4.23 ');
```

**Scilab code Exa 20.2.4** example 4

```
clc;
//page no 762
//prob no. 20.2.4
//refer example 20.2.3
a=2;//gradding profile index
V=69.1;//normalized cutoff freq.
N=2390;//number of modes supported as a step index
    fiber
```

```
//Determination of no. of modes supported by graded
   index fiber
N_a=(N*a)/(a+2);
disp(N_a,'no. of modes supported by graded index
   fiber');
```

**Scilab code Exa 20.2.5** example 5

```
clc;
//page no 763
//prob no. 20.2.5
d=10*10^-6;wav=1.3*10^-6;n1=1.55;V_max=2.405clc;
//page no 762
//prob no. 20.2.4
NA_max=(V_max*wave)/(%pi*d);
//a)Dtermination of maximum normailized index
   difference
del=(1/2)*(NA/n1)^2;
disp(del,'a)the normilized index difference is');
//b)Determination of reffactive index of claddin
   glass
n2=n1*(1-del);
disp(n2,'b)cladding index required is');
//Determination of the fiber acceptance angle
theta_max=asind(NA);
disp(theta_max,'the max acceptance angle is');
```

**Scilab code Exa 20.3.1** example 6

```
clc;
//page no
//prob no. 20.3.1
//A silica fiber with
```

```
A_max=25;A1=2;A2=0.3;
//a)Determination of repeater dist at 0.9um wavelength
z1=A_max/A1;
disp('km',z1,'a)the repeater dist for 0.9um wavelength is');
//b)Determination of repeater dist at 1.5um wavelength
z2=A_max/A2;
disp('km',z2,'a)the repeater dist for 1.5um wavelength is');
```

**Scilab code Exa 20.4.1** example 7

```
clc;
//page no 772
//prob no. 20.4.1
//Refer example 20.4.1
n1=1.55;del=0.0258;l=12.5;z=1000;c=3*10^8;
//a)Determination of intermodal dispersion
del_per_km=(n1*z*del)/((1-del)*c);
disp('s/km',del_per_km,'the intermodal dispersion is');
//b)Determination of intermodal dispersion for l=12.5
del_l=del_per_km*l/1000;
disp('s',del_l,'the intermodal dispertion for l=12.5 is');
```

**Scilab code Exa 20.4.2** example 13

```
clc;
//page no 773
```

```
//prob no. 20.4.2
//Refer example 20.4.1
n1=1.55;del=0.0258;z=1000;c=3*10^8;z_disp=12.5;
del_graded=(n1*z*del^2)/(8*c);
//Determination of intermodal dispersion
del_total=del_graded*z_disp;
disp('sec',del_total,'the intermodal dispersion is')
    ;
```

**Scilab code Exa 20.4.3** example 8

```
clc;
//page no 774
//prob no. 20.4.3
//Refer example 20.4.1
wav_0=0.8*10^-6;Dm=-0.15;wav_3=1.5;z=12.5;
del_t=Dm*wav_3;
//Determination of total material dispersion
del_md=del_t*z;
disp('ns',del_md,'The total material dispersion is')
    ;
```

**Scilab code Exa 20.4.4** example 9

```
clc;
//page no 775
//prob no. 20.4.4
Dm=6.6;z=12.5;del_3=6;
del_wg=Dm*z*del_3;
disp('ps',del_wg,'Expected waveguide dispersion is')
    ;
```

**Scilab code Exa 20.4.5** example 10

```
clc;
//page no 776
//prob no. 20.4.5
del_imd=0;del_md=2.81;del_wgd=0.495;t_w=2.5;
del_tot=((del_imd^2)+(del_md^2)+(del_wgd^2))^(1/2);
disp('ns',del_tot,'The total dispersion is');
t_r=((t_w^2)+(del_tot^2))^(1/2)
//Determination of max allowed bit rate
B=(1000/(2*t_r));
disp('Mbps',B,'The max allowed bit rate is');
```

**Scilab code Exa 20.4.6** example 11

```
clc;
//page no 778
//prob no. 20.4.6
//A multimode step index fiber
del_t=4;B=10;
//a)Determination of BW distance product
BDP=1/(2*del_t);
disp('Mbps-km',BDP,'a)The BW distance product for
   fiber is');
//b)Determiation of dispersion limited length
z_max_disp=BDP/(B*10^-3);
disp('km',z_max_disp,'b)The disp limited length for
   a fiber is');
```

**Scilab code Exa 20.5.1** example 14

```
clc;
//page no 780
//prob no. 20.5.1
//3 semiconductor diodes are given
E1=1.9;E2=1.46;E3=0.954;eV=1.9;//All in eV
c=3*10^8;//speed of light
//a)Determination of wavelength and freq for E1=1.9
wav1=1.241/E1;f1=c/(wav1*10^-6);
disp('um',wav1,'a)i)the wavelength is');
disp('Hz',f1,'a)ii)the freq is');
//b)Determination of wavelength and freq for E2=1.46
wav2=1.241/E2;f2=c/(wav2*10^-6);
disp('um',wav2,'b)i)the wavelength is');
disp('Hz',f2,'b)ii)the freq is');
//c)Determination of wavelength and freq for E3
    =0.945
wav3=1.241/E3;f3=c/(wav3*10^-6);
disp('um',wav3,'c)i)the wavelength is');
disp('Hz',f3,'c)ii)the freq is');
```

---

**Scilab code Exa 20.8.1** example 12

```
clc;
//page no 799
//prob no. 20.8.1
//A fiber link is given
pt=0;pr=-57;Nc=2;BER=10^-9;N=5;Lpt=6;Lpr=6;Lc=1;Ls
    =0.5;Lf=2;M=5;del_t=0.505;B=35;Ns=5;
//a)Determination of loss-limited fiber length
z=(pt-pr-M-(Nc*Lc)-(Ns*Ls)-Lpt-Lpr)/Lf;
disp('km',z,'a)the loss-limited fiber is');
//b)Determination of max BW for loss-limited fiber
    length
```

```
B_max=1/(5*del_t*z);
disp('Gbps',B_max,'b)the max BW for loss-limited
   length is');
//c)Determination of dispersion-limited length
z_disp=1000/(5*del_t*B);
disp('km',z_disp,'the dispertion limited length is')
   ;
```