

Scilab Textbook Companion for
Modern Electronics Communication
by J. S. Beasley and G. Miller¹

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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.

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Chapter 1

Introductory topics

Scilab code Exa 1.1 example1

```
1 //Introductory Topics :example 1-1 : (pg no. 8)
2 P1=0.001;
3 dB=10*log(0.001/0.001);
4 x=10^0;
5 y=x*P1*600;
6 V=sqrt(y);
7 printf("\ndB =10log(P1/P2) = 10log(1mW/1mW) = %.f
      dBm",dB);
8 //0 dBm indicates result was obtained to a 1-mW
      reference
9 // voltage measured across 600 ohm load for 0dBm
      level is 0.775 V
10 printf("\ndB =10log(P1/P2) \nwhere P2=V2^2/600 \nP1
      =0.001 W");
11 printf("\n0 dBm = 10log((V2^2)/600)/0.001");
12 printf("\nV2 =%.5 f V",V);
13 //value of V2 is used to calculate the dBm(600)
      value
14 printf("\ndBm(600)=20log(V2/0.775)");
```

Scilab code Exa 1.2 example2

```
1 //Introductory Topics :example 1-2 : (pg no. 9 & 10)
2 P=0.001;
3 R=75;
4 R1=50;
5 x=(8/20);
6 y=(10^x);
7 V2=(y*0.775);
8 V=sqrt(P*R);
9 V1=sqrt(P*R1);
10 //It is a 600 ohm system so 0.775 V reference is
    used
11 printf("\ndBm(600)= 20log(V2/0.775)");
12 printf("\nV2 = %.3f V",V2);
13 //voltage reference for 75-ohm system
14 printf("\nV=sqrt(P*R) = %.3f V",V);
15 printf("\ndBm(75)= 20log(V/0.274)");
16 //voltage reference for 50-Ohm system
17 printf("\nV=sqrt(P*R) = %.4f V",V1);
18 printf("\ndB(50)= 20log(V/0.2236)");
```

Scilab code Exa 1.3 example3

```
1 //Introductory Topics :example 1-3 : (pg no. 10)
2 x=(10/10);
3 y=(10^x);
4 P2=(y*0.001);
5 a=(log10(0.01/1));
6 z=(10*a);
7 //Converting +10dBm to Watts
8 printf("\n+10dBm =10log(P2/0/001)");
```

```

9 printf("\nP2 =%.2 f W",P2);
10 //Converting +10dBm to dBW
11 printf("\ndBW = 10 log (0.01W/1W)");
12 printf("\ndBW = %. f dBW",z);

```

Scilab code Exa 1.4 example4

```

1 //Introductory Topics :example 1-4 : (pg no. 16)
2 kT=(1.6*10^-20);
3 f=(1*10^6);
4 R=(1*10^6);
5 x=sqrt(kT*f*R);
6 //4kT at room temperature (17 degree C) is
   1.6*10^-20 Joules
7 printf("\nen = sqrt(4*k*T*delta(f)*R) \nen = %.6 f
   Vrms",x);

```

Scilab code Exa 1.5 example5

```

1 //Introductory Topics :example 1-5 : (pg no. 16)
2 k=(1.38*10^-23);
3 T=(27+273);
4 f=(4*10^6);
5 R=100;
6 x=sqrt(4*k*T*f*R);
7 // to convert degrees to kelvin, add 273 to it
8 printf("\nen = sqrt(4kT.delta(f)R) \nen = %.8 f Vrms"
   ,x);

```

Scilab code Exa 1.6 example6

```

1 //Introductory Topics :example 1-6 : (pg no. 18 &
   19)
2 x=10;
3 y=5;
4 z=(x/y);
5 a=(10*log10(z));
6 b=(10*log10(x));
7 c=(10*log10(y));
8 d=(b-c);
9 //part(a)
10 printf("\nNR = (( Si/Ni)/(So/No)) = %.f",z);
11 //part(b)
12 printf("\nNF = 10log(( Si/Ni)/(So/No)) = 10logNR \
   nNF = %.f dB",a);
13 //part(c)
14 printf("\n 10log(Si/Ni) = %.f dB",b);
15 printf("\n 10log(So/No) = %.f dB",c);
16 printf("\ntheir difference = %.f dB",d);

```

Scilab code Exa 1.7 example7

```

1 //Introductory Topics :example 1-7 : (pg no. 21 &
   22)
2 BW=200*10^3;
3 k=(1.38*10^-23);
4 T=(273+22); //converting degrees C into kelvin
5 R=(10*10^3);
6 R1=300;
7 NF1=3;
8 NF2=8;
9 NR1=2;
10 NR2=6.31;
11 df=((%pi/2)*BW);
12 Pn=(k*T*df);
13 en=sqrt(4*Pn*R);

```

```

14 x=(14+20+20); //sum of the power gain of the three
    stages
15 y=(x/10);
16 Pg=(10^y);
17 Po=(Pn*Pg);
18 eno=sqrt(Po*R1);
19 pg1=(10^(1.4));
20 pg2=(10^(20));
21 NR=(NR1+((NR2-1)/pg1)+((NR2-1)/(pg1*pg2)));
22 NF=10*log10(NR);
23 No=(NR*Pn*Pg);
24 a=sqrt(No*R1);
25 //part(a)
26 printf("\ndelta(f)= (pi/2)*BW = %.f Hz",df); //
    effective noise bandwidth
27 printf("\nPn = k.T. delta(f) = %.17f W",Pn); // at the
    input
28 printf("\nen=sqrt(4.k.T. delta(f).R) = %.8f V",en); //
    Voltage
29 printf("\nTpg = 14dB+20dB+20dB = %.f dB",x); //total
    power gain in decibels
30 printf("\n54dB = 10logPG \nPG = %.f",Pg); //total
    power gain
31 printf("\nPn(out) = Pn(in).PG = %.12f W",Po); //
    assuming perfect noiseless amplifiers
32 printf("\nen(out)= %.6f V",eno); //output driven by
    300 Ohm load & P=V^2/R
33 //part(b)
34 printf("\nPG1=14dB = 25.1 \nPG2=PG3= 20dB =100 \nNF1
    = 3dB \nNR1=2 \nNF2=NF3=8dB \nNR2=NR3=6.31");
35 printf("\nNR=NR1+(NR2-1/PG1) +.... + (NRn-1/PG1.PG2...
    PG(n-1))"); //friiss 's formula
36 printf("\nNR = %.3f",NR); //noise ratio
37 printf("\nNF = %.2f dB",NF); //noise figure
38 //part(c)
39 printf("\nNR = (Si/Ni)/(So/No) \nPG = %.1f*10^5",pg1
    );
40 printf("\nNR = No/(Ni*PG) \nNo = %.12f W",No);

```

```
41 printf("\nNo = (en^2)/R \nen= %.6 f V",a);//  
    outputnoise voltage
```

Scilab code Exa 1.8 example8

```
1 //Introductory Topics :example 1-8 : (pg no. 24)  
2 k=1.38*10^-23;  
3 T=(35+40+52);//total temperature  
4 df=(1*10^6);  
5 Teq=52;  
6 To=290;  
7 Pn=(k*T*df);  
8 x=(Teq/To);  
9 NR=(x+1);  
10 NF=(10*log10(NR));  
11 printf("\nPn = k.T. delta(f) = %.17 f W",Pn);//Noise  
    power  
12 printf("\nTeq = To(NR-1) \nNR = %.2 f",NR);//noise  
    ratio  
13 printf("\nNF = 10 log(NR) =%.3 f dB",NF);//noise  
    figure
```

Scilab code Exa 1.9 example9

```
1 //Introductory Topics :example 1-9 : (pg no. 25)  
2 x=7*10^-3;  
3 y=0.18*10^-3;  
4 z=10*log10(x/y);  
5 // o/p power measured 400-Hz audio signal modulates  
    a carrier  
6 printf("\nS+N+D = %.3 f W",x);  
7 // o/p power measured when a filter cancels 400-Hz  
    portion of the o/p
```

```
8 printf("\nN+D = %.5 f W",y);
9 printf("\nSINAD = 10log(S+N+D/N+D)");
10 printf("\nSINAD = %.1 f dB",z);
```

Scilab code Exa 1.10 example10

```
1 //Introductory Topics :example 1-10 : (pg no. 26)
2 i= 14*10^-3;//dc current
3 R=50;
4 x=(20*i*R);
5 y=10*log10(x);
6 printf("\nNR = 20.Idc.R = %. f",x);//noise ratio
7 printf("\nNF = 10log(NR) = %.2 f dB",y);//noise
  figure
```

Scilab code Exa 1.11 example11

```
1 //Introductory Topics :example 1-11 : (pg no. 37)
2 f=(12*10^3);
3 L=3*10^-3;
4 C=(0.1*10^-6);
5 R=30;
6 x=L*C;
7 y=sqrt(x);
8 z=(2*pi*y);
9 a=(1/z);
10 Xl=(2*pi*f*L);
11 Xc=(1/(2*pi*f*C));
12 b=(Xl-Xc)^2;
13 c=R^2;
14 d=sqrt(c+b);
15 printf("\nfr = 1/2.pi.sqrt(LC) = %. f Hz",a);
16 //at 12kHz
```

```

17 printf("\nXL = 2.pi.f.L = %.f Ohm",Xl);
18 printf("\nXC = 1/2.pi.f.C = %.f Ohm",Xc);
19 printf("\nZ = sqrt(R^2+(XL-XC)^2) = %.1f Ohm",d);//
    impedance when f=12 Hz

```

Scilab code Exa 1.12 example12

```

1 //Introductory Topics :example 1-12 : (pg no. 38 &
    39)
2 R1=20;
3 R2=1;
4 L=1*10^-3;
5 C=0.4*10^-6;
6 ein=50*10^-3;
7 f=12*10^3;
8 x=sqrt(L*C);
9 y=(1/(2*pi*x));
10 eo= ein*(R2/(R2+R1));
11 XL=(2*pi*f*L);
12 XC=(1/(2*pi*f*C));
13 a=(R1+R2)^2;
14 b=(XL-XC)^2;
15 z=sqrt(a+b);
16 zo=sqrt((R2^2)+b);
17 m=(ein*(zo/z));
18 printf("\nfr = 1/2.pi.sqrt(LC) = %.f Hz",y);//
    resonant frequency
19 printf("\neout = ein *(R2/R1+R2) = %.5f V",eo);//o/p
    voltage at resonance
20 // at f=12 kHz
21 printf("\nXL = 2.pi.f.L = %.1f Ohm",XL);
22 printf("\nXC = 1/2.pi.f.C = %.1f Ohm",XC);
23 printf("\nZtotal = sqrt((R1+R2)^2 +(XL-XC)^2) = %.1f
    Ohm",z);
24 printf("\nZout = sqrt(R2^2)+(XL-XC)^2 = %.1f Ohm",zo

```



```
);  
25 printf("\neout = %.4 f V",m); //o/p voltage at 12kHz
```

Scilab code Exa 1.13 example13

```
1 //Introductory Topics :example 1-13 : (pg no. 40 &  
  41)  
2 a=460*10^3;  
3 b=450*10^3;  
4 BW=a-b;  
5 fr=455*10^3;  
6 Q=(fr/BW);  
7 C=0.001*10^-6;  
8 x=(fr*2*%pi);  
9 y=(1/x)^2;  
10 z=y/C;  
11 R=(2*%pi*z*BW);  
12 //part(a) : bandwidth  
13 printf("\nBW = fhc - flc = %. f Hz",BW);  
14 //part(b) : Quality factor  
15 //filter 's peak o/p occurs at 455kHz  
16 printf("\nQ = fr /BW = %.1 f kHz",Q);  
17 //part(c) : value of inductance  
18 printf("\nfr = 1/2. pi .sqrt(LC) = %.5 f H",z);  
19 //part(d): total circuit resistance  
20 printf("\nBW = R/2. pi .L \nR = %.2 f Ohm",R);
```

Scilab code Exa 1.14 example14

```
1 //Introductory Topics :example 1-14 : (pg no. 42)  
2 R=2;  
3 L=3*10^-3;  
4 C=0.47*10^-6;
```

```

5 x=(2*%pi*sqrt(L*C));
6 y=1/x;
7 XL=(2*%pi*y*L);
8 Q=(XL/R);
9 Z=((Q^2)*R);
10 BW=(R/(2*%pi*L));
11 //part(a) : resonant frequency
12 printf("\nfr = 1/2.pi.sqrt(LC) = %.f Hz",y);
13 //part(b) : Quality factor
14 printf("\nQ = XL/R \n XL =2.pi.f.L \nXL = %.1 f Ohm",
        XL);
15 printf("\nQ = %.1 f",Q);
16 //part(c) : maximum impedance
17 printf("\nZmax = Q^2*R = %.f Ohm",Z);
18 //part(d) : Bandwidth
19 printf("\nBW = R/2.pi.L = %.f Hz",BW);

```

Chapter 2

Amplitude Modulation Transmission

Scilab code Exa 2.1 example1

```
1 // Amplitude Modulation-Transmission : example 2-1
  : pg(74 & 75)
2 //upper sideband is equal to the sum of carrier and
  intelligence frequencies
3 c=1.4*10^6;
4 m1=20;
5 m2=10*10^3;
6 Ur1=c+m1;
7 Ur2=c+m2;
8 Lr1=c-m1;
9 Lr2=c-m2;
10 //range of upper sideband(usb)
11 printf("\nupper sideband will include frequencies
  from %.f Hz",Ur1 );
12 printf("\nto \n %.f Hz",Ur2);
13 //range of lower sideband (lsb)
14 printf("\nlower sideband will include frequencies
  from %.f Hz",Lr1);
15 printf("\nto \n %.f Hz",Lr2);
```

Scilab code Exa 2.2 example2

```
1 // Amplitude Modulation-Transmission : example 2-2 :
  pg(78)
2 b=100;
3 a=60;
4 d=125;
5 c=35;
6 x=180;
7 y=0;
8 m1=((b-a)/(b+a))*100;
9 m2=((d-c)/(d+c))*100;
10 m3=((x-y)/(y+x))*100;
11 //part(a)
12 printf("\npercent(m) = (B-A/B+A)*100percent = %.f
  percent",m1);
13 //part(b)
14 printf("\npercent(m) = (B-A/B+A)*100percent = %.f
  percent",m2);
15 //part(c)
16 printf("\npercent(m) = (B-A/B+A)*100percent = %.f
  percent",m3);
17 //part(d) : this is a case of overmodulation
18 //part(e) : this is a distorted AM wave as the
  increase > decrease in carrier's amplitude
```

Scilab code Exa 2.3 example3

```
1 // Amplitude Modulation-Transmission : example 2-3 :
  pg(79 & 80)
2 // m=1 or 100 percent
```

```

3 //each side frequency = 1/2 the carrier amplitude
4 //power is proportional to (V)^2
5 //each side band power = 1/4 carrier power
6 c=1*10^3;
7 esb= 1/4*(c);
8 tsp=(esb*2);
9 tp=(tsp+c);
10 printf("\nESF = mEc/2 ");
11 printf("\nCarrier power = %.f W",c);
12 printf("\n Each side-band power = 1/4 of carrier
    power = %.f W",esb);
13 printf("\nTotal side-band power = %.f W",tsp);
14 printf("\nTotal transmitted power = %.f W",tp);

```

Scilab code Exa 2.4 example4

```

1 // Amplitude Modulation-Transmission : example 2-4 :
    pg(81)
2 m=0.9; //modulation index
3 Pc=500; //carrier Power
4 x=(m^2)/2;
5 y=(1+x)*Pc;
6 printf("\nPt = Pc*(1+(m^2)/2)");
7 printf("\nPt = %.1f W",y); //total transmitted power

```

Scilab code Exa 2.5 example5

```

1 // Amplitude Modulation-Transmission : example 2-5 :
    pg(81)
2 m=0.95; //modulation index
3 Pt= 50*10^3; //total transmitted power
4 x=(m^2)/2;
5 y=1+x;

```

```

6 z=(Pt/y);
7 Pi=Pt-z;
8 printf("\nPt = Pc*(1+(m^2)/2)");
9 printf("\nPc = %.f W",z); // carrier power
10 printf("\nPi = Pt-Pc = %.f W",Pi); // intelligence
    signal

```

Scilab code Exa 2.6 example6

```

1 // Amplitude Modulation-Transmission : example 2-6 :
    pg(81 & 82)
2 Ic=12; // antenna current of AM transmitter when
    unmodulated
3 It=13; // current when modulated
4 x=2*((13/12)^2-1);
5 m=sqrt(x);
6 a=m*100;
7 printf("\nIt = Ic.sqrt(1+(m^2)/2) \nm^2 = %.2f ",x);
8 printf("\nm = %.2f",m);
9 printf("\npercent(m) = %.f percent",a); // percentage
    of modulation

```

Scilab code Exa 2.7 example7

```

1 // Amplitude Modulation-Transmission : example 2-7 :
    pg(82)
2 n=0.7; // efficiency
3 c=10*10^3; // carrier wave
4 Is=0.5*c; // intelligence signal
5 p=(Is/n);
6 printf("\ndc input power = %.f W",p); // dc input
    power

```

Scilab code Exa 2.8 example8

```
1 // Amplitude Modulation-Transmission : example 2-8 :
   pg(82 & 83)
2 Pc=10*10^3; // carrier power
3 Pt=11.2*10^3; // transmitted power
4 m2=0.5; // modulation index of another sine wave
5 x=2*((Pt/Pc)-1);
6 m=sqrt(x);
7 meff=sqrt((m^2)+(m2^2));
8 a=Pc*(1+((meff^2)/2));
9 printf("\nPt = Pc.(1+m^2/2) \nm=%0.2 f",m);
10 printf("\nmeff = sqrt(m1^2+m2^2) \nmeff = %0.1 f",meff
   ); // effective modulation index
11 printf("\nPt = Pc.(1+m^2/2) \n Pt = %0. f W",a); //
   total transmitted power
```

Scilab code Exa 2.9 example9

```
1 // Amplitude Modulation-Transmission : example 2-9 :
   pg(100)
2 a=1;
3 b=0.03;
4 c=0.05;
5 d=0.02;
6 e=0.04;
7 x=sqrt((b^2+c^2+d^2+e^2)/a^2);
8 y=x*100;
9 printf("\nTHD = sqrt((V2^2)+(V3^3)+(V4^2)+(V5^2)/(V1
   ^2)) \nTHD = %0.5 f",x);
10 printf("\nTHD = %0.2 f percent",y); // total harmonic
   distortion
```


Chapter 3

Amplitude Modulation Reception

Scilab code Exa 3.1 example1

```
1 // Amplitude Modulation-Reception : example 3-1 : (  
   pg 120)  
2 fr=550*10^3;  
3 L=10*10^-6;  
4 fr1=1550*10^3;  
5 a=fr*2*%pi;  
6 x=fr1*2*%pi;  
7 b=1/a;  
8 y=1/x;  
9 C1=((b)^2/L);  
10 C2=((y)^2/L);  
11 fr2=1100*10^3;  
12 BW=10*10^3;  
13 Q=(fr2/BW);  
14 BW1=(fr1/Q);  
15 BW2=(fr/Q);  
16 //part(a) : calculate C at 550kHz  
17 printf("\nfr = 1/2.pi.(LC) \nC1= %.12 f F",C1);  
18 //at 1550 kHz
```

```

19 printf("\nC2 = %.11f F",C2);
20 printf("\nrequired range of capacitance is from 1.06
    to 8.37 nF");
21 //part(b) : Quality factor
22 printf("\nQ = fr/BW \nQ = %.f Hz",Q);
23 //part(c) : Q at 1550 kHz
24 printf("\nBW = fr/Q \nBW = %.f Hz",BW1);
25 // Q at 550 kHz
26 printf("\nBW = %.f Hz",BW2);

```

Scilab code Exa 3.2 example2

```

1 // Amplitude Modulation-Reception : example 3-2 : (
    pg 134)
2 f=620*10^3;
3 IF=455*10^3;
4 LO=f+IF;
5 X=IF+LO;
6 // image frequency of local oscillator
7 //station frequency = 620 kHz
8 printf("\nLO - 620 kHz = IF");
9 printf("\nLO = %.f Hz",LO);
10 // determining at what other frequency, when mixed
    with 1075kHz,yields an o/p component at 455kHz
11 printf("\nX-1075kHz=IF \nX = %.f Hz",X);

```

Scilab code Exa 3.3 example3

```

1 // Amplitude Modulation-Reception : example 3-3 : (
    pg 150 & 151)
2 V=8*10^-6;
3 R=50;
4 P=(V^2)/R;

```

```

5 dBm=10*log10(P/0.001);
6 dBW=10*log10(P/1);
7 a=(-89+8+3+24+26+26-2+34);
8 x=(a/10);
9 y=10^x;
10 z=y*0.001;
11 printf("\nP = V^2/R = %.15 f W",P); //input power in
    Watts
12 printf("\ndBm = 10log(P/1mW) = %.f dBm",dBm); //input
    power in dBm
13 printf("\ndBW = 10log(P/1W) = %.f dBW",dBW); //input
    power in dBW
14 printf("\nPout(dBm) = %.f dBm into speaker",a); //o/p
    power in dBm
15 printf("\nPout(dBW) = %.f W",z);

```

Chapter 4

Single Sideband Communications

Scilab code Exa 4.1 example1

```
1 //Single-Sideband Communications : example 4-1 : (pg
   172 & 173)
2 x=1*10^6;
3 y=10^(80/20);
4 z=sqrt(y);
5 df=200;
6 Q=(x*z)/(4*df);
7 a=100*10^3;
8 Q1=(a*z)/(4*df);
9 disp(Q1);
10 //part(a) : Q when 1-MHz & 80-dB sideband
   suppression
11 printf("\nQ1 = fc.(log^-1(dB/20)^1/2)/4*delta(f) = %
   .f",Q);
12 //part(b) : Q when 100-kHz & 80-dB sideband
   suppression
13 printf("\nQ2 = fc.(log^-1(dB/20)^1/2)/4*delta(f) = %
   .f",Q1);
```

Scilab code Exa 4.2 example2

```
1 //Single-Sideband Communications : example 4-2 : (pg
   178)
2 a=3*10^6;
3 b=3.1*10^6; //new DSB signal range
4 c=2.9*10^6; //new DSB signal range
5 Q=(a/(b-c));
6 printf("\nthe required filter Q is = %.f",Q);
```

Scilab code Exa 4.4 example4

```
1 //Single-Sideband Communications : example 4-4 : (pg
   187)
2 a=455;
3 x=2000+1;
4 y=2000+3;
5 c=2000+455;
6 d=2455-2001;
7 e=2455-2003;
8 f=455-454;
9 g=455-452;
10 mprintf("\nRF and first mixer input: \n %.f kHz \n%.
   f kHz",x,y);
11 printf("\nlocal oscillator = %.f kHz",c);
12 mprintf("\nFirst mixer output: \n%.f kHz \n%.f kHz",
   d,e); //IF amp and second mixer input
13 printf("\nBFO = %.f kHz",a);
14 mprintf("\nSecond mixer output & audio amp: \n%.f
   kHz \n%.f kHz",f,g);
```

Chapter 5

Frequency Modulation Transmission

Scilab code Exa 5.1 example1

```
1 //Frequency Modulation : Transmission : example 5-1
   : (pg 209)
2 v=25*10^-3;
3 f=750;//deviation constant
4 vg=10*10^-3;//deviation constant
5 pfd=v*(f/vg);//positive frequency deviation
6 nfd=-v*(f/vg);//negative frequency deviation
7 //part(a)
8 printf("\npositive frequency deviation = %.f Hz",pfd
   );
9 printf("\nnegative frequency deviation = %.f Hz",nfd
   );
10 mprintf("\nThe total deviation is written as +-2.25
   kHz for the given input signal level");
11 //part(b)
12 printf("\nThe input frequency (fi) is 400 Hz
   therefore , by eqn \nfout = fc+kei");
13 mprintf("\nThe carrier wil deviate %.f Hz and %.f Hz
   at a rate of 400 Hz",pfd,nfd);
```

Scilab code Exa 5.3 example3

```
1 //Frequency Modulation : Transmission : example 5-3
   : (pg 214)
2 d=20*10^3;
3 fi=10*10^3;
4 mf=d/fi;
5 a=mf*40;
6 printf("\nmf = %.f",mf); //maximum deviation
7 printf("\nJ0, J1, J2, J3, J4 are the significant
   components are obtained"); //from Bessel func
8 printf("\nJ1=+-10kHz \nJ2=+-20kHz \nJ3 = +-30kHz \
   nJ4=+-40kHz");
9 printf("\ntotal required bandwidth is %.f kHz",a);
```

Scilab code Exa 5.4 example4

```
1 //Frequency Modulation : Transmission : example 5-4
   : (pg 214)
2 d=20*10^3;
3 fi=5*10^3;
4 mf=d/fi;
5 a=2*35;
6 printf("\nmf = %.f",mf);
7 printf("\nhighest significant side-frequency
   component is J7"); //from bessel function
8 printf("\nrequired bandwidth is %.f kHz",a);
```

Scilab code Exa 5.5 example5

```

1 //Frequency Modulation : Transmission : example 5-5
  : (pg 215)
2 fc=(2*pi*(10^8))/2*pi;
3 Vm=2000;
4 R=50;
5 P=(2000/sqrt(2))^2/R;
6 mf=2; //by inspection of FM equation
7 fi=(pi*10^4)/(2*pi);
8 d=(mf*fi);
9 BW=mf*40;
10 bw=2*(d+fi);
11 P1=((0.58*2000/sqrt(2))^2)/R;
12 P2=((0.3*2000/sqrt(2))^2)/R;
13 //part(a)
14 printf("\nfc = %.f Hz",fc); //by inspection of FM
  equation
15 //part(b)
16 printf("\nthe peak voltage is 2000V \nP = %.f W",P);
17 //part(c)
18 printf("\nmf = 2"); //by inspection of FM equation
19 //part(d)
20 printf("\nthe intelligence frequency fi = %.f Hz",fi
  );
21 //part(e)
22 printf("\nmf = d/fi \nd = %.f Hz",d); //d is maximum
  deviation
23 printf("\nas mf=2, significant sidebands exist to J4
  \nBW = %.f Hz",BW);
24 printf("\n BW = %.f Hz",bw); //using carson's rule (
  BW = 2(dmax+fimax))
25 //part(f)
26 printf("\nJ1 is the largest sideband at at 0.58
  times the unmodulated carrier amplitude");
27 printf("\nP = %.f W",P1);
28 printf("\nor 2*135 = 27kW for two sidebands at +-5
  kHz from carrier");
29 printf("\nThe smallest sideband J4 is 0.03 times the
  carrier = %.f W",P2);

```

Scilab code Exa 5.6 example6

```
1 //Frequency Modulation : Transmission : example 5-6
  : (pg 218)
2 d=75*10^3;
3 fi=30*10^3;
4 fi1=15*10^3;
5 d1=1*10^3;
6 fi2=100;
7 fi3=2*10^3;
8 a=d/fi;
9 b=d/fi1;
10 c=d1/fi2;
11 d=d1/fi3;
12 DR=d1/fi3;
13 //part(a)
14 printf("\nThe maximum deviation in broadcast FM is
  75 kHz");
15 printf("\nmf = %.f",a); //for fi=30kHz
16 printf("\nFor fi = 15kHz, \nmf1 = %.f",b);
17 //part(b)
18 printf("\nmf2 = %.f",c); //for fi=100Hz and d=1kHz
19 printf("\nfor fi=2kHz \nmf3 = %.f",d);
20 printf("\nDR = fdev(max)/fi(max) = %.1f",DR); //
  deviation ratio
```

Scilab code Exa 5.7 example7

```
1 //Frequency Modulation : Transmission : example 5-7
  : (pg 218 & pg 219)
2 mf=0.25;
```

```

3 a=0.98;
4 b=0.12;
5 x=10*10^3;
6 P=(a^2)*x;
7 P1=(b^2)*x;
8 t=P+2*P1;
9 printf("\nFor mf=0.25,the carrier is equal to0.98
    times its unmodulated amplitude & the only
    significant sideband is J1 with a relative
    amplitude of 0.12");
10 printf("\ncarrier power = %.f W",P);
11 printf("\npower of each sideband = %.f W",P1);
12 printf("\ntotal power = %.f W",t)

```

Scilab code Exa 5.8 example8

```

1 //Frequency Modulation : Transmission : example 5-8
  : (pg 222)
2 phi=0.5;
3 fi=5*10^3;
4 d=phi*fi;
5 x=75*10^3;
6 y=x/d;
7 printf("\nThe i/p =2 means that the worst case
    deviation is about 1/2 rad");
8 printf("\nd = %.f Hz",d);
9 printf("\nbecause full volume in broadcast FM
    corresponds to 75kHz deviation");
10 printf("\no/p S/N = %.f",y);

```

Scilab code Exa 5.9 example9

```
1 //Frequency Modulation : Transmission : example 5-9
   : (pg 222 & 223)
2 dm=10*10^3;
3 x=(1/3); //N/S input ratio
4 phi=asind(x);
5 phi1=asin(x);
6 fi=3*10^3;
7 d=phi1*fi;
8 a=dm/d;
9 printf("\nThe worst-case phase shift due to the
   noise occurs when phi=asin(N/S)");
10 mprintf("\nphi = %.1f degrees or %.2f rad",phi,phi1)
   ;
11 printf("\nd= %.f Hz",d);
12 printf("\nThe S/N output will be %.f",a);
```

Chapter 6

Frequency Modulation Reception

Scilab code Exa 6.1 example1

```
1 //Frequency Modulation – Reception : example 6–1 : (  
   pg 265)  
2 G=200000;  
3 v=200*10^-3;//quieting voltage  
4 in=v/G;  
5 printf("\nTo reach quieting , the input must be %.8f  
   V",in);//reciever's sensitivity
```

Scilab code Exa 6.2 example2

```
1 //Frequency Modulation – Reception : example 6–2 : (  
   pg 272)  
2 f=10*10^6;  
3 f1=50*10^3;  
4 f2=200*10^3;  
5 x=f1*2;
```

```
6 y=f2*2;
7 printf("\nThe capture occurred at %.f Hz from the
   free-running VCO frequency.",f1);
8 printf("\nAssume symmetrical operation, which implies
   a capture range of %.f Hz",x)
9 mprintf("\nOnce captured the VCO follows the input
   to a %.f Hz deviation, implying a lock range of %.
   f Hz",f2,y);
```

Chapter 7

Communication Techniques

Scilab code Exa 7.6 example

```
1 //Communication Techniques : example 7-6 : (pg 304)
2 Q=60;
3 IF=455*10^3;
4 x=680*10^3;
5 imf=x+2*(IF); //image frequency
6 a=(imf/x);
7 b=(x/imf);
8 c=(Q*(a-b));
9 d=20*log10(c);
10 printf("\nimage rejection (dB)=20log((fi/fs-fs/fi).Q)
    ");
11 printf("\nThe image frequency is %.f Hz",imf);
12 printf("\nimage rejection = %.f dB",d);
```

Scilab code Exa 7.7 example7

```
1 //Communication Techniques : example 7-7 : (pg 314)
2 NF=20;
```

```

3 df=10^6;
4 x=10*log10(df);
5 S=-174+NF+x;
6 a=5;//input intercept
7 dr=2/3*(a-S);
8 printf("\nS = -174dBm + NF + 10log10df + S/N = %.f
    dB",S);//sensitivity
9 printf("\ndynamic range = 2/3.(input intercept-noise
    floor) = %.d dB",dr);

```

Scilab code Exa 7.8 example8

```

1 //Communication Techniques : example 7-8 : (pg 315)
2 nf=5;
3 x=24;
4 y=20;
5 NR0=10^(nf/10);
6 NR1=10^(y/10);
7 PG1=10^(x/10);
8 NR=NR0+((NR1-1)/PG1);
9 NF=10*log10(NR);
10 S=-174+NF+60;
11 a=nf-x;//the system's third-order intercept point
12 dr=2/3*(a-S);
13 printf("\nNR = antilog(NF/10)");//noise ratio
14 printf("\nNR1 = %.2 f",NR0);
15 printf("\nNR2 = %.f",NR1);
16 printf("\nOverall NR = NR1+NR2-1/PG1");
17 printf("\nPG1= antilog(24dB/10) = %.f",PG1);
18 printf("\nNR = %.2 f",NR);
19 printf("\nNF = %.1 f dB",NF);//total system noise
    figure
20 printf("\nS = %.1 f dBm",S);//sensitivity
21 printf("\nthe systems third-order intercept point is
    %.f dBm",a);

```

```
22 printf("\ndynamic range = %.1 f dB",dr);
```

Scilab code Exa 7.9 example9

```
1 //Communication Techniques : example 7-9 : (pg 315
  & 316)
2 x=24;
3 nf=-5;
4 NR = 3.16+(99/10);
5 NF = 10*log10(NR);
6 S=-174+NF+60;
7 dr = 2/3*(nf-S);
8 printf("\nNR = %.1 f",NR);//noise ratio
9 printf("\nNF = %.1 f dB",NF);//noise figure
10 printf("\nS = %.1 f dBm",S);//sensitivity
11 printf("\ndynamic range = %.1 f dB",dr);
```

Scilab code Exa 7.10 example10

```
1 //Communication Techniques : example 7-10 : (pg
  329)
2 x=0.40*100*10^6;
3 y=(100*10^6/(2^32));
4 //fCLK is reference oscillator
5 printf("\nThe maximum output frequency is
  approximately 40 percent of fCLK MAX");
6 printf("\n %.f Hz",x);
7 printf("\nThe frequency resolution is given by fCLK
  / 2^N");
8 printf("\n%.3 f Hz",y);
```

Chapter 8

Digital Communication Coding Technique

Scilab code Exa 8.1 example1

```
1 //Digital Communication–Coding Techniques : example
   8–1 : (pg 357)
2 fa=20*10^3;
3 fs=2*fa;//minimum sample rate
4 printf("\nfs >= 2.f fa \nfs >= %.f Hz",fs);
```

Scilab code Exa 8.2 example2

```
1 //Digital Communication–Coding Techniques : example
   8–1 : (pg 362)
2 dr=55;
3 n=(dr/6.02);
4 x=(1.76+(6.02*10));//signal–to–noise ratio for
   digitizing system
5 l=2^10;
6 y=10*log10(3*(l^2));//signal–to–quantization–noise
   level
```

```

7 printf("\nDR = 6.02dB/bit(n) \n n= %.3 f",n);
8 printf("\nS/N = %.2 f dB",x);
9 printf("\nL = 2^10 = %. f",1);
10 printf("\n(S/N)q(dB) = 10log3L^2 = %.2 f dB",y);

```

Scilab code Exa 8.3 example3

```

1 //Digital Communication–Coding Techniques : example
   8–3 : (pg 368)
2 R=100*10^3;
3 Rf=10*10^3;
4 Vref=-10;
5 Vo=-(Vref)*(Rf/R);// resolution
6 a=(10/100);
7 b=(10/50);
8 c=(10/25);
9 d=(10/12.5);
10 V=-(Vref)*(a+b+c+d);//output voltage
11 printf("\nThe step–size is determined by leaving all
   switches open and closing the lsb");
12 printf("\nVo = -(-10V)(Rf/R) = %.1 f",Vo);
13 printf("\nThe resolution is 1.0. If all switches are
   closed ,a logic 1 is input.");
14 printf("\nVo = %. f V",V);

```

Scilab code Exa 8.4 example4

```

1 //Digital Communication–Coding Techniques : example
   8–4 : (pg 375)
2 d=2;
3 d1=3;
4 d2=4;
5 x=d-1;

```

```
6 a=(d/2) -1;
7 y=d1-1;
8 b=1/2*(d1-1);
9 z=d2-1;
10 c=(d2/2) -1;
11 //part (a)
12 printf("\nDmin = 2, the no. of error detected is (
    Dmin-1) = %.f",x);
13 printf("\nDmin is even, the no. of errors corrected
    equal = (Dmin/2)-1 = %.f",a);
14 printf("\nDmin = 3, the no. of error detected is (
    Dmin-1) = %.f",y);
15 printf("\nDmin is odd, the no. of errors corrected
    equal = (Dmin/2)-1 = %.f",b);
16 printf("\nDmin = 4, the no. of error detected is (
    Dmin-1) = %.f",z);
17 printf("\nDmin is even, the no. of errors corrected
    equal = (Dmin/2)-1 = %.f",c);
```

Chapter 9

Wired Digital Communications

Scilab code Exa 9.1 example1

```
1 //Wired Digital Communications : example 9-1 : (pg
   405 & 406)
2 M=110;
3 x=7;
4 n=log2(M);
5 a=(log10(110)/log10(2));
6 b=2^a;
7 u=(a/x)*100;
8 y=log10(b);
9 u1=(y/3)*100;
10 printf("\nIn binary system , n=log2M = %.2f",n);//
    number of bits
11 printf("\n2^6.78 = %.f",b);
12 printf("\n7 bits are required and efficiency is u =
    %.f percent",u);
13 printf("\nIn a decimal system , the number of dits
    required is %.f i.e total of 3 dits",y);
14 printf("\nThe efficiency is %.f percent",u1);
```

Scilab code Exa 9.2 example2

```
1 //Wired Digital Communications : example 9-2 : (pg
   407)
2 m=10^7;
3 Pe=10^-6; //error probability
4 a=m*Pe; //average number of errors
5 printf("\naverage number of errors = m*error
   probability (Pe) \n= %.f",a);
6 mprintf("\n%.f expected bit errors if %.f million
   bits are recieved",a,a);
```

Scilab code Exa 9.3 example 3

```
1 //Wired Digital Communications : example 9-3 : (pg
   407)
2 Tb=1/9600; //bit frequency
3 Pt=0.8; //transmit power
4 Eb=Pt*Tb; //energy per bit
5 printf("\nbit frequency = %.7f",Tb);
6 printf("\nEb = Pt.Tb =%.8f J",Eb);
```

Scilab code Exa 9.4 example4

```
1 //Wired Digital Communications : example 9-4 : (pg
   410)
2 bw=3*10^3; //bandwidth
3 x=1023; //signal-to-noise ratio
4 C=bw*log2(1+x); //capacity of telephone channel
5 printf("\nthe telephone channel has a bandwidth of
   about %.f Hz",bw);
6 printf("\nC = BW.log2(1+S/N) = %.f bits per second",
   C);
```

Scilab code Exa 9.5 example4

```
1 //Wired Digital Communications : example 9-5 : (pg
   411)
2 Tb=1/(8*10^3); //bit frequency
3 BWmin=1/(2*Tb); //minimum bandwidth
4 printf("\nTb = %.8f s",Tb);
5 printf("\nBWmin = 1/2.Tb = %.f Hz",BWmin);
```

Chapter 10

Wireless Digital Communication

Scilab code Exa 10.2 example2

```
1 //Wireless Digital Communications : example 10-2 : (  
   pg 467)  
2 n=3;  
3 n1=7;  
4 x=(2^n)-1;  
5 y=(2^7)-1;  
6 //part(a)  
7 mprintf("\n n=%f,PN sequence length = %f",n,x);  
8 //part(b)  
9 mprintf("\n n=%f,PN sequence length = %f",n1,y);
```

Scilab code Exa 10.3 example3

```
1 //Wireless Digital Communications : example 10-3 : (  
   pg 477)  
2 x=56; //modulation bit rate
```

```
3 y=560; //chip rate
4 a=256; //modulation bit rate
5 b=1792; //chip rate
6 z=y/x;
7 c=b/a;
8 //part(a)
9 printf("\nSpreading = %.f",z);
10 printf("\nSpreading = %.f",c);
```

Chapter 12

Transmission Lines

Scilab code Exa 12.1 example1

```
1 //Transmission Lines : example 12-1 : (pg 575)
2 L=73.75*10^-9;
3 C=29.5*10^-12;
4 Z=sqrt(L/C);
5 x=5280;
6 z=sqrt((x*L)/(x*C));
7 printf("\nFor the 1-ft section, \nZ0 = sqrt(L/C) = %
    .f Ohm",Z);
8 printf("\nFor the 1-mi section, \nZ0 = %.f Ohm",z);
```

Scilab code Exa 12.2 example2

```
1 //Transmission Lines : example 12-2 : (pg 574 & 575)
2 a=2;//parallel wire line
3 //D/d where D is spacing between the wires n d is
    diameter of 1 conductor
4 b=2.35;//coaxial line
5 D=0.285;
```

```

6 d=0.08;
7 e=1; //dielectric constant of insulating material
      relative to air
8 z=(276/e)*log10(2*2);
9 z1=(138/e)*log10(b);
10 z2=(138/sqrt(2.3)*log10(D/d));
11 //part(a) Zo of parallel wire with D/d = 2
12 printf("\nZo = 276/sqrt(e).log10.(2D/d) = %.f Ohm",z
      );
13 //part(b) Zo of coaxial line with D/d = 2.35
14 printf("\nZo = 138/sqrt(e).log10.(D/d) = %.1f Ohm",
      z1);
15 //part(c) Zo of RG-8A/U coaxial cable with D=0.285
      in. & d=0.08 in.
16 printf("\nZo = 138/sqrt(2.3).log10.(D/d) = %.f Ohm",
      z2);

```

Scilab code Exa 12.3 example3

```

1 //Transmission Lines : example 12-3 : (pg 579)
2 L=73.75*10^-9;
3 C=29.5*10^-12;
4 d=1; //distance
5 t=sqrt(L*C);
6 Vp=d/t;
7 printf("\nthe delay introduced is t = sqrt(L.C) = %
      .11f s",t);
8 printf("\nThe velocity of propagation is , \nVp = d/
      sqrt(L.C) = %.f ft/s",Vp);

```

Scilab code Exa 12.4 example4

```

1 //Transmission Lines : example 12-4 : (pg 580)

```

```

2 v=2.07*10^8;//velocity
3 c=3*10^8;//velocity of light
4 Er=2.3;//relative dielectric constant
5 vf=(v/c);//velocity factor
6 vf1=1/sqrt(Er);
7 printf("\nThe velocity was 2.07*10^8 m/s \nvf = %.2 f
      ",vf);
8 printf("\nvf = 1/sqrt(Er) = %.2 f",vf1);

```

Scilab code Exa 12.5 example5

```

1 //Transmission Lines : example 12-5 : (pg 581)
2 c=3*10^8;//speed of light
3 f=100*10^6;//frequency of signal
4 x=2.07*10^8;//velocity of wave propagation
5 w=c/f;//wavelength in free-space
6 w1=x/f;//wavelength while traveling through an RG-8A
  /U coaxial cable
7 printf("\nIn free space , lambda = c/f = %.f m",w);
8 printf("\nWhile traveling through RG-8A/U cable ,
      lamda = c/f = %.2 f m",w1);

```

Scilab code Exa 12.7 example7

```

1 //Transmission Lines : example 12-7 : (pg 592 & 593)
2 Zl=300;//load impedance
3 Zo=50;//characteristic impedance
4 v=2.07*10^8;//velocity in RG-8A/U cable
5 f=27*10^6;//operating frequency of citizen 's band
  transmitter
6 Po=4;//output power of transmitter
7 l=10;//length of RG-8A/U cable
8 Rl=300;//input resistance of antenna

```

```

 9 T=((Zl-Zo)/(Zl+Zo)); //reflection coefficient
10 h=v/f; //length of cable in wavelength
11 le=1/h; //electrical length
12 x=Rl/Zo; //VSWR
13 y=((1+T)/(1-T)); //VSWR
14 rp=(T)^2*Po; //reflected power
15 Pl=Po-rp; //load power
16 //part(a): The reflection coefficient
17 printf("\nT = ZL-Z0/ZL+Z0 = %.2f",T);
18 //part(b) : The electrical length of the cable in
    wavelengths(h)
19 printf("\nh = v/f = %.2f m",h);
20 mprintf("\nBecause the cable is 10m long, its
    electrical length is (%.f m)/(%.2f m/wavelength)
    = %.1fh",l,h,le);
21 //part(c) : The VSWR
22 printf("\nBecause load is resistive , \nVSWR = %.f",x
    );
23 printf("\nAn alternativr solution , because T is
    known, \nVSWR = 1+T/1-T = %.f",y);
24 //part(d) : absorbed power
25 mprintf("\nthe reflected voltage is T times the
    incident voltage ,\nreflected voltage = %.2f W \
    nPload = %.2f W",rp,Pl);

```

Scilab code Exa 12.8 example8

```

1 //Transmission Lines : example 12-8 : (pg 597)
2 Zo=100; //characteristic impedance
3 j=%i;
4 Zl = 200-j*150; //load impedance
5 l=4.3; //length of transmission line
6 x=200/Zo;
7 y=150/Zo;
8 a=0.4*Zo;

```

```

9 b=0.57*Zo;
10 mprintf("\nTo normalize the load impedance: \nzL =
      ZL/Zo = %.f - j*%.1f",x,y);
11 //VSWR and equation of zin should b drawn from
      impedance smith chart,the plotted points should
      be read
12 printf("\n zin = 0.4 + j*0.57");//from smith chart
13 mprintf("\nZin = zin*Zo = %.f Ohm + j* %.f Ohm",a,b)
      ;

```

Scilab code Exa 12.9 example9

```

1 //Transmission Lines : example 12-9 : (pg 599)
2 j=%i;
3 RL=120;//load resistance from smith chart
4 ZL=75+j*50;//load impedance
5 Z0=50;//characteristic impedance
6 a=75/Z0;
7 y=50/Z0;//normalized load impedance
8 z=2.4;//normalized z at a point that is purely
      resistive
9 ar=z*Z0;//actual resistance
10 x=sqrt(Z0*RL);
11 printf("\nzl = ZL/Z0 = %.1f + j*%.f",a,y);
12 //VSWR,zin,R can be found out from smith chart
      manually
13 printf("\nZ0^ = sqrt(Z0*RL) = %.1f Ohm",x);//
      characteristic impedance of matcing section
14 //^ indicates (') complement sign

```

Scilab code Exa 12.10 example10

```

1 //Transmission Lines : example 12-10 : (pg 601)

```

```
2 Z0=75; //characteristic impedance
3 j=%i;
4 ZL=50-j*100; //load impedance
5 x=50/Z0;
6 y=100/Z0;
7 mprintf("\nzL = ZL/Z0 = %.2f - j* %.2f",x,y);
8 //rest of the values have to be calculated manually
  by smith chart or by using smith chart's
  softwares
```

Chapter 13

Wave Propagation

Scilab code Exa 13.1 example1

```
1 //Wave Propagation : example 13-1 : (pg 628)
2 x=(2*(1/2));
3 a=15;
4 d=53.5*10^-6;//duration for each horizontal line on
   the reciever
5 t=1/186000;//time delay between direct and reflected
   signal
6 g=(t/d)*a;//ghost width
7 printf("\nt = d/v = %.8f",t);
8 printf("\nghost width = %.2f in.",g);
```

Scilab code Exa 13.2 example2

```
1 //Wave Propagation : example 13-2 : (pg 641 & 642)
2 S=83;//satellite longitude in degrees
3 N=90;//site longitude in degrees
4 L=35;//site latitude in degrees
5 G=S-N;
```

```

6 a=atand(-0.128/0.5736);
7 A=180+a;
8 x=cosd(G)*cosd(L);
9 b=0.1512;
10 d=x-b;
11 n=(cosd(G))^2;
12 m=(cosd(L))^2;
13 o=1-(m*n);
14 w=sqrt(o);
15 y=d/w;
16 E=atand(y);
17 printf("\nThe azimuth is equal to A = 180+arctan(
      tanG/tanL) = %.f degrees",A);
18 printf("\nThe elevation calculated ,\ntan(E)=cosG.
      cosL-0.1512/sqrt(1-cos^2G*cos^2L) = %.4f",y);
19 printf("\nE = %.3f degrees",E);

```

Scilab code Exa 13.3 example3

```

1 //Wave Propagation : example 13-3 : (pg 646)
2 x=(32+(44/60)+(36/3600)); // N latitude
3 y=(106+(16/60)+(37/3600)); //W longitude
4 D=42.1642*10^6; //distance from the satellite to the
      center of the earth
5 R=6.378*10^6; //earth's radius
6 a=32.74333;
7 B=-7.27694;
8 m=D^2;
9 n=R^2;
10 e=2*D*R;
11 q=cosd(a)*cosd(B);
12 d=sqrt(m+n-(e*q));
13 c=2.997925*10^5; //velocity of light
14 de=d/c;
15 rd=(2*d)/c;

```



```

16 printf("\n N latitude \nconverted into degrees = %.5
    f",x);
17 printf("\n W longitude \n covered into degrees = %
    .7f",y);
18 printf("\nd = sqrt(D^2 + R^2 - 2.D.R. cosa.cosB) = %.
    f meters",d);
19 printf("\ndelay = d/c  and roundtrip delay = 2d/c ")
    ;
20 printf("\ndelay = 0.%.f seconds",de);
21 printf("\nroundtrip delay = 0.%.f seconds",rd);

```

Scilab code Exa 13.4 example4

```

1 //Wave Propagation : example 13-4 : (pg 651 & 652)
2 G=45;//antenna gain
3 nt=25;//antenna noise temperature
4 nt1=70;//LNB noise temperature
5 nt2=2;//noise temperature(reciever and passive
    components)
6 T=nt+nt1+nt2;//total noise temperature
7 x=G-10*log10(T);//figure of merit
8 printf("\nSum of all of the noise temperature
    contributions \nTs = %.f K",T);
9 printf("\nThe figure of merit (G/T) \nG/T = G-10.log
    (Ts) = %.2f dB",x);

```

Scilab code Exa 13.5 example5

```

1 //Wave Propagation : example 13-5 : (pg 652 & 653)
2 d=41.130383*10^6;//distance
3 c=2.997925*10^8;//velocity of light
4 f=14.25*10^9;//uplink frequency
5 h=c/f;//wavelength

```

```
6 x=(4*%pi*d)/h;
7 Lp=20*log10(x); //free-space path loss
8 printf("\nThe wavelength is calculated by, \nh=c/f =
    %.6f",h);
9 printf("\nThe free-space path loss(Lp) expressed in
    dB");
10 printf("\nLp(dB)= 20log(4.pi.d/h) = %.3f dB",Lp);
```

Chapter 14

Antennas

Scilab code Exa 14.1 example1

```
1 //Antennas : example 14-1 : pg(669)
2 c=3*10^8;
3 f=150*10^6;
4 h=c/f;
5 x=1/2;
6 D=0.5*2;
7 Rff=5*D;
8 printf("\nThe wavelength (h) for a h/2 dipole at 150
    MHz is , \nh=c/f = %.f m/cycle",h);
9 printf("\nh/2 = 1m, which is the antennas dimension(
    D) \nD/h = 1/2 = %.1 f",x);
10 printf("\n Rff = 5D = %.f m",Rff);
```

Scilab code Exa 14.2 example2

```
1 //Antennas : example 14-2 : pg(669)
2 c=3*10^8;//velocity of light
3 f=12*10^9;//frequency
```

```

4 D=4.5; //diameter of parabolic reflector
5 h=c/f; //wavelength
6 x=D/h;
7 R=(2*D^2)/h;
8 printf("\nThe wavelength, \nh= %.3 f m/cycle",h);
9 printf("\nD=4.5 meter \nD/h = %. f",x);
10 printf("\nselect equation, \nR > %. f m",R);

```

Scilab code Exa 14.3 example3

```

1 //Antennas : example 14-3 : pg(671)
2 Pt=10; //transmitted power
3 //dipoles have gain 2.15dB
4 Gr=10^(2.15); //recieving antenna gain(ratio)
   compared to isotropic radiator
5 Gt=Gr; //transmiting antenna gain(ratio) compared to
   isotropic radiator
6 Gr=1.64;
7 c=3*10^8; //velocity of light
8 f=144*10^6; //frequency
9 d=50*10^3; //distance between antennas
10 x=c/f; //wavelength
11 y=x^2;
12 z=Pt*Gt*Gr*y;
13 a=(16*(%pi)^2);
14 b=a*(d^2);
15 Pr=z/b; //powed recieved
16 printf("\nPr = Pt.Gt.Gr.h^2/16.pi^2.d^2 = %.12 f W",
   Pr);

```

Scilab code Exa 14.4 example4

```

1 //Antennas : example 14-4 : pg(674)

```

```
2 c=3*10^8; //velocity of light
3 f=100*10^6; //frequency
4 h=c/f; //wavelength
5 x=h/2; //dipole i.e h/2
6 l=0.95*x; //applying 95% correction ,the actual
    optimum physical length
7 L=486/100; //alternative method to find length
8 printf("\nAt 100MHz, \nh=c/f = %.f m",h);
9 printf("\nlength of antenna = %.2f m",l);
10 mprintf("\nalternate method, L = 486/f = %.2f ft
    which is equal to %.2f m",L,l);
```

Chapter 16

Microwaves and Lasers

Scilab code Exa 16.1 example1

```
1 //Microwaves and Lasers : example 16-1 : pg(753)
2 h=0.3;//curve depth of parabolic reflector
3 D=3;//diameter of parabolic reflector
4 f=D/(16*h);//focal length
5 printf("\nFocal length(f)= D/16.h = %.3f m",f);
6 mprintf("\nThe focal length is %.3f m out from the
   center of the parabolic reflector",f);
```

Scilab code Exa 16.2 example2

```
1 //Microwaves and Lasers : example 16-2 : pg(755)
2 D=3;//diameter of microwave dish
3 k=0.6;//efficiency of reflector
4 c=2.997925*10^8;//velocity of light
5 f=10*10^9;//frequency
6 h=c/f;//wavelength
7 x=(%pi*D)^2;
8 y=(h^2);
```

```

9 a=k*(x/y);
10 Ap=10*log10(a); //powergain
11 B=(70*h)/D; //beamwidth
12 printf("\nAp(dBi)=10logk(pi.D)^2/(h^2)");
13 printf("\nh= c/f = %.3f m",h);
14 printf("\nAp(dBi) = %.2f dBi",Ap);
15 printf("\nbeamwidth = 70h/D = %.1f degrees",B);

```

Scilab code Exa 16.3 example3

```

1 //Microwaves and Lasers : example 16-3 : pg(756)
2 D=4.5; //diameter of parabolic reflector
3 k=0.62; //efficiency factor
4 x=(D/2)^2;
5 y=(k*pi);
6 Ae=y*x; //aperture efficiency
7 i=(pi*x); //ideal capture area
8 printf("\nAe = k.pi(D/2)^2 sq.m = %.2f sq.m",Ae);
9 mprintf("\nThe ideal capture area for %.1f m
    parabolic antenna is pi.(D/2)^2 = %.1f sq.m",D,i)
    ;

```

Chapter 17

Television

Scilab code Exa 17.1 example1

```
1 //Television : example 17-1 : pg(822)
2 bw=5*10^6; //bandwidth
3 t=53.5*10^-6; //time allocated for each visible trace
4 T=2*bw*t; //increase in horizontal resolution
5 mprintf("\nThe %.8f s allocated for each visible
   trace could now a develop a maximum %.f Hz video
   signal",t,bw);
6 printf("\nThus, the total number of vertical lines
   resolvable is %.f lines",T);
```

Scilab code Exa 17.2 example2

```
1 //Television : example 17-2 : pg(822)
2 bw=5*10^6; //bandwidth
3 l=428; //horizontal resolution
4 t=1/(bw*2); //trace time
5 x=1/30; //time available for a full picture
6 y=t+10*10^-6; //assuming that 10us is used for
   horizontal blanking
```



```
7 n=x/y;//no. of horizontal traces
8 c=600*0.7;//allowing 32 lines for vertical retrace
9 printf("\ntrace time = %.8f s",t);
10 printf("\ntotal no. of horizontal traces = %.f lines
    ",n);
11 printf("\nvertical resolution = %.f lines",c);
```

Chapter 18

Fibre Optics

Scilab code Exa 18.1 example1

```
1 //Fibre Optics : example 18-1 : pg(859)
2 c=3*10^8; //velocity of light
3 f=4.4*10^14; //frequency of red light
4 f1=7*10^14; //frequency of violet light
5 h1=c/f; //wavelength of red light
6 h2=c/f1; //wavelength of violet light
7 printf("\nFor red, \nh = c/f = %.9f m",h1);
8 printf("\nFor violet \nh = c/f = %.9f m",h2);
```

Scilab code Exa 18.2 example2

```
1 //Fibre Optics : example 18-1 : pg(859)
2 n1=1.535; //refractive index of fibre optics
3 n2=1.490; //refractive index of cladding
4 x=(n1^2)-(n2^2);
5 y=sqrt(x); //numerical aperture
6 z=asind(y); //theta
7 printf("\nNA = sin(theta) in(max) = sqrt(n1^2-n2^2) =
    %.3f",y);
```

```
8 printf("\n(theta)in(max) = %.1f degrees",z);
```

Scilab code Exa 18.3 example3

```
1 //Fibre Optics : example 18-3 : pg(868)
2 w=22; //spectral width of LED
3 l=2; //length of fibre
4 d=95; //dispersion value
5 p=d*w; //pulse dispersion
6 pt=p*l; //total pulse dispersion
7 printf("\npulse dispersion = %.f ps/km",p);
8 printf("\ntotal pulse dispersion = pulse dispersion*
   length = %.f ps/km",pt);
```

Scilab code Exa 18.4 example4

```
1 //Fibre Optics : example 18-4 : pg(885)
2 d=30; //length of fibre cable
3 l=0.4; //loss
4 T=d*l; //total cable loss
5 printf("\ntotal cable loss = %.f dB",T);
```

Scilab code Exa 18.5 example5

```
1 //Fibre Optics : example 18-5 : pg(887)
2 b=565; //Line bit rate of fibre 1
3 c=3.5; //Cable dispersion of fibre 1
4 t=4; //Transmitter spectral width of fibre 1
5 b1=1130; //Line bit rate of fibre 2
6 c1=3.5; //Cable dispersion of fibre 2
```

```
7 t1=2; //Transmitter spectral width of fibre 2
8 x=440000; //assumed gaussian constant based on a 3-dB
    optical bandwidth using a FWHM pulse shape
9 L1=x/(b*c*t); //span length in km of fibre 1
10 L2=x/(b1*c1*t1); //span length in km of fibre 2
11 printf("\nL1 = %.1f km",L1);
12 printf("\nL2 = %.1f km",L2);
```
