

Scilab Textbook Companion for  
Electronics Communication Systems  
by R. Blake<sup>1</sup>

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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

## Introduction to communication system

Scilab code Exa 1.1 example 1

```
1 clc;  
2 // page no 7  
3 // prob no 1.1  
4 //part a) freq= 1MHz(AM radio broadcast band)  
5 // We have the equation  $c=freq*wavelength$   
6  $c=3*10^8$ ;  
7  $f=1*10^6$ ;  
8  $wl=c/f$ ;  
9 disp('m',wl,+ 'WAVELENGTH IN FREE SPACE IS ');  
10 //part B) freq= 27MHz(CB radio band)  
11  $f=27*10^6$ ;  
12  $wl=c/f$ ;  
13 disp('m',wl,+ 'WAVELENGTH IN FREE SPACE IS ');  
14 //part C) freq= 4GHz(used for satellite television)  
15  $f=4*10^9$ ;  
16  $wl=c/f$ ;  
17 disp('m',wl,+ 'WAVELENGTH IN FREE SPACE IS ');
```

---

#### Scilab code Exa 1.4 example 4

```
1 clc;  
2 // page no 18  
3 // prob no. 1.4  
4 // In given problem noise power bandwidth is 10kHz;  
   resistor temp T(0c)=27  
5 // First we have to convert temperature to kelvins:  
6 T0c=27;  
7 Tk=T0c+273;  
8 // noise power contributed by resistor , Pn= k*T*B  
9 k=1.38*10(-23);  
10 B=10*103;  
11 Pn= k*Tk*B;  
12 disp('W',Pn,'noise power contributed by resistor');
```

---

#### Scilab code Exa 1.5 example 5

```
1 clc;  
2 // page no 20  
3 // prob no 1.5  
4 // In the given problem B=6MHz, Tk=293, k  
   =1.38*10-23  
5 B=6*106; Tk=293; k=1.38*10-23;R=300;  
6 Pn=k*Tk*B;  
7 disp('W',Pn,'The noise power is');  
8 // Th noise voltage is given by Vn=sqrt(4*k*Tk*B*R)  
9 Vn=sqrt(4*k*Tk*B*R);  
10 disp('volts',Vn,'Th noise voltage is');  
11 // only one-half of this voltage is appears across  
   the antenna terminals , the other appears across
```

the source resistance. Therefore the actual noise voltage at the input is 2.7 uV

---

#### Scilab code Exa 1.6 example 6

```
1 clc;
2 // page no 21
3 // prob no 1.6
4 // given: FM broadcast receiver :- Vn=10uV, R=75V, B
   =200 kHz
5 Vn=10; //in uV
6 R=75; B=200*10^3;
7 //By Ohm's law
8 In=Vn/R;
9 disp('uA',In,'Noise current is ');
10 // Noise voltage is also given as In=sqrt(2*q*Io*B)
11 q=1.6*10^-19;
12 // solving this for Io=In^2/2*q*B;
13 Io=(In*10^-6)^2/(2*q*B);
14 disp('A',Io,'current through the diode is');
```

---

#### Scilab code Exa 1.7 example 7

```
1 clc;
2 //page no 23
3 //pro no 1.7
4 //Given: refer fig.1.12 of page no.23; R1=100ohm,300K;
   R2=200ohm,400k;B=100kHz; Rl=300ohm
5 R1=100; T1=300; R2=200; T2=400; B=100*10^3; Rl=300; k
   =1.38*10^-23;
6 //open-ckt noise voltage is given by
7 //Vn1 =sqrt(Vr1^2 + Vr2^2)
8 //    =sqrt[sqrt(4kTBR1)^2 + sqrt(4kTBR2)^2]
```

```

9 //by solving this we get Vn1=sqrt[4kB(T1R1 + T2R2)]
10 Vn1=sqrt(4*k*B*(T1*R1 + T2*R2));
11 disp('volts ',Vn1,'Open-ckt noise voltage is ');
12 // since in this case the load is equal in value to
    the sum of the resistors ,
13 // one-half of this voltage is appear across the
    load.
14 // Now the load power is P= Vn1^2/Rl
15 P= (Vn1/2)^2/Rl;
16 disp('W',P,'The load power is ');

```

---

#### Scilab code Exa 1.8 example 8

```

1 clc;
2 // page no 24
3 // prob no 1.8
4 // Given: N=0.2W; S+N=5W; ∴ S=4.8W
5 N=0.2; S=4.8;
6 p=(S+N)/N;
7 pdB=10*log10(p);
8 disp('dB',pdB,'The power ratio in dB');

```

---

#### Scilab code Exa 1.9 example 9

```

1 clc;
2 //page no 25
3 //prob no 1.9
4 //Given: Si=100uW; Ni=1uW; So=1uW; No=0.03W
5 Si=100; Ni=1; So=1; No= 0.03// all powers are in uW
6 r1=Si/Ni;// input SNR
7 r2=So/No;// output SNR
8 NF=r1/r2;// Amplifier noise figure
9 disp(NF,'Te noise figure is ');

```

---

**Scilab code Exa 1.10** example 10

```
1 clc ;
2 //page no 25
3 //prob no 1.10
4 //giiven: SNRin=42 dB, NF=6dB
5 // NF in dB is given as SNRin(dB)-SNRop(dB)
6 SNRin=42 ; NF=6;
7 SNRop=SNRin-NF;
8 disp('dB',SNRop,'SNR at the output is ');
```

---

**Scilab code Exa 1.11** example 11

```
1 clc ;
2 //page no 27
3 // prob no 1.11
4 //Given NFdB=2dB, ∴ NF=antilog(NFdB)/10=1.585
5 NF=1.585;
6 Teq=290*(NF-1);
7 disp('K',Teq,'The noise temperature is ');
```

---

**Scilab code Exa 1.12** example 12

```
1 clc ;
2 //page no 29
3 //prob no 1.12
4 //Given:
5 A1=10; A2=25; A3=30; NF1=2; NF2=4; NF3=5;
6 At=A1*A2*A3;
```

```

7 disp(At,'The power gain is ');
8 // The noise figure is given as
9 NFt=NF1+((NF2-1)/A1) + ((NF3-1)/(A1*A2));
10 disp(NFt,'The noise figure is ');
11 // Noise temp can be found as
12 Teq=290*(NFt-1);
13 disp('K',Teq,'The noise temperature is ');

```

---

### Scilab code Exa 1.13 example 13

```

1 clc;
2 // page no 34
3 // prob no1.13 refer fig 1.20 of page no 34
4 // part A) The signal frequency is f1=110MHz.
5 f=110;// in MHz
6 disp('MHz',f,'A)The freq is ');
7 //The signal peak is two divisions below the
  reference level of -10dBm, with 10dB/division ,so
  its -30dBm.
8 PdBm=-30;
9 disp('dBm',PdBm,'The power in dBm');
10 // The equivalent power can be found from  $P(\text{dBm})=10 \log P/1 \text{ mW}$ 
11 // $P(\text{mW})=\text{antilog dBm}/10= \text{antilog } -30/10=1*10^{-3}\text{mW}=1\mu\text{W}$ 
12 //the voltage can be found from the graph but it is
  more accurately from  $P=V^2/R$ 
13 P=10^-6; R=50;
14 disp('W',P,'The power is ');
15 V=sqrt(P*R);
16 disp('volts',V,'The voltage is ');
17
18 // part B)The signal is 1 division to theleft of
  center, with 100kHz/div. The freq is 100kHz less
  than the ref freq of 7.5MHz
19 f=7.5-0.1;// in MHz

```



```

20 disp('MHz',f,'B)The freq is ');
21 // With regards to the amplitude, the scale is 1dB/
    div & the signal is 1 div below the reference
    level. Therefore the signal has a power level
    given as
22 PdBm=10-1;// in dBm
23 // This can be converted to watts & volts as same in
    part A
24 //P(mW)=antilog dBm/10= antilog 9/10=7.94mW
25 P=7.94*10^-3; R=50;
26 disp('W',P,'The power is ');
27 disp('dBm',PdBm,'The power in dBm');
28 V=sqrt(P*R);
29 disp('volts',V,'The voltage is ');
30
31 //part C) The signal is 3 divisions to the right of
    the center ref freq of 543MHz, with 1MHz/div.
    Therefore the freq is
32 f=543+3*1;// in MHz
33 disp('MHz',f,'C)The freq is ');
34 // from the spectrum, signal level is
35 V=22.4*6/8;
36 disp('mV',V,'The voltage is ');
37 // power is given as
38 P=V^2/R;
39 disp('uW',P,'The power is ');
40 PdBm=10*log10(P*10^-6/10^-3);
41 disp('dBm',PdBm,'The power in dBm');

```

---

## Chapter 2

# Radio Frequency Circuits

Scilab code Exa 2.1 example 1

```
1 clc;  
2 //page no 50  
3 //prob no 2.1  
4 //Refer the fig 2.6 of page 50. L1=25uH;C1=50pF  
5 L1=25*10-6;C1=50*10-12;Q=15;  
6 //A) The resonent frequency is given as  
7 fo=(1/(2*%pi*sqrt(L1*C1)));  
8 disp('Hz',fo,'a')The resonent frequency is ');  
9 //B) The bandwidth is given as  
10 B=fo/Q;  
11 disp('Hz',B,'The bandwidth is ');
```

---

Scilab code Exa 2.2 example 2

```
1 clc;  
2 //page no 62  
3 // prob no. 2.2  
4 // Given : Hartley oscillators L=10uH; C=100pF
```

```

5 L=10*10^-6; C=100*10^-12;N1=10;N2=100
6 // A)The operating frequency is
7 fo=1/(2*pi*sqrt(L*C));
8 disp('Hz',fo,'1)The operating frequency is');
9 // The feedback fraction is given by
10 B=-N1/N2;
11 //Operating gain is given as
12 A=1/B;
13 disp(A,'2)Operating gain');
14 disp('The -ve sign denotes a phase inversion');
15 //B) The operating frequency is same as in part A)
16 N1=20;N2=80;
17 // The feedback fraction is given by
18 B=(N1+N2)/N1;
19 //Operating gain is given as
20 A=1/B;
21 disp(A,'3)Operating gain');

```

---

### Scilab code Exa 2.3 example 3

```

1 clc;
2 // page no 66
3 //prob no 2.3
4 C1=10*10^-12; C2=100*10^-12; L=1*10^-6;
5 // The effective capacitance is
6 CT=(C1*C2)/(C1+C2);
7 disp(CT);
8 // The operating frequency is
9 fo=1/(2*pi*sqrt(L*CT));
10 disp('Hz',fo,'1)The operating frequency is');
11 // The feedback fraction is given approximately by
12 B=-C1/C2;
13 disp(B,'The feedback fraction is');
14 // For the common-base ckt, the op-freq is same but
    the feedback fraction willbe different.

```

```
15 C1=100*10^-12; C2=10*10^-12;
16 // It is given by
17 B=C2/(C1+C2);
18 disp(B,'The feedback fraction is');
```

---

#### Scilab code Exa 2.4 example 4

```
1 clc;
2 // page no 68
3 //prob no 2.4
4 //Refer fig 2.22
5 c1=1000;c2=100;c3=10;//all values are in pf
6 //The effective total capacitance
7 Ct=1/((1/c1)+(1/c2)+(1/c3));
8 disp('pF',Ct,'The effective total capacitance is');
9 CT=Ct*10^-12;L=10^-6;
10 //The operating freq is
11 f0=1/(2*%pi*sqrt(L*CT));
12 disp('Hz',f0,'The operating freq is');
```

---

#### Scilab code Exa 2.5 example 5

```
1 clc;
2 // page no 70
3 //prob no 2.5
4 C=80*10^-12; L= 100*10^-6;
5 //Part a) The resonent frequency is
6 f0=1/(2*%pi*sqrt(L*C));
7 disp('Hz',f0,'The resonent freq is');
8 // Part b) In this part the circuit is resonate on
   doubling the frequency ,therefore
9 f1=2*f0;
10 // from the equation of resonent frequency
```

```

11 C1=1/(4*(%pi*f1)^2*L);
12 // Now for tuning voltage we have to use equation
    C1=Co/sqrt(1+2V)
13 Co=C;
14 // after solving the expression
15 v=((Co/C1)^2 -1)/2;
16 disp('V',v,'The tuning voltage is ');

```

---

#### Scilab code Exa 2.7 example 6

```

1 clc;
2 //page no 76
3 //problem 2.7
4 // all frequencies are in MHz
5 f1=11;f2=10;
6 // output frequencies at the output of square-law
    mixer
7 a=f1+f2;
8 b=f1-f2;
9 disp('MHz',b,'MHz',a,'The output frequencies at the
    output of square-law mixer are :');

```

---

#### Scilab code Exa 2.8 example 7

```

1 clc;
2 //page no 85
3 //problem no. 2.8
4 // all the frequencies are in MHz
5 freq_free_run =12;
6 freq_lock1 =10;
7 freq_lock2 =16;

```

```

8 // capture range is approximately twice the
   difference between the free-running freq and the
   freq at which lock is first achieved
9 capture_range =2*(freq_free_run - freq_lock1 );
10 disp('MHz',capture_range,'The capture range is ');
11 // lock range is approximately twice the the
   difference between the freq where lock is lost
   and free-running freq
12 lock_range = 2*(freq_lock2 - freq_free_run);
13 disp('MHz',lock_range,'The lock range is ');
14 // The PLL freq response id approximate symmetrical.
   This means the free-running freq is in the center
   of the lock range and capture range. Therefore
15 freq_lock_acquired = freq_free_run + (capture_range
   /2);
16 freq_lock_lost = freq_free_run - capture_range
17 disp('MHz',freq_lock_acquired,'The freq at which the
   lock is acquired , moving downward in freq is ');
18 disp('MHz',freq_lock_lost,'Lock will be lost on the
   way down at ');

```

---

#### Scilab code Exa 2.9 example 8

```

1 clc;
2 //page no 86
3 // prob no 2.9
4 // refer fig 2.38
5 //Here we are using a 10MHz crystal , it will be
   necessar to devide it by a factor to get 10kHz
6 f_osc = 10*10^6; f_ref=10*10^3;f0_1=540*10^3;f0_2
   =1700*10^3;
7 Q=f_osc/f_ref;
8 // we have to specify the range of values of N. Find
   N at each and of the tuning range
9 N1=f0_1/f_ref;

```

```
10 N2=f0_2/f_ref;
11 disp(N2,'The values of N at high end is ',N1,'The
    values of N at low end is ');
```

---

#### Scilab code Exa 2.10 example 9

```
1  clc;
2  //page no 89
3  // prob no 2.10
4  // refer fig 2.40
5  P=10;f_ref=10*10^3;M=10;
6  //consider
7  N=1;
8  // With a fixed-modulus prescalar , the min freq step
   is
9  step_size=M*f_ref;
10 // With the two-modulus system , let the main divider
    modulus N remain constant & increase the modulus
    m to (m+1) to find how much the freq changes.
11 // for 1st case , o/p freq
12 fo=(M+N*P)*f_ref;
13 // for 2nd case where leave N alone but changes M to
    M+1, new o/p freq
14 fo_=(M+1+N*P)*f_ref;
15 // The difference is
16 f= fo_-fo;
17 disp('Hz',f,'The step size that would have been
    obtained without prescaling');
```

---

#### Scilab code Exa 2.11 example 10

```
1  clc;
2  //page no 91
```

```
3 //prob no 2.11
4 //refer fig 2.42
5 f_ref= 20*10^3;
6 f_osc= 10*10^6;
7 N1=10;N2=100;
8 f0=(N1*f_ref) + f_osc;
9 f1=(N2*f_ref) + f_osc;
10 disp('Hz',f1,'Hz',f0,'The output frequencies are');
11 step_size=(f1-f0)/(N2-N1);
12 disp('Hz',step_size,'The step size is');
```

---



# Chapter 3

## The Amplitude Modulation

Scilab code Exa 3.1 example 1

```
1 clc;  
2 // page no 105  
3 // prob no 3.1  
4 Erms_car=2; f_car=1.5*10^6; f_mod=500; Erms_mod=1; //  
   given  
5 // Equation requires peak voltages & radian  
   frequencies  
6 Ec=sqrt(2)*Erms_car; Em=sqrt(2)*Erms_mod;  
7 wc=2*%pi*f_car; wm=2*%pi*f_mod; t=1;  
8 // Therefore the equation is  
9 disp('v(t) = (2.83+1.41*sin(3.14*10^3*t))*sin  
   (9.42*10^6*t) V');
```

---

Scilab code Exa 3.2 example 2

```
1 clc;  
2 //page no 106  
3 //prob no 3.2
```

```

4 // To avoid the round-off errors we should use the
   original voltage values
5 Em=1;Ec=2;
6 m=Em/Ec;
7 disp(m, 'm=');
8 disp('v(t) = 2.83(1+0.5*sin(3.14*10^3*t))*sin
   (9.42*10^6*t) V', 'The equation can be obtained as
   ');

```

---

#### Scilab code Exa 3.3 example 3

```

1 clc;
2 //page no 109
3 //prob no 3.3
4 E_car=10;E_m1=1;E_m2=2;E_m3=3;
5 m1=E_m1/E_car;
6 m2=E_m2/E_car;
7 m3=E_m3/E_car;
8 mT=sqrt(m1^2+m2^2+m3^2);
9 disp(mT, 'The modulation index is ');

```

---

#### Scilab code Exa 3.4 example 4

```

1 clc;
2 //page no 110
3 //prob no 3.4
4 //refer fig 3.2
5 E_max=150; E_min=70; // voltages are in mV
6 m=(E_max-E_min)/(E_max+E_min);
7 disp(m, 'The modulation index is ');

```

---

### Scilab code Exa 3.6 example 5

```
1 clc ;
2 //page no 114
3 //prob no 3.6
4 B=10*103;
5 // maximum modulation freq is given as
6 fm=B/2;
7 disp('Hz',fm,'The maximum modulation freq is');
```

---

### Scilab code Exa 3.7 example 6

```
1 clc ;
2 //page no 116
3 //prob no 3.7
4 // AM broadcast transmitter
5 Pc=50;m=0.8;//power is in kW
6 Pt=Pc*(1+m2 /2);
7 disp('kW',Pt,'The total power is');
```

---

### Scilab code Exa 3.8 example 7

```
1 clc ;
2 // page no 328
3 // prob no 8.6
4 //2 kHz tone is present on channel 5 of group 3 of
   supergroup
5 //signal is lower sided so
6 fc_channel_5=92*103;
7 fg=fc_channel_5 - (2*103);// 2MHz baseband signal
8 // we know group 3 in the supergroup is moved to the
   range 408–456 kHz with a suppressed carrier
   frequency of 516kHz
```

```
9 f_s_carr=516*10^3;
10 fsg=f_s_carr - fg;
11 disp(fsg);
```

---

### Scilab code Exa 3.9 example 8

```
1 clc;
2 //page no 122
3 //prob no. 3.9
4 // refer fig 3.14
5 // from spectrum we can see that each of the two
   sidebands is 20dB below the ref level of 10dBm.
   Therefore each sideband has a power of -10dBm i.e
   . 100uW.
6 power_of_each_sideband = 100;
7 Total_power = 2* power_of_each_sideband;
8 disp('uW',Total_power,'The total power is ');
9 div=4; freq_per_div=1;
10 sideband_separation = div * freq_per_div;
11 f_mod= sideband_separation/2;
12 disp('kHz',f_mod,'The modulating freq is ');
13 // Even if this siganl has no carrier , it still has
   a carrier freq which is midway between the two
   sidebands. Therefore
14 carrier_freq = 10;
15 disp('MHz',carrier_freq,'The carrier freq');
```

---

### Scilab code Exa 3.10 example 9

```
1 clc;
2 // page no 126
3 // prob no 3.10
4 f_car=8*10^6;f_mod1=2*10^3;f_mod2=3.5*10^3;
```

```

5 //Signal is LSB hence o/p freq is obtained by
   subtracting f_mod from f_car
6 f_out1=f_car-f_mod1;
7 disp('MHz',f_out1/(10^6),'The o/p freq f_out1 is ');
8 f_out2=f_car-f_mod2;
9 disp('MHz',f_out2/(10^6),'The o/p freq f_out1 is ');

```

---

### Scilab code Exa 3.11 example 10

```

1 clc;
2 // page no 127
3 // prob no 3.11
4 //Referring the fig. 3.17
5 //From fig it is clear that thee waveform is made
   from two sine waves
6 Vp=12.5;//Since Vp-p is 25V from fig hence
   individual Vp is half of Vp-p
7 R1=50;//Load resistance is 50 ohm
8 //Determination of average power
9 Vrms=Vp/sqrt(2);
10 P=((Vrms)^2)/R1;
11 disp('W',P,'The value of average power of signal is
   ');

```

---

# Chapter 4

## Angle Modulation

Scilab code Exa 4.1 example 1

```
1  clc;
2  //page no 139
3  //prob no. 4.1
4  //An FM modulator is given with kf=30kHz/V operate
   at carrier freq 175MHz
5  fc=175*10^6;kf=30*10^3;
6  //a) Determination of o/p freq for modulating signal
   value em1=150mV
7  em1=150*10^-3;
8  fsig1=fc+(kf*em1);
9  disp('MHz',fsig1/(10^6),'a)The value of o/p freq is
   ');
10 //b) Determination of o/p freq for modulating signal
   value em2=-2V
11 em2=-2;
12 fsig2=fc+(kf*em2);
13 disp('MHz',fsig2/(10^6),'b)The value of o/p freq is
   ');
```

---

### Scilab code Exa 4.2 example 2

```
1 clc;  
2 //page no 140  
3 //prob no. 4.2  
4 //An FM modulator is given which is modulated by  
   sine wave 3V  
5 v=3;  
6 kf=30*103;  
7 //Determination of peak value  
8 Em=v*sqrt(2);  
9 //Determination of deviation delta  
10 delta=kf*Em;  
11 disp('kHz',delta/1000,'The value of deviation is ');
```

---

### Scilab code Exa 4.3 example 3

```
1 clc;  
2 //page no 140  
3 //prob no. 4.3  
4 //An FM broadcaster transmitter operate at max  
   deviatn of 75kHz  
5 delta=75*103;  
6 //a) Determination of modulation index with  
   modulating freq of signal =15kHz  
7 fm1=15*103;  
8 mf1=delta/fm1;  
9 disp(mf1,'a)The value of modulation index for fm=15  
   kHz is ');  
10 //b) Determination of modulation index with  
   modulating freq of signal =50Hz  
11 fm2=50;  
12 mf2=delta/fm2;  
13 disp(mf2,'b)The value of modulation index for fm=50  
   Hz is ');
```

---

**Scilab code Exa 4.4** example 4

```
1 clc;  
2 //page no 141  
3 //prob no. 4.4  
4 //A phase modulator is given with  $k_p=2\text{rad/V}$   
5  $k_p=2$ ;  
6 //Peak phase deviation of 60 degree  
7 //Converting degree in radian  
8  $\text{phi}=(2*\%pi*60)/360$ ;  
9 //Determination of peak voltage that cause that  
   deviation  
10  $V_p=\text{phi}/k_p$ ;  
11 //Determination of rms voltage  
12  $V_{\text{rms}}=V_p/(\text{sqrt}(2))$ ;  
13 disp('V', $V_{\text{rms}}$ , 'The rms voltage that cause deviation  
   is ');
```

---

**Scilab code Exa 4.6** example 5

```
1 clc;  
2 //page no 145  
3 //prob no. 4.6  
4 //Phase modulator with sensitivity  $k_p=3\text{rad/V}$  & sine  
   wave i/p 2 V peak at 1kHz  
5  $k_p=3$ ;  $V_p=2$ ;  $f=1*10^3$ ;  
6 //As max value of sine functn is 1, hence max value  
   of phi is  $k_p*V_p$   
7  $\text{phi\_max}=k_p*V_p$ ;  
8 //phi_max is nothing but mp  
9  $\text{mp}=\text{phi\_max}$ ;
```



```

10 //value of mf is same as mp if signal is considered
    as freq modulation
11 //Determination of freq deviation
12 dev=mp*f;
13 disp('kHz',dev/1000,'The freq deviation produce is')
    ;

```

---

#### Scilab code Exa 4.7 example 6

```

1  clc;
2  //page no 149
3  //prob no. 4.7
4  //An FM signal has deviation 3kHz & modulating freq
    1kHz with total power Pt=5W developed across 50
    ohm with fc=160 MHz
5  dev=3*10^3; fm=10^3; Pt=5; Rl=50; fc=160*10^6;
6  //a) Determination of RMS signal voltage
7  Vt=sqrt(Pt*Rl);
8  disp('V',Vt,'a)The rms signal voltage is');
9  //b) Determination of rms voltage at
    carrier freq
10 //for that modulation index needs to be found out
11 mf=dev/fm;
12 //From bessel function table, the coeff for the
    carrier first 3 side bands
13 J=[0.26,0.34,0.49,0.31];
14 disp('b)The rms voltage of side bands are')
15 for i=1:4,
16     V(i)=J(i)*Vt;
17 end;
18 disp('V',V(4),'V3=', 'V',V(3),'V2=', 'V',V(2),'V1=', 'V
    ',V(1),'Vc=');
19 //c) Determination of freq of each side
    bands
20 disp('c)The 3 side bands at different freq. are ')

```

```

21 for j=1:3,
22     f_usb(j)=fc/10^6+(fm*j/10^6);
23 end
24 disp('MHz',f_usb(3),'f_usb3=', 'MHz',f_usb(2),'f_usb2
    =','MHz',f_usb(1),'f_usb1=');
25
26 for j=1:3,
27     f_lsb(j)=fc/10^6-(fm*j/10^6);
28 end
29 disp('MHz',f_lsb(3),'f_lsb3=', 'MHz',f_lsb(2),'f_lsb2
    =','MHz',f_lsb(1),'f_lsb1=');
30 ///////////////d) Determination of power of each side
    band////////////////////
31 for i=1:4,
32     P(i)=(V(i))^2/R1;
33     a(i)=(P(i))/(10^-3);
34 end;
35 disp('d)The power of each side band is ');
36 disp('W',P(4),'P3=', 'W',P(3),'P2=', 'W',P(2),'P1=', 'W
    ',P(1),'Pc=',);
37 ///////////////e) Determination of power that is uncounted
38 P=P(1)+2*(P(2)+P(3)+P(4));
39 //As total power is 5 W
40 P_x=Pt-P;
41 //Percentage of total power uncounted
42 Px=(P_x/P)*100;
43 disp('%',Px,'e)Percentage total power which is
    uncounted is ');
44 ///////////////f) Ploting the signal in freq domain
    //////////////////////
45 //Converting power in dBm
46 for i=1:4,
47     //a(k)=(P(k))/(10^-3);
48     P_dBm(i)=10*log10(a(i));
49 end;
50 disp('f)Power of each side bands in dBm is ')
51 disp('dBm',P_dBm(4),'P3(dBm)=','dBm',P_dBm(3),'P2(
    dBm)=','dBm',P_dBm(2),'P1(dBm)=','dBm',P_dBm(1),'

```

```

    Pc(dBm) ',);
52 x=[159.997:0.001:160.003];
53 y=[26.8,30.8,27.6,25.3,27.6,30.8,26.8];
54 plot(x,y);

```

---

#### Scilab code Exa 4.9 example 7

```

1  clc;
2  //page no 157
3  //prob no. 4.9
4  //An FM signal has freq deviation of 5kHz modulating
   freq fm=1kHz with SNR at i/p is 20 dB
5  //Converting dB in voltage ratio
6  fm=1*10^3; dev_s=5*10^3; snr=20;
7  Es_En=10^(snr/20);
8  //Since Es>>En then
9  phi=1/(Es_En);
10 m_fn=phi;//modulation index equal to phi_n
11 dev_n=(m_fn)*fm;//Equivalent freq deviation due to
   noise
12 //SNR as a voltage ratio is given as
13 SNR=(dev_s)/(dev_n);
14 //Converting this voltage ration in dB
15 SNR_dB=20*(log10(SNR));
16 disp('dB',SNR_dB,'The SNR at detector o/p is');

```

---

#### Scilab code Exa 4.10 example 10

```

1  clc;
2  //page no 163
3  //prob no. 4.10
4  //Refer the fig. 4.19

```

```
5 // We know this transmitter is designed for voice
   frequencies ,so we have to use trial and error
   method to produce a carrier null for a deviation
   of 5kHz
6 mf=2.4; // starting with the first null for mf=2.4
7 dev=5; //in kHz
8 fm=dev/mf;
9 if (0.3<=fm & 3>=fm) then
10     disp('kHz',fm,'The freq is widin the acceptable
           range ');
11 else
12     mf=5.5;
13     fm=dev/mf;
14     disp('kHz',fm,'The freq is widin the acceptable
           range ');
15 end
16 // for this calculated fm, set the function
   generator to the value of fm so that the
   deviation is 5kHz
```

---

# Chapter 5

## Transmitters

Scilab code Exa 5.2 example 1

```
1 clc;  
2 //page no 179  
3 //prob no. 5.2  
4 //A transmitter with carrier power o/p 10W at  
   efficiency 70% at 100% modulatr  
5 Po=10;eta=0.7;  
6 //Determination of dc power o/p  
7 Ps=Po/eta;  
8 disp('W',Ps,'The value of dc power input is');  
9 //Determination of audio power  
10 Pa=0.5*Ps;  
11 disp('W',Pa,'The value of audio power is');
```

---

Scilab code Exa 5.3 example 2

```
1 clc;  
2 //page no 181  
3 //prob no. 5.3
```

```

4 //A transmitter operates at 12V, with collector
   current 2A.Modulatn transformer has turn ratio
   4:1
5 //Determination of impedance at transformer
   secondary
6 Vcc=12;Ic=2;N1=4;N2=1;
7 Za=Vcc/Ic;
8 disp('ohm',Za,'The impedance of transformer
   secondary is');
9 //Determination of impedance of transformer primary
10 Zp=Za*(N1/N2)^2;
11 disp('ohm',Zp,'The impedance of transformer primary
   is');

```

---

#### Scilab code Exa 5.4 example 3

```

1 clc;
2 //page no 182
3 //prob no. 5.4
4 //Class C amplifier with carrier o/p power of 100W
   with efficiency of 70% & with 100% modulation
5 Pc=100;eta=0.7;
6 //Determination of o/p power
7 Po=1.5*Pc;
8 disp('W',Po,'The o/p power with 100% modulation is')
   ;
9 //Determination of supply power
10 Ps=Po/eta;
11 disp('W',Ps,'The value of supply power is');
12 //Determination of power dissipated Pd
13 Pd=Ps-Po;
14 disp('W',Pd,'Power dissipated is');

```

---

#### Scilab code Exa 5.5 example 4

```
1 clc ;
2 //page no 184
3 //prob no. 5.5
4 //An FM transmitter produce 10W of carrier power
   operating at 15V
5 Vcc=15;Pc=10;
6 //Determination of load impedance seen from
   collector
7 Rl=((Vcc)^2)/(2*Pc);
8 disp('ohm',Rl,'The load impedance is');
```

---

#### Scilab code Exa 5.6 example 5

```
1 clc ;
2 //page no 193
3 //prob no. 5.6
4 //Refer fig. 5.13
5 //Filter method SSB generator
6 fc=5*10^6;//filter centre freq.
7 BW=3*10^3;//Filter bandwidth
8 foc=4.9985*10^6;//carrier oscillator freq.
9 disp('a)The USB will be passed');//Since carrier
   freq is at low end of passband
10 disp('b)The carrier freq should be moved to the high
   end of filter at 5.0015MHz');//To generate the
   LSB
```

---

#### Scilab code Exa 5.7 example 6

```
1 clc ;
2 //page no 196
```

```

3 //prob no. 5.7
4 //SSB transmitter refering fig.5.17 to transmit USB
  signal at carrier freq 21.5MHz
5 fo=21.5;//carrier freq in MHz
6 foc=8.9985;//carrier oscillator freq. in MHz
7 //Determination of freq of local oscillator
8 flo=fo-foc;
9 disp('MHz',flo,'The freq of local oscillator');

```

---

#### Scilab code Exa 5.8 example 7

```

1 clc;
2 //page no 199
3 //prob no. 5.8
4 //LSB transmitter refering fig.5.14 with new carrier
  freq 9.0015 MHz & local oscillator freq 12.5015
  MHz
5 fco=9.0015;//carrier oscillator freq
6 flo=12.5015;//local oscillator freq
7 //Determination of new o/p freq
8 fo=fco+flo;
9 disp('MHz',fo,'The o/p carrier freq');

```

---

#### Scilab code Exa 5.9 example 8

```

1 clc;
2 //page no 204
3 //prob no. 5.9
4 //A direct FM transmitter with kf=2kHz/V & max
  deviatn of 300Hz.
5 kf=2*10^3;tx_dev=300;
6 disp('a)See fig.5.23 for this block diagram');

```



```

7 f_mul=3*2*3;//3 stage freq multiplier with tripler
  doubler and tripler
8 //b) Determination of max dev at oscillator
9 dev_o=5*10^3;//Deviation at o/p
10 dev_osc=dev_o/f_mul;
11 if dev_osc < tx_dev then
12     disp('b) Transmitter is capable of 5kHz deviation
        ');
13 else
14     disp('b) Transmitter is not capable of 5kHz
        deviation')
15 end;
16 //c) Determination of oscillator freq
17 fo=150;//carrier freq in MHz
18 fosc=fo/f_mul;
19 disp('MHz',fosc,'c) The oscillator freq is');
20 //d) Determination of audio voltage for full
    deviation
21 Vi_peak=dev_osc/kf;//dev at oscillator of 278Hz
    causes full 5kHz deviation
22 //converting peak voltage to rms voltage
23 Vi_RMS=Vi_peak/sqrt(2);
24 disp('mV',Vi_RMS*10^3,'The audio RMS voltage is')

```

---

#### Scilab code Exa 5.10 example 9

```

1 clc;
2 //page no 206
3 //prob no. 5.10
4 //Refer fig.5.24
5 //Till the antenna there are 2 doubler and 4 tripler
6 f_mul=18*18;
7 dev_o=75*10^3;//o/p freq deviation is 75kHz
8 //Determination of reqd freq deviation of oscillator
9 dev_osc=dev_o/f_mul;

```

```
10 disp('Hz',dev_osc,'Freq deviation of oscillator is')
    ;
```

---

#### Scilab code Exa 5.11 example 10

```
1  clc;
2  //page no 207
3  //prob no. 5.11
4  //A PLL FM generator refering fig.5.25 with
5  f_ref=100*10^3;N=200;kf=50*10^3;//in Hz/V
6  //a) Determination of carrier freq of o/p signal
7  fc=N*f_ref;
8  disp('MHz',fc/10^6,'The carrier freq of o/p signal')
    ;
9  //b) Determination of RMS modulating voltage for 10
    kHz deviation
10 dev=10*10^3;
11 Vp=dev/kf;
12 //Converting peak voltage to RMS voltage
13 V_RMS=Vp/sqrt(2);
14 disp('mV',V_RMS*1000,'The RMS voltage for needed
    deviation is ');
```

---

# Chapter 6

## Receivers

Scilab code Exa 6.1 example 1

```
1 clc;  
2 //page no 227  
3 //prob no. 6.1  
4 //A tuned ckt with broadcast band (540 to 1700 kHz).  
   Bw=10kHz at 540 kHz  
5 BW1=10*103;f1=540*103;f2=1700*103; //all in Hz  
6 //Determination of BW at 1700kHz  
7 BW2=BW1*sqrt(f2/f1);  
8 disp('kHz',BW2/1000,'The Bandwidth at 1700kHz');
```

---

Scilab code Exa 6.4 example 2

```
1 clc;  
2 //page no 236  
3 //prob no. 6.4  
4 //A receiver with sensitivity 0.5uV & blocking  
   dynamic range 70dB.  
5 //Determination of vptage signal V1
```

```

6 P1_P2=70;V2=0.5*10^-6; //let
7 V1=V2*10^(P1_P2/20);
8 disp('mV',V1*1000,'The voltage value of signal is')
;

```

---

#### Scilab code Exa 6.5 example 3

```

1 clc;
2 //page no 238
3 //prob no. 6.5
4 //Refer the fig 6.5
5 //A receiver tuned to station at 590kHz
6 f_if=455*10^3; //Intermediate freq
7 f_sig=590*10^3;
8 //a) Determintion of image freq
9 f_image=f_sig+2*f_if;
10 disp('kHz',f_image/1000,'a)The image freq is');
11 Q=40; // Q_factor
12 //b) Determination of image rejection
13 x=(f_image/f_sig)-(f_sig/f_image);
14 Asig_Aimage=sqrt(1+(Q*x)^2); //image rejection
15 //converting in dB
16 IR_dB=20*log10(Asig_Aimage);
17 disp('dB',IR_dB,'b)The image rejection is');

```

---

#### Scilab code Exa 6.6 example 4

```

1 clc;
2 //page no 239
3 //prob no. 6.6
4 //An AM high-freq receiver with IF=1.8MHz tuned at
  freq 10MHz
5 f_sig=10;f_if=1.8; //All freq in MHz

```

```

6 //Determination of local oscillator freq f_lo
7 f_lo=f_sig+f_if;
8 //determination of freq. that cause IF response
9 m=[1 1 2 2]; //values of m that are integer
10 n=[1 2 1 2]; //values of n that are integer
11 for i=1:4
12     fs1(i)=((m(i)/n(i))*(f_lo))+((f_if)/n(i));
13 end;
14 for i=1:4
15     fs2(i)=((m(i)/n(i))*(f_lo))-((f_if)/n(i));
16 end;
17 disp('All freqs are in MHz',fs2,fs1,'The different
      freqs are');

```

---

#### Scilab code Exa 6.7 example 5

```

1 clc;
2 //page no 245
3 //prob no. 6.7
4 //An FM detector produce Vpp=1.2V with dev=10kHz
5 Vpp=1.2; dev=10*10^3;
6 //Determination of detector sensitivity
7 Vp=Vpp/2; //Peak voltage
8 kd=Vp/dev;
9 disp('uV/Hz',kd*10^6,'the sensitivity of detector is
      ');

```

---

#### Scilab code Exa 6.8 example 6

```

1 clc;
2 //page no 249
3 //prob no. 6.8
4 //A PLL FM detector with kf=100kHz/V & dev=75kHz

```

```

5 kf=100*10^3;dev=75*10^3;
6 //Determination of RMS voltage
7 Vp_op=dev/kf;
8 //Converting peak voltage in RMS voltage
9 V_RMS=Vp_op/sqrt(2);
10 disp('V',V_RMS,'The RMS voltage is');

```

---

#### Scilab code Exa 6.9 example 7

```

1 clc;
2 //page no 258
3 //prob no. 6.9
4 //An IF transformer at 455kHz & primary ckt has Qp
   =40 & secondary Q=30
5 fo=455*10^3;Qp=40;Qs=30;
6 //a)Determination of critical coupling factor
7 kc=1/sqrt(Qp*Qs);
8 disp(kc,'a)The critical coupling factor is');
9 //b)Determination of optimum coupling factor
10 Kopt=1.5*kc;
11 disp(Kopt,'b)The optimum coupling factor is');
12 //c)Determination of optimum coupling factor
13 B=Kopt*fo;
14 disp('kHz',B/1000,'c)The BW using optimum coupling
   factor is');

```

---

#### Scilab code Exa 6.10 example 8

```

1 clc;
2 //page no 261
3 //prob no. 6.10
4 //Receiver refering in fig.6.28
5 f_sig=25*10^6;//signal i/p freq

```

```

6 f_lo1=29.5*10^6; //Ist local oscillator freq
7 //determination of Ist IF which uses high side
  injection
8 f_IF1=f_lo1-f_sig; //high side injection
9 disp('MHz',f_IF1/10^6,'The first IF is ');
10 //Determination of IInd IF which uses low side
  injection
11 f_lo2=4*10^6; //IInd local oscillator freq
12 f_IF2=f_IF1-f_lo2;
13 disp('kHz',f_IF2/10^3,'The second IF is ');

```

---

**Scilab code Exa 6.11** example 9

```

1 clc;
2 //page no 265
3 //prob no. 6.11
4 //An S-meter is given
5 V1=50*10^-6; //signal strength at transmitter in V
6 P=18; //18 dB power
7 V2=V1/(10^(P/20));
8 disp('uV',V2*10^6,'Signal strength at receiver i/p
  is ');

```

---

# Chapter 7

## Digital communication

Scilab code Exa 7.1 example 1

```
1  clc;
2  //page no 285
3  //prob no 7.1
4  // In the given problem a signal is transmitted
   using a four level code
5  M=4;
6  B=3.2; // in KKz
7  SNR=35; //in dB
8  //By using Shannon–Hartley theorem, ignoring noise
   we have
9  c=2*B*log2 (M);
10 disp('kb/s',c,'maximum data rate for four–level code
   in the available bandwidth');
11 //Now we have to use Shannon limit to find the
   maximum data rate for any code
12 //SNR in power ratio is
13 SNR1=10^(35/10);
14 C=B*log2(1+SNR1);
15 disp('kb/s',C,'maximum data rate for four–level code
   in the available bandwidth');
16 // Both results are maxima, we have to choose lesser
```



of the two.  
17 // Therefore we choose  $c=12.8\text{kp/s}$

---

**Scilab code Exa 7.2** example 2

```
1 clc;  
2 //page no. 289  
3 // prob no. 7.2  
4 // In the given problem  
5 fm=30; // in KHz  
6 fs=44.1; //sampling rate in KHz  
7 fa=fs-fm; // audible frequency  
8 disp('KHz',fa, 'The audible frequency is');
```

---

**Scilab code Exa 7.3** example 3

```
1 clc;  
2 //page no 291  
3 //prob no 7.3  
4 //part a: no of samples ,  
5 m=8;  
6 N=2m; // the number of levels  
7 disp('levels',N, 'a) The number of levels with m=8  
   are');  
8 // part b:  
9 m=16;  
10 N=2m; // the number of levels  
11 disp('levels',N, 'b) The number of levels with m=16  
   are');
```

---

#### Scilab code Exa 7.4 example 4

```
1 clc ;
2 // page no 292
3 // prob no 7.4
4 //In the given problem
5 m=16;
6 DR=1.76 +6.02*m ; //Dynamic range for a linear PCM
   in dB
7 disp('dB',DR,'Dynamic range for a linear PCM');
```

---

#### Scilab code Exa 7.5 example 5

```
1 clc ;
2 //page no 295
3 // prob no 7.5
4 // in the given problem
5 fs=40; m=14;
6 // the minimum data rate needed to transmit audio is
   given by
7 D=fs*m;
8 disp('Kb/s',D,'The minimum data rate needed to
   transmit audio is ');
```

---

#### Scilab code Exa 7.6 example 6

```
1 clc ;
2 // page no 294
3 // prob no 7.6
4 // In the given problem , input to a mu-law
   compressor is +ve ,
5 // with its voltage one-half the max value
6 u=255;
```

```
7 Vi=1;//maximum input value is considered as unity
  volts
8 vi=0.5;
9 V0=1;//consider maximum output voltage as unity
  volts
10 vo=V0* log(1+u*vi/Vi)/log(1+u);
11 disp('volts ',vo,'The maximum output voltage produced
      is ');
```

---

# Chapter 8

## The Telephone System

Scilab code Exa 8.3 example 1

```
1 clc;  
2 // page no 323  
3 // prob no 8.3  
4 //A telephone signal takes 3 ms to rreaach its  
   destination  
5 t=2;  
6 //Determination of net loss VNL reqd for acceptable  
   amount of echo.  
7 VNL=(0.2*t)+0.4;  
8 disp('dB',VNL,'The net loss is');
```

---

Scilab code Exa 8.5 example 2

```
1 clc;  
2 // page no 326  
3 // prob no 8.5  
4 //Referring the fig.8.15 channel 12 has lowest  
   carrierr freq 64 kHz
```

```

5 F=64;
6 c_total=12;
7 //Carrier freq goes up 4kHz per channel
8 f_up=4;
9 //Determination of carrier freq for channel 5
10 c=5;
11 fc=F+(f_up*(c_total-c));
12 disp('kHz',fc,'The value of carrier freq for channel
      5 is ');

```

---

### Scilab code Exa 8.6 example 3

```

1 clc;
2 //page no 328
3 //prob no 8.6
4 // 2kHz tone is present on channel 5 of group 3 of a
      supergroup
5 // refer to example 8.5, calculated fc=92kHz
6 fc=92;//in kHz
7 // Here signal is lower sideband ,the 2kHz baseband
      signal therefore will be
8 fg=fc-2;
9 //from fig 10.15,group 3 in the supergroup is moved
      to the range 408-456 kHz, with a suppressed
      carrier frequency of 516kHz.
10 fsc=516;// in kHz
11 //the modulation is lower sideband ,so the supergroup
      o/p freq will be 90kHz lower than carrier freq
12 fsg=fsc-fg;
13 disp('kHz',fsg,'The tone appear in the supergroup
      output at frequency of ');

```

---

# Chapter 9

## Data Transmission

Scilab code Exa 9.2 example 1

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

---

Scilab code Exa 9.6 example 2

```
1 clc;  
2 // page no 358  
3 // prob no 9.6  
4 m=21;  
5 // The correct number of check bits is the smallest  
   number that satisfy the equation  $2^n \geq m+n+1$ ;  
6 for n=1:1:10 // we choose range of 1 to 10  
7     a=m+n+1;
```

```
8     b=2^n;  
9     if(b>=a)  
10        disp(n,'hammming bits are required')  
11        break;  
12     end  
13 end
```

---

# Chapter 12

## Digital Modulation and Modems

Scilab code Exa 12.1 example 1

```
1  clc;
2  // page no 407
3  // prob no 12_1
4  //A radio channel with BW=10KHz and SNR=15 dB
5  B=10*103;
6  snr=15;
7  //converting dB in power ratio
8  SNR=10(snr/10);
9  //a) Determination of theoretical max data rate
10 C1=B*log2(1+SNR);
11 disp('kb/s',C1/1000,'a')The theoretical max data rate
    is ');
12 //b) Determination of data rate with 4 states i.e M=4
13 M=4;
14 C2=2*B*log2(M);
15 disp('kb/s',C2/1000,'b')The data rate for 4 states is
    ');
```

---



### Scilab code Exa 12.2 example 2

```
1 clc;  
2 // page no 408  
3 // prob no 12_2  
4 //A modulator transmit symbol with symbol rate=10k/  
   sec with 64 states  
5 M=64;  
6 S=10000;  
7 //Baud rate is simply symbol rate  
8 disp('kbaud',S/1000,'The baud rate is ');  
9 //Determination of bit rate  
10 C=S*log2(64);  
11 disp('kb/s',C/1000,'The bit rate is ');
```

---

### Scilab code Exa 12.3 example 3

```
1 clc;  
2 // page no 411  
3 // prob no 12_3  
4 f=200*103;  
5 fb=270.833 *103;  
6 data_rate=270.833 *103  
7 fc=880*106;  
8 bandwidth=200*103;  
9 freq_shift=0.5*fb;  
10 disp('Hz',freq_shift,'a)The frequency shift is');  
11 // The shift each way from the carrier frequency is  
   half the freq_shift  
12 f_max=fc+0.25*fb;  
13 disp('Hz',f_max,'b)The maximum frequency is');  
14 f_min=fc-0.25*fb;
```

```
15 disp('Hz',f_min,'The minimum frequency is');
16 bandwidth_efficiency=data_rate/bandwidth;
17 disp('b/s/Hz',bandwidth_efficiency,'The bandwidth
    efficiency in b/s/Hz is');
```

---

#### Scilab code Exa 12.4 example 4

```
1 clc;
2 // page no 412
3 // prob no 12_4
4 baud_rate=24.3;// in kilobaud
5 // In this problem dibit system is used.
6 //Therefore symbol_rate=baud_rate=0.5*bit_rate
7 bit_rate=2*baud_rate;
8 disp('kb/s',bit_rate,'The channel data rate is');
```

---

#### Scilab code Exa 12.5 example 5

```
1 clc;
2 // page no 413
3 // prob no 12_5
4 no_of_phase_angles=16;
5 no_of_amplitudes=4;
6 no_of_states_per_symbol=no_of_phase_angles*
    no_of_amplitudes;
7 bit_per_symbol=log2(no_of_states_per_symbol);
8 disp(bit_per_symbol,'The no. of bits per symbol is')
    ;
```

---

#### Scilab code Exa 12.6 example 6

```
1 clc;  
2 // page no 415  
3 // prob no 12_6  
4 B=3*103;SNR_dB=30;  
5 SNR_power=10(30/10);  
6 C=B*log2(1+SNR_power);  
7 disp('b/s',C,'Shannon limit');
```

---

# Chapter 13

## Multiplexing and Multiple Access Techniques

Scilab code Exa 13.1 example 1

```
1  clc;
2  // page no 437
3  // prob no 13_1
4  freq_band=1*10^6;
5  // A)For SSBSC AM, the bandwidth is the same as the
   maximumm modulating freq.
6  fmax=4*10^3;
7  B=fmax;
8  no_of_signal=freq_band/B;
9  disp(no_of_signal,'a)The number of signals are');
10 // B)For DSB AM, the bandwidth is twice the maximumm
   modulating freq.
11 B=2*fmax;
12 no_of_signal=freq_band/B;
13 disp(no_of_signal,'b)The number of signals are');
14 // C)Using Carson's Rule to approximate the
   bandwidth
15 f_max=15*10^3; deviation=75*10^3;
16 B=2*(deviation + f_max);
```

```

17 no_of_signal=freq_band/B;
18 disp(no_of_signal,'c)The number of signals are');
19 // D)Use Shannon–Hartley theorem to find the
    bandwidth
20 C=56*10^3;M=4;//for QPSK
21 B=C/(2*log2(M));
22 no_of_signal=freq_band/B;
23 disp(no_of_signal,'d)The number of signals are');

```

---

### Scilab code Exa 13.2 example 2

```

1  clc;
2  // page no 444
3  // prob no 13_2
4  //Voice transmisssion occupies 30 kHz.Spread
    spectrum is used to increase BW to 10MHz
5  B1=30*10^3;//BW is 30 kHz
6  B2=10*10^6;//BW is 10 MHz
7  T=300;//noise temp at i/p
8  PN=-110;//signal has total signal power of -110 dBm
    at receiver
9  k=1.38*10^-23;//Boltzmann's const in J/K
10 //Determination of noise power at B1=30kHz
11 PN1=10*(log10(k*B1*T/10^-3));
12 disp('dBm',PN1,'The noise power at BW=30 kHz is');
13 //Determination of noise power at B2=10MHz
14 PN2=10*(log10(k*B2*T/10^-3));
15 disp('dBm',PN2,'The noise power at BW=10 MHz is');
16 //Determination of SNR for 30kHz BW
17 SNR1=PN-PN1;
18 disp('dB',SNR1,'The value of SNR for BW=30 kHz is');
19 //Determination of SNR for 10MHz BW
20 SNR2=PN-PN2;
21 disp('dB',SNR2,'The value of SNR for BW=10 MHz is');

```

---

### Scilab code Exa 13.3 example 3

```
1 clc;  
2 // page no 445  
3 // prob no 13_3  
4 no_of_freq_hops =100; total_time_req=10;  
5 time_for_each_freq = total_time_req /  
    no_of_freq_hops;  
6 disp('sec/hop',time_for_each_freq,'Time required for  
    each freq');
```

---

### Scilab code Exa 13.4 example 4

```
1 clc;  
2 // page no 446  
3 // prob no 13_4  
4 bit_rate=16*103; //in bps  
5 chip_rate =10:1;  
6 no_of_chip=10;  
7 total_bit_rate=no_of_chip*bit_rate;  
8 m=4;n=log2(m);  
9 symbol_rate = total_bit_rate/n;  
10 disp('baud',symbol_rate,'The no of signal changes i.  
    e. symbol rate is');
```

---

### Scilab code Exa 13.5 example 5

```
1 clc;  
2 // page no 447
```

```

3 // prob no 13_5
4 //signal with bandwidth Bbb=200 kHz & SNR=20 dB
   spread at chip rate 50:1
5 Bbb=200*10^3; //Bandwidth
6 Gp=50; //chip rate
7 SNR_in=20; //SNR is 20 dB without spreading
8 //Determination of BW after spreading
9 Brf=Gp*Bbb;
10 disp('MHz',Brf,'The value of BW after spreading');
11 //Converting into dB
12 Gp_dB=10*log10(Gp);
13 disp('dB',Gp_dB,'The value of processing gain');
14 //Determination of SNR after spreadng
15 SNR_out=SNR_in-Gp_dB;
16 disp('dB',SNR_out,'The value of SNR after spreading
   in dB');

```

---

# Chapter 14

## Transmission Lines

Scilab code Exa 14.1 example 1

```
1 clc ;
2 //page no 461
3 //prob no. 14.1
4 //A coaxial cable with capacitance=90pF/m &
   characteristic impedance=50 ohm
5 C=90*10-12;Zo=50;
6 //Determination of inductance of 1m length
7 L=(Zo2)*C;
8 disp('nH/m',L*109, 'The inductance of 1m length is ')
   ;
```

---

Scilab code Exa 14.2 example 2

```
1 clc ;
2 //page no 462
3 //prob no. 14.2
4 //a) Determination of impedance of open wire with
   diameter 3mm & r=10mm
```



```

5 D=3/2;r=10;// All values are in mm
6 Zo1=276*log10(r/D);
7 disp('ohm',Zo1,'a')The characteristic impedance of
  conductor is');
8 //b) Determination of impedance of coaxial with er
  =2.3,inner diameter=2mm & outer diameter=8mm
9 er=2.3;D=8;d=2;// All diameter values in mm
10 Zo2=(138/sqrt(er))*log10(D/d);
11 disp('ohm',Zo2,'b')The characteristic impedance of
  coaxial cable is');

```

---

#### Scilab code Exa 14.3 example 3

```

1 clc;
2 //page no 463
3 //prob no. 14.3
4 //Cable with teflon dielectric er=2.1
5 er=2.1;c=3*10^8;//Velocity of light
6 //Determination of velocity factor
7 Vf=1/sqrt(er);
8 disp(Vf,'The value of velocity factor is');
9 //Determination of propagation velocity
10 Vp=Vf*c;
11 disp('m/s',Vp,'The value of propagation velo. is');

```

---

#### Scilab code Exa 14.4 example 4

```

1 clc;
2 //page no 468
3 //prob no. 14.4
4 //Refer fig. 14.13(a)
5 vs=1;//source voltage
6 Rs=50;//source resistance

```

```

7 Zo=50; //line impedance
8 RL=25; //load resistance
9 l=10; //length of line
10 vf=0.7; //velocity factor
11 Vi=0.5;
12 c=3*10^8; //velo of light
13 //Vs will divide between Rs and Zo of the line. Since
    two resistors are equal, the voltage will divide
    equally.
14 //Therefore at t=0, the voltage at the source end of
    the line will rise from zero to 0.5V. The voltage
    at the load will remain zero until the surge
    reaches it. The time for this is
15 T=1/(vf*c);
16 // After T sec, the voltage at the load will rise.
    The reflection coefficient is given as
17 refl_coeff=(RL-Zo)/(RL+Zo)
18 //Now reflection voltage is
19 Vr=refl_coeff * Vi;
20 //The total voltage at the load is
21 Vt=Vr+Vi;
22 disp('V',Vt,'The total voltage at the load is');
23 // The reflected voltage will propagate back along
    the line, reaching the source at time 2T. After
    this the voltage will be 0.3335V all along the
    line
24 //The voltage across the line, and the load will be
25 VL=vs*(RL/(RL+Zo));
26 disp('V',VL,'The voltage across the line,');

```

---

#### Scilab code Exa 14.5 example 5

```

1 clc;
2 //page no 472
3 //prob no. 14.5

```

```

4 //Standard coaxial cable RG-8/U with 45 degree phase
  shift at 200MHz
5 p=45;f=200*10^6;c=3*10^8;//Speed of light in m/s
6 vf=0.66;//velo. factor for this line
7 vp=vf*c;//Determination of propagation velo.
8 wav=vp/f;//Determination of wavelength of signal
9 //Determination of reqd length for 45 degree phase
  shift
10 L=wav*(p/360);
11 disp('m',L,'The length reqd for phase shift is');

```

---

#### Scilab code Exa 14.6 example 6

```

1 clc;
2 //page no 476
3 //prob no. 14.6
4 //A 50ohm line terminated in 25ohm resistance
5 Zo=50;Zl=25;
6 //Determination of SWR
7 SWR=Zo/Zl;//In this case Zo>Zl
8 disp(SWR,'The value of SWR is');

```

---

#### Scilab code Exa 14.7 example 7

```

1 clc;
2 //page no 477
3 //prob no. 14.7
4 //A generator sends 50mW at 50ohm line & reflection
  coeff I=0.5
5 Pi=50;I=0.5;
6 //Determination of amount of power reflected
7 Pr=(I^2)*Pi;
8 disp('mW',Pr,'The amount of power reflected is');

```

```

9 //Determination of remainder power that reaches load
10 P1=Pi-Pr;
11 disp('mW',P1,'The power dissipated in load is');

```

---

#### Scilab code Exa 14.8 example 8

```

1 clc;
2 //page no 478
3 //prob no. 14.8
4 //A transmitter supplies 50W with SWR 2:1
5 Pi=50;SWR=2;
6 //Determination of power absorbed by load
7 P1=(4*SWR*Pi)/(1+SWR)^2;
8 disp('W',P1,'The power absorbed by load is');

```

---

#### Scilab code Exa 14.9 example 9

```

1 clc;
2 // page no 545
3 // prob no 14.9
4 Zo=50;// line impedance in ohm
5 ZL=100;// load impedance in ohm
6 vf=0.8;//velocity factor
7 l=1;//length of line
8 f=30*10^6;// freq of operation
9 c=3*10^8;//velo of light
10 // we have to find the length of line in degree
11 wl=vf*c/f//wavelength
12 // Then the length of line in degree is
13 ang=l/wl*360
14 // calculation of impedance
15 Z=Zo*(ZL+(%i*Zo*tand(ang)))/(Zo+(%i*ZL*tand(ang)));

```

```
16 disp('ohm',Z,'The impedance looking toward the load '
    ');
```

---

#### Scilab code Exa 14.10 example 10

```
1 clc;
2 //page no 481
3 //prob no. 14.10
4 //A series tuned ckt tuned at 1GHz
5 vf=0.95;c=3*10^8;f=10^9;
6 vp=vf*c;//determination of propagation velo.
7 wav=vp/f;//Determination of wavelength
8 //Determination of length
9 L=wav/2;//Since half wavelength section will be
    series resonant
10 disp('m',L,'The length should be');
```

---

#### Scilab code Exa 14.11 example 11

```
1 clc;
2 //page no 481
3 //prob no. 14.10
4 //A Tx deliver 100W to antenna through 45m coaxial
    cable with loss=4dB/100m
5 loss=4/100;L=45;Pout=100;
6 loss_dB=L*loss;//Determination of loss in dB
7 Pin_Pout=10^(loss_dB/10);
8 //Determination of Tx power
9 Pin=Pout*Pin_Pout;
10 disp('W',Pin,'The transmitter power must be');
```

---

### Scilab code Exa 14.13 example 12

```
1 clc ;
2 //page no 490
3 //prob no. 14.13
4 Zo=50; //line impedance in ohm
5 f=100*10^6; //operating freq
6 vf=0.7; //velocity factor
7 L=6; //length in m
8 c=3*10^8; //velo of light
9 ZL=50+%i*50; //load impedance in ohm
10 // we have to calculate length in degree ,so for this
    first find wl
11 wl=vf*c/f; //wavelength in m
12 ang=360*L/wl;
13 // now from the graph input impedance is 19.36+%i5
    .44;
14 Zi=19.36+%i*5.44;
15 disp('ohm',Zi,'Input impedance is');
```

---

### Scilab code Exa 14.14 example 13

```
1 clc ;
2 //page no 492
3 //prob no. 14.14
4 Zo=50; //line impedance in ohm
5 ZL=75+%i*25;
6 // the requirment of this is simply to match the 50
    ohm line to the impedsnce at this point on the
    line ,which is 88.38 ohm, resistive.
7 Z2=88.38; //in ohm
8 //The required turn ratio is
9 N1_N2=sqrt(Zo/Z2);
10 disp(N1_N2,'The required turn ratio is');
```

---

**Scilab code Exa 14.15** example 14

```
1 clc ;
2 //page no 494
3 //prob no. 14.15
4 // refer prob no 14.14
5 Zo=50; //line impedance in ohm
6 Z2=88.38; //in ohm
7 Zo_=sqrt(Zo*Z2);
8 disp(Zo_ '');
```

---

**Scilab code Exa 14.16** example 15

```
1 clc ;
2 //page no 494
3 //prob no. 14.16
4 Zo=50; //line impedance in ohm
5 f=100*106; //operating freq in Hz
6 ZL1=50+%i*75; // load impedance with Xc=75
7 Xc=75;
8 // Capacitance in farads is given as
9 C=1/(2*%pi*f*Xc);
10 disp('F',C, 'Capacitance is');
```

---

**Scilab code Exa 14.17** example 16

```
1 clc ;
2 //page no 497
3 //prob no. 14.17
```

```

4 Zo=72; //line impedance in ohm
5 ZL=120-%i*100; //load impedance
6 //The stub must be inserted at a point on the line
   where the real part of the load admittance is
   correct. This alue is
7 s=1/Zo;
8 disp('S',s,'The value of stude is');

```

---

#### Scilab code Exa 14.18 example 17

```

1 clc;
2 //page no 501
3 //prob no. 14.18
4 //A TDR display shows dscontinuity at 1.4us & vf
   =0.8
5 t=1.4*10^-6;vf=0.8;c=3*10^8; //Speed of light
6 //Determination of distance of fault
7 d=(vf*c*t)/2; //One-half time is used to calculate
8 disp('m',d,'The distance is');

```

---

#### Scilab code Exa 14.19 example 18

```

1 clc;
2 //page no 503
3 //prob no. 14.19
4 //2 adjacent minima on slotted are 23cm apart with
   velo factor=95%
5 L=23*10^-2;vf=0.95;c=3*10^8; //Velo. of light in m/s
6 //Determination of wavelength
7 wav=2*L; //Minima are seperated by one-half
   wavelength
8 disp('cm',wav*100,'The wavelength is');
9 //Determination of freq.

```



```
10 f=(vf*c)/wav; //vp=vf*c
11 disp('MHz',f/10^6,'The freq is');
```

---

**Scilab code Exa 14.20** example 19

```
1 clc;
2 //page no 504
3 //prob no. 14.20
4 //Frwd power in Tx line is 150W, Reverse power=20W
5 Pi=150;Pr=20; //All power in watt
6 //Determination of SWR
7 SWR=(1+sqrt(Pr/Pi))/(1-sqrt(Pr/Pi));
8 disp(SWR,'The value of SWR is');
```

---

# Chapter 15

## Radio Wave Propagation

Scilab code Exa 15.1 example 1

```
1 clc;  
2 //page no 517  
3 //prob no. 15.1  
4 //Dielectric constt=2.3  
5 er=2.3;  
6 //Determination of characteristic impedance  
7 Z=377/sqrt(er);  
8 disp('ohm',Z,'The charasteristic impedance of  
    polyethylene is');
```

---

Scilab code Exa 15.2 example 2

```
1 clc;  
2 //page no 518  
3 //prob no. 15.2  
4 //Dieleelectric strength of air=3MV/m  
5 e=3*106; //electric field strength  
6 Z=377; //impedance of air
```

```
7 Pd=(e^2)/Z; //Determination of power density
8 disp('GW/m2',Pd/10^9,'The max power density is');
```

---

#### Scilab code Exa 15.3 example 3

```
1 clc;
2 //page no 520
3 //prob no. 15.3
4 //An isotropic radiator with power 100W & dist given
   is 10km
5 Pt=100;r=10*10^3;
6 //Determination of power density at r=10km
7 Pd=Pt/(4*%pi*(r^2));
8 disp('nW/m2',Pd*10^9,'Power density at a point 10km'
   );
```

---

#### Scilab code Exa 15.4 example 4

```
1 clc;
2 //page no 521
3 //prob no. 15.4
4 //An isotropic radiator radiates power=100W at point
   10km
5 Pt=100;r=10*10^3;
6 //Determination of electric field strength
7 e=sqrt(30*Pt)/r;
8 disp('mW/m',e*1000,'The electric field strength is')
   ;
```

---

#### Scilab code Exa 15.5 example 5

```

1  clc;
2  //page no 525
3  //prob no. 15.5
4  //A transmitter with power o/p=150W at fc=325MHz.
   antenna gain=12dBi receiver antenna gain=5dBi at
   10km away
5  //considering no loss in the system
6  d=10;Gt_dBi=12;Gr_dBi=5;fc=325;Pt=150;
7  //Determination of power delivered
8  Lfs=32.44+(20*log10(d))+(20*log10(fc))-(Gt_dBi)-(
   Gr_dBi);
9  Pr=Pt/(10^(Lfs/10));
10 disp('nW',Pr*10^9,'The power delivered to receiver
   is ');

```

---

#### Scilab code Exa 15.6 example 6

```

1  clc;
2  //page no 525
3  //prob no. 15.6
4  //A transmitter with o/p power=10W at fc=250MHz,
   connected to Tx 10m line with loss=3dB/100m to
   antenna with gain=6dBi.Rx antenna 20km away with
   gain=4dBi
5  //Refer fig.15.6,assuming free space propagation
6  d=20;fc=250;Gt_dBi=6;Gr_dBi=4;loss=3/100;Zl=75;Zo
   =50;L=10;Pt=10;
7  Lfs=32.44+(20*log10(d))+(20*log10(fc))-Gt_dBi-Gr_dBi
   ;//path loss
8  disp(Lfs);
9  L_tx=L*loss;//Determination of loss
10 ref_coe=(Zl-Zo)/(Zl+Zo);//Reflection coefficient
11 L_rx=1-(ref_coe^2);//Proportion of incident power
   that reaches load
12 L_rx_dB=-10*log10(L_rx);//Converting that proportion

```

```

        in dB
13 //Determination of total loss Lt
14 Lt=(Lfs)+(L_tx)+(L_rx_dB);
15 //Determination of power delivered to receiver
16 Pt_Pr=10^(Lt/10); //Power ratio
17 Pr=Pt/Pt_Pr;
18 disp('W',Pr,'The power delivered to receiver is');

```

---

#### Scilab code Exa 15.7 example 7

```

1 clc;
2 //page no 530
3 //prob no. 15.7
4 //A radio wave moves from air(er=1) to glass(er=7.8)
   .angle of incidence=30 deg
5 theta_i=30;er1=1;er2=7.8;
6 //determination of angle of refraction
7 theta_r=asind((sind(theta_i))/(sqrt(er2/er1)));
8 disp('degree',theta_r,'The angle of refraction is');

```

---

#### Scilab code Exa 15.8 example 8

```

1 clc;
2 //page no 537
3 //prob no. 15.8
4 //A Tx statn with fc=11.6MHz & angle of incidence=70
   degree
5 theta_i=70;fc=11.6; //in MHz
6 //determination of max usable freq(MUF)
7 MUF=fc/(cosd(theta_i));
8 disp('MHz',MUF,'The max usable freq MUF is');

```

---

### Scilab code Exa 15.9 example 9

```
1  clc;  
2  //page no 539  
3  //prob no. 15.9  
4  //A taxi compony using central dispatcher with  
   antenna height=15m & taxi antenna height=1.5m  
5  ht=15;hr=1.5;  
6  //a) Determination of max commn dist betn dispatcher  
   and taxi  
7  d1=sqrt(17*ht)+sqrt(17*hr);  
8  disp('km',d,'a)The max commn dist betn dispatcher &  
   taxi');  
9  //b) Determination of max ommn dist betn 2 taxis  
10 d2=sqrt(17*hr)+sqrt(17*hr); //ht=hr=height of antenna  
   of taxi cab  
11 disp('km',d2,'The max commn dist betn two taxi is');
```

---

### Scilab code Exa 15.11 example 10

```
1  clc;  
2  // page no 545  
3  // prob no 15.11  
4  // An automobile travels at 60km/hr  
5  v=60*103/(60*60); //conversion of car's speed to m/s  
6  c=3*108; //speed of light  
7  //part a) calculation of time between fades if car  
   uses a cell phone at 800*106Hz  
8  f=800*106;  
9  T=c/(2*f*v);  
10 disp('sec',T,'The fading period is');
```

```
11 //part b) calculation of time between fades if car
    uses a PCS phone at  $1900 \times 10^6$  Hz
12 f=1900*10^6;
13 T=c/(2*f*v);
14 disp('sec',T,'The fading period is');
15 // Note that the rapidity of the fading increases
    with both the frequency of the transmissions and
    the speed of the vehicle
```

---

Scilab code Exa 15.12 example 11

```
1 clc;
2 //page no 550
3 // problem no 15.12
4 A=1000;//metropolitan area expressed in sq. km
5 r=2;//radius of cell in km
6 // Number of cell sites given as
7 N=A/(3.464*r^2);
8 disp(N,'Number of cell sites are');
```

---

# Chapter 16

## Antennas

Scilab code Exa 16.1 example 1

```
1 clc;  
2 //page no 564  
3 //prob no. 16.1  
4 //Determination of length of half-wave dipole  
5 f=20;//Operating freq in MHz  
6 L=142.5/f;  
7 disp('m',L,'The length of half-wave dipole is');
```

---

Scilab code Exa 16.2 example 2

```
1 clc;  
2 //page no 566  
3 //prob no. 16.2  
4 //A dipole antenna with radiatn resistance=67ohm &  
   loss resistance 5ohm  
5 Rr=67;Rl=5;  
6 //Determination of efficiency  
7 eta=Rr/(Rr+Rl);  
8 disp('%',eta,'The efficiency of dipole antenna is');
```



---

**Scilab code Exa 16.3** example 3

```
1 clc;  
2 //page no 569  
3 //prob no. 16.3  
4 //Two antennas with gain 5.3dBi & 4.5dBd  
5 //Converting unit dBd in dBi for comparison  
6 G1_dBi=5.3;G2_dBd=4.5;  
7 G2_dBi=2.14+G2_dBd;  
8 if G2_dBi > G1_dBi then  
9     disp('Second antenna with gain=4.5dBd has higher  
        gain ');  
10 else  
11     disp('First antenna with gain=5.3dBi has higher  
        gain ');  
12 end;
```

---

**Scilab code Exa 16.4** example 4

```
1 clc;  
2 //page no 571  
3 //prob no. 16.4  
4 //A dipole antenna with efficiency=85% given  
5 n=0.85;D_dBi=2.14;//Directivity in dBi  
6 //Determination of gain in dB  
7 D=10^(D_dBi/10);  
8 G=D*n;//Determination of gain  
9 G_dBi=10*log10(G);//Converting to dBi  
10 disp('dBi',G_dBi,'The gain is');
```

---

### Scilab code Exa 16.6 example 5

```
1 clc ;
2 //page no 573
3 //prob no. 16.6
4 //ERP of Tx statn=17W
5 ERP=17;
6 //Determnation of EIRP
7 ERP_dBm=10*log10(ERP/10^-3); //Converting ERP in dBm
8 EIRP_dBm=ERP_dBm+2.14; //Converting ERP in EIRP
9 disp('dBm',EIRP_dBm,'EIRP in dBm is expressed as');
```

---

### Scilab code Exa 16.7 example 6

```
1 clc ;
2 //page no 582
3 //prob no. 16.7
4 //a helial antenna with 8 turns with freq=1.2GHz
   given
5 N=8;f=1.2*10^9;c=3*10^8; //Speed of light in m/s
6 //a)Determination of optimum diameter of antenna
7 wav=c/f;
8 D=wav/%pi;
9 disp('m',D,'a)1.The optimum diameter for antenna is ');
10 S=wav/4; //Determination of spacing for the antenna
11 disp('m',S,'a)2.The spacing for the antenna');
12 L=N*S; //Determination of total length of an antenna\
13 disp('m',L,'a)3.The total length of an antenna is ');
14 //b)Determination of antenna gain in dBi
15 G=(15*N*S*(%pi*D)^2)/(wav^3);
16 G_dBi=10*log10(G); //Converting in dBi
17 disp('dBi',G_dBi,'b)The antenna gain is ');
18 //c)determination of beamwidth
19 theta=((52*wav)/(%pi*D))*sqrt(wav/(N*S));
```

```
20 disp('degree',theta,'The beamwidth is');
```

---

#### Scilab code Exa 16.8 example 7

```
1 clc;
2 //page no 590
3 //prob no. 16.8
4 //Design of log periodic antenna to cover freq
   100-300MHz & t=0.7,a=30 degree
5 t=0.7;a=30;
6 //For good performance converting range to 90MHz to
   320MHz
7 f2=90;f1=320;
8 //Determination of lengths of elements
9 L1=142.5/f1;//For freq of 320MHz
10 L2=L1/t;L3=L2/t;L4=L3/t;L5=L4/t;
11 disp('The length of elements are');
12 disp('m',L5,'L5=', 'm',L4,'L4=', 'm',L3,'L3=', 'm',L2,'
   L2=', 'm',L1,'L1=',);
13 //Determination of spacing betn elements
14 D1=L1/(2*tand(a/2));
15 D2=D1/t;D3=D2/t;D4=D3/t;D5=D4/t;
16 disp('The spacing betn elements are');
17 disp('m',D5,'D5=', 'm',D4,'D4=', 'm',D3,'D3=', 'm',D2,'
   D2=', 'm',D1,'D1=',);
```

---

#### Scilab code Exa 16.9 example 8

```
1 clc;
2 //page no 598
3 //prob no. 16.9
4 //A parabolic antenna with diameter=3m & efficiency
   =60% operate at 4GHz
```

```
5 D=3;n=0.6;f=4*10^9;c=3*10^8;//Speed of light
6 //Determination of gain & beamwidth
7 wav=c/f;//Determination of free space wavelength
8 theta=(70*wav)/D;//Calculaing beamwidth
9 disp('degree',theta,'The beamwidth is');
10 G=(n*(%pi^2)*(D^2))/wav^2;//Calculating gain
11 //Converting gain in dBi
12 G_dBi=10*log10(G);
13 disp('dBi',G_dBi,'The gain is');
```

---

# Chapter 17

## Microwave Devices

Scilab code Exa 17.1 example 1

```
1 clc;  
2 //page no 621  
3 //prob no. 17.1  
4 //TE10 mode in air dielectric mode with inside cross  
   sectn=2cm*4cm  
5 //Determination of cut-off freq  
6 a=4*10^-2;//largest dimn is used for calculation  
7 c=3*10^8;//Speed of light in m/s  
8 fc=c/(2*a);  
9 //Determination of dominant mode of propagation over  
   2:1  
10 MUF=2*fc;  
11 disp('Hz',MUF,'The max usable freq is');
```

---

Scilab code Exa 17.2 example 2

```
1 clc;  
2 //page no 624
```

```

3 //prob no. 17.2
4 //Determination of group velo for waveguide in
   example 7.1
5 f=5*10^9; //freq.in Hz
6 fc=3.75*10^9; //cut-off freq from eg.7.1
7 c=3*10^8; //speed of light in m/s
8 vg=c*sqrt(1-(fc/f)^2);
9 disp('m/s',vg,'The group velo.is ');

```

---

### Scilab code Exa 17.3 example 3

```

1 clc;
2 //page no 624
3 //prob no. 17.3
4 //A waveguide with fc=10GHz.2 signal withfreq 12 &
   17GHz propogate down=50m
5 fc=10*10^9;c=3*10^8;f1=12*10^9;f2=17*10^9;d=50;
6 //Determination of group velo for 12GHz
7 vg1=c*sqrt(1-(fc/f1)^2);
8 disp('m/s',vg1,'The group velo. for 12GHz signal is ');
9 //Determination of group velo for 17GHz
10 vg2=c*sqrt(1-(fc/f2)^2);
11 disp('m/s',vg2,'The group velo. for 17GHz signal is ');
12 //Determination of time taken for 50m dist by f1
13 t1=d/vg1;
14 //Determination of time taken for 50m dist by f2
15 t2=d/vg2;
16 //Determination of diffn in the travel times for 2
   signals
17 del=t1-t2;
18 disp('sec',del,'The diffn in the travel times for 2
   signals is ');

```

---

#### Scilab code Exa 17.4 example 4

```
1 clc;  
2 //page no 627  
3 //prob no. 17.4  
4 //Determination of phase velo.with given 5GHz freq  
5 f=5*109;c=3*108;fc=3.75*109; //Cut-off freq  
   refering eg.17.1  
6 vp=c/sqrt(1-(fc/f)2); //Calculation of phase velo.  
7 disp('m/s',vp,'The phase velo is');
```

---

#### Scilab code Exa 17.5 example 5

```
1 clc;  
2 //page no 628  
3 //prob no. 17.5  
4 //determination of characteristic impedance of  
   waveguide with given 5GHz freq  
5 f=5*109;fc=3.75*109; //Refering in eg. 17.4  
6 Zo=377/sqrt(1-(fc/f)2);  
7 disp('ohm',Zo,'The characteristic impedance of  
   waveguide is');
```

---

#### Scilab code Exa 17.7 example 6

```
1 clc;  
2 //page no 631  
3 //prob no. 17.7  
4 //A signal with level of 20dBm & insertion loss=1dB  
   & coupling =20dB,directivity=40dB
```

```

5 sig_in=20;loss=1;couple=20;direct=40;
6 //Determination of signal level in main guide
7 sig_level_main=signal_in-loss;
8 disp('dBm',sig_level_main,'The signal level in main
    guide is ');
9 //Determination of signal level in secondary guide
10 sig_level_sec=sig_in-couple;
11 disp('dBm',sig_level_sec,'The signal level in
    secondary guide is ');
12 //If signal dirn in main guide were reversed,the
    signal level in sec gide would reduced by 40dB to
13 sig_sec_rev=(sig_level_sec)-(direct);
14 disp('dBm',sig_sec_rev,'The signal level from sec
    guide when reversed guide is ');

```

---

#### Scilab code Exa 17.8 example 7

```

1 clc;
2 //page no 642
3 //prob no. 17.8
4 //A Gunn device with thickness=7um
5 d=7*10^-6;v=10^5;//Basic velocity of e
6 t=d/v;//Basic velocity relation
7 //Determination of freq of oscillation
8 f=1/t;//Inverse of period is freq
9 disp('Hz',f,'The freq of oscillation is ');

```

---

#### Scilab code Exa 17.9 example 8

```

1 clc;
2 //page no 648
3 //prob no. 17.9

```



```

4 //A pulse magnetron with avg power=1.2kW & peak
   power=18.5kW & 1 pulse is generated every 10ms
5 Pavg=1.2*10^3;Pp=18.5*10^3;Tt=10*10^-3;
6 //Determination of duty cycle
7 D=Pavg/Pp;
8 disp(D,'The duty cycle is ');
9 //Determination of length of pulse
10 Ton=D*Tt;
11 disp('sec',Ton,'The length of pulse is ');

```

---

#### Scilab code Exa 17.10 example 9

```

1 clc;
2 //page no 652
3 //prob no. 17.10
4 //A pyramidal horn has aperture=58mm in E-plane & 78
   mm in H-plane & operates at 10GHz
5 f=10*10^9;c=3*10^8;dH=78*10^-3;dE=58*10^-3;
6 //a)Determination of gain in dB
7 wl=c/f;//calculation of wavelength
8 G=(7.5*dE*dH)/(wl^2);
9 G_dBi=10*log10(G);//Converting to dBi
10 disp('dBi',G_dBi,'a)The gain is ');
11 //b)Determination of beamwidth in H-plane
12 theta_H=(70*wl)/dH;
13 disp('degree',theta_H,'b)The beamwidth in H-plane is
   ');
14 //c)Determination of beamwidth in E-plane
15 theta_E=(56*wl)/dE;
16 disp('degree',theta_E,'c)The beamwidth in H-plane is
   ');

```

---

#### Scilab code Exa 17.11 example 10

```

1  clc;
2  //page no 654
3  // problem no 17.11
4  //for a square patch antenna
5  f=2*106; // freq of operation in Hz
6  Er=2; // relative permittivity
7  c=3*108; // velo of light
8  //wavelength is given as
9  wl=c/(f*sqrt(Er));
10 //The antenna width and length are each
    approximately half of this.
11 w=wl/2;
12 l=wl/2;
13 disp('m',w,'The antenna width ','and','m',l,'The
    antenna length ');

```

---

#### Scilab code Exa 17.12 example 11

```

1  clc;
2  //page no 657
3  //prob no. 17.12
4  //A radar Tx has power=10kW at freq=9.5GHz & target
    at 15km with cross sectn=10.2 m2 with gain of
    antenna is 20dBi
5  f=9.5*109; Pt=10*103; c=3*108; G_dBi=20; a=10.2; r
    =15*103;
6  //Determination of received power
7  wl=c/f; //calculating wavelength
8  G=10^(G_dBi/10); //Converting to power ratio
9  Pr=((wl2)*Pt*(G2)*a)/(((4*%pi)3*(r4));
10 disp('W',Pr,'The received power is ');

```

---

#### Scilab code Exa 17.13.a example 12

```

1 clc;
2 //page no 659
3 //prob no. 17.13a
4 //a pulse sent ,returns after 15us
5 t=15*10-6;c=3*108;
6 //Determination of distance of target
7 R=(c*t)/2;
8 disp('m',R,'The distance of target is ');

```

---

#### Scilab code Exa 17.13.b example 13

```

1 clc;
2 //page no 660
3 //prob no. 17.13.b
4 tp=10-6;//pulse duration of pulse radar
5 f=103;//operating freq in Hz
6 //The maximum unambiguous range is
7 Rmax=c/(2*f);
8 disp('m',Rmax,'The maximum range is ');
9 //The minimum unambiguous range is
10 Rmin=c*tp/2;
11 disp('m',Rmin,'The minimum range is ');

```

---

#### Scilab code Exa 17.14 example 14

```

1 clc;
2 //page no 662
3 //prob no. 17.14
4 v=60;//speed of vehicle moving towards radar in mph
5 c=3*108;//velo of light in m/s
6 f=1010;// operating frequency in Hz
7 // conversion of speed from mph to km/hr
8 v1=60*1.6;

```

```
9 // conversion of speed from km/hr to m/s
10 v2=v1*10^3/3600;
11 // Now the Doppler shift is found as
12 fd=2*v2*f/c;
13 disp('Hz',fd,'The Doppler shift is ');
```

---

# Chapter 18

## Terrestrial Microwave Communication system

Scilab code Exa 18.1 example 1

```
1 clc;  
2 // page no 676  
3 // prob no 18_1  
4 // Transmitter and receiver have same height at dist  
   40km  
5 d=40; //dist is 40 km  
6 h=(d^2)/68; // As  $d = \sqrt{17h} + \sqrt{17h}$   
7 disp('m',h, 'The height of each tower must be at  
   least ')1;
```

---

Scilab code Exa 18.2 example 2

```
1 clc;  
2 // page no 678  
3 // prob no 18_2  
4 // A line of sight radio link at freq 6GHz with  
   seperation 40 km betn antennas
```

```

5 f=6;d1=10;d2=30;//obstacle located at 10 km
6 //Determination of dist R to clear obstacle
7 R=10.4*sqrt((d1*d2)/(f*(d1+d2)));
8 disp('m',R,'The dist by which beam must clear the
      obstacle is')

```

---

### Scilab code Exa 18.3 example 3

```

1 clc;
2 // page no 679
3 // prob no 18_3
4 //A transmitter and receiver at 6GHz seperated by 40
   km with o/p power 2 W
5 f=6*10^9;d=40;Pt=2;// power in watt
6 //transmitting antenna gain Gt=20dBi,receiving
   antenna Gr=25dBi
7 Gt=20;Gr=25;
8 f_mhz=6000;//f=6000 MHz
9 Pr_Pt_dB=(Gt+Gr)-(32.44+(20*log10(d))+(20*log10(
   f_mhz)));
10 Pt_dBm=10*log10(Pt/10^-3);
11 Pr_dBm=Pt_dBm + Pr_Pt_dB;
12 disp('dBm',Pr_dBm,'The power delivered to the Rx is')
   );

```

---

### Scilab code Exa 18.4 example 4

```

1 clc;
2 // page no 680
3 // prob no 18_4
4 T_sky=120;// Sky temp expressed in K
5 L_dB=2;// antenna feedline loss
6 L=10^(L_dB/10);

```

```

7 // the noise temp is given as
8 Ta=((L-1)*290 + T_sky)/L;
9 disp('K',Ta,'Noise temperature is ');

```

---

#### Scilab code Exa 18.5 example 5

```

1 clc;
2 // page no 681
3 // prob no 18.5
4 NF_dB=2;
5 NF_power = 10^(NF_dB/10);
6 T_eq=290*(NF_power -1);
7 disp('K',T_eq,'The equivalent noise temperature');

```

---

#### Scilab code Exa 18.6 example 6

```

1 clc;
2 // page no 681
3 // prob no 18.6
4 // refer example no 18.4 and 18.5
5 // The antenna and feedline combination from ex 18.4
   is used with the Rx from ex 18.5
6 Ta=182;// noise temp of the antenna and feedline
   combination expressed in K
7 Teq=169;// noise temperature of the Rx
8 B=20*10^6;// BW of the receiver
9 Tn_sys=Ta+Teq;//Noise temp for the system
10 k=1.38*10^-23;//Boltzmann constant
11 // Noise power of the system is given as
12 Pn=k*Tn_sys*B;// where k is Boltzmann constant
13 disp('W',Pn,'The noise power is');
14 Pn_dBm=10*log10(Pn/10^-3);
15 disp('dBm',Pn_dBm,'The thermal noise power is');

```

---

Scilab code Exa 18.7 example 7

```
1 clc;
2 // page no 682
3 // prob no 18.7
4 // refer ex no 18.3 and 18.6
5 Pr_dBm=-62; //power at the receiver in dBm
6 Pn_dBm=-100; //thermal noise power in dBm
7 // carrier to noise ratio in dB is given as
8 C_N=Pr_dBm -Pn_dBm;
9 disp('dB',C_N,'Carrier to noise ratio is');
```

---

Scilab code Exa 18.8 example 8

```
1 clc;
2 // page no 683
3 // prob no 18.8
4 // refer ex 18.7
5 fb=40*10^6; // bit rate in bps
6 Pr_dBm=-62; //power at the receiver in dBm
7 Pr=10^(Pr_dBm/10)*10^-3; // power at the receiver in
  W
8 Eb=Pr/fb; // the energy per bit in J
9 k=1.38*10^-23; //Boltzmann constant
10 T=350;
11 // the noise power density is
12 No=k*T;
13 // Energy per bit to noise density ratio in dB is
14 Eb_No=10*log10(Eb/No);
15 disp('dB',Eb_No,'Energy per bit to noise density
  ratio is');
```

---



### Scilab code Exa 18.9 example 9

```
1 clc;  
2 // page no 686  
3 // prob no 18.9  
4 // refer fig 18.7(b)  
5 //This is the standard superheterodyne receiver  
6 fc=6870;// the received carrier freq in MHz  
7 IF=70;// IF in MHz  
8 // The local oscillator freq is given as  
9 f_lo=fc-IF;  
10 disp('MHz',f_lo,'The local oscillator freq is ');
```

---

### Scilab code Exa 18.10 example 10

```
1 clc;  
2 // page no 688  
3 // prob no 18.10  
4 // refer fig 18.9a)  
5 fc_r=6870;// carrier freq of received signal in MHz  
6 fc_t=6710;// carrier freq of transmitted signal in  
   MHz  
7 IF=70;//in MHz  
8 // the freq of shift oscillator is  
9 fso=fc_r - fc_t;  
10 disp('MHz',fso,'The freq of shift oscillator is ');  
11 //the local oscillator freq is given as  
12 flo=fc_t-IF;  
13 disp('MHz',flo,'The local oscillator freq is ');  
14 //from fig , mixer 3 will produce an o/p as  
15 op_mix3=flo+fso;  
16 disp('MHz',op_mix3,'O/P of Mixer 3 is');
```

---

Scilab code Exa 18.11 example 11

```
1 clc;  
2 // page no 690  
3 // prob no 18.11  
4 // A typical microwave digital radio system uses 16-  
   QAM.  
5 fb=90.524; //bit rate expressed in Mbps  
6 n=16; // for 16-QAM system  
7 //part a) calculation of no of bits per symbol  
8 m=log2(n);  
9 disp('bits ',m,'The number of bits per symbol are');  
10 // part b) calculation of baud rate  
11 // baud rate is 1/4th of the bit rate  
12 baud=fb/4;  
13 disp('Mbaud',baud,'The baud rate is');
```

---

# Chapter 19

## Television

Scilab code Exa 19.1 example 1

```
1 clc;  
2 // page no 703  
3 // prob no 19.1  
4 // In the given problem ,a video signal has 50% of  
   the maximum luminance level  
5 //A black setup level of 7.5 IRE represents zero  
   luminance ,and 100 IRE is max brightness .Therefore  
   the range from min to max luminnance has  
    $100 - 7.5 = 92.5$  units .  
6 //Therefore the level is  
7 IRE=7.5 + (0.5*92.5);  
8 disp('IRE units ',IRE,'Level of video signals in IRE  
   units ');
```

---

Scilab code Exa 19.2 example 2

```
1 clc;  
2 // page no 704
```

```

3 // prob no 19.2
4 // part a) horizontal blanking
5 // Horizontal blanking occupies approximately 10 us
   of the 63.5 us duration of each line ,
6 Hzt1_blnk=10/63.5 *100;
7 disp('of the signal ', '%', Hzt1_blnk, 'Horizontal
   blanking occupies ');
8 // part b) vertical blanking
9 // Vertical blanking occupies approximately 21 lines
   per field or 42 lines per frame. A frame has 525
   lines altogether ,so
10 Vert_blnk=42/525 *100;
11 disp('of the signal ', '%', Vert_blnk, 'vertical
   blanking occupies ');
12 // part c) active signal
13 // since 8% of the time is lost in vertical blanking
   , 92% of the time is involved in the transmission
   of the active lines.
14 act_vid = (100-Hzt1_blnk)*(100-Vert_blnk)/100;
15 disp('%', act_vid, 'The active video is ');

```

---

### Scilab code Exa 19.3 example 3

```

1 clc;
2 // page no 707
3 // prob no 19.3
4 // A typical low-cost monochrome receiver has a
   video bandwidth of 3MHz
5 B=3; // bandwidth in MHz
6 // The horizontal resolution in lines is given as
7 L_h=B*80;
8 disp('lines ', L_h, 'The horizontal resolution in lines
   is ');

```

---

#### Scilab code Exa 19.4 example 4

```
1 clc;  
2 // page no 709  
3 // prob no 19.4  
4 // A RGB video signal has normalized values as  
5 R=0.2;G=0.4;B=0.8;  
6 //The luminance signal is given as  
7 Y=0.30*R+0.59*G+0.11*B;  
8 disp(Y, 'The luminance signal is ');  
9 //The in-phase component of the color signal is  
   given as  
10 I=0.60*R-0.28*G-0.32*B;  
11 disp(I, 'The in-phase component of the color signal  
   is ');  
12 //The quadrature component of the color signal is  
   given as  
13 Q=0.21*R-0.52*G+0.31*B;  
14 disp(Q, 'The quadrature component of the color signal  
   is ');
```

---

#### Scilab code Exa 19.5 example 5

```
1 clc;  
2 // page no 712  
3 // prob no 19.5  
4 .....///// refer table 19.1////////.....  
5 // The proportion in the table are voltage levels  
   and have to be squared to get power.  
6 // for black setup the voltage level is given as  
7 v=0.675;
```

```

8 //Therefore the power level as a fraction of the
   maximum transmitter power is
9 P_black_setup=v^2 *100;
10 disp('of the maximum transmitter power is used to
   transmit a black setup', '%', P_black_setup, )

```

---

### Scilab code Exa 19.6 example 6

```

1 clc;
2 // page no 728
3 // prob no 19.6
4 // refer fig 19.27 of the page no 729
5 // from fig , we can write down the values directly
   as given
6 In1=100*10^-3; //expressed in mV
7 In1_dBmV=20*log10(In1/1);
8 disp('dBmV', In1_dBmV, 'The input of Amp 1 is ');
9 // this above calculated signal is applied to the
   input of the first amplifier ,i.e. head-end signal
   processing
10 G1=40; // gain of Amp 1 expressed in dB
11 // o/p level of Amp 1 is
12 Out1=In1_dBmV + G1;
13 disp('dBmV', Out1, 'The output of Amp 1 is ');
14 L=15; //expressed in dB
15 // The input level of Amp 2 is
16 In2_dBmV=Out1-L;
17 disp('dBmV', In2_dBmV, 'The input of Amp 2 is ');
18 G2=25; //gain of Amp2 expressed in dB
19 // o/p level of Amp 2 is
20 Out2=In2_dBmV+G2;
21 disp('dBmV', Out2, 'The output of Amp 2 is ');
22 L1=10; // loss in cable
23 L2=12; //loss in directional coupler
24 // The input level of Amp 3 is

```

```

25 In3_dBmV=Out2-L1-L2;
26 disp('dBmV',In3_dBmV,'The input of Amp 3 is');
27 G3=20;//gain of Amp3 expressed in dB
28 Out3=In3_dBmV+G3;
29 disp('dBmV',Out3,'The output of Amp 3 is');
30 // There is further 3dB cable loss and 20dB loss in
    the tap
31 L3=3;//loss in cable
32 L4=20;// loss in tap
33 //signal strength at the tap is
34 Vdrop_dBmV=Out3-L3-L4;
35 V_drop=10^(Vdrop_dBmV/20);// expressed in mV
36 disp('mV',V_drop,'Signal strength at subscriber tap
    is');
37 // Calculation of power into 75 ohm
38 R=75;//expressed in ohm
39 Pdrop = (V_drop*10^-3)^2/R;
40 Pdrop_dBm=10*log10(Pdrop/10^-3);
41 disp('dBm',Pdrop_dBm,'The power at the end is');

```

---

#### Scilab code Exa 19.7.a example 7

```

1 clc;
2 // page no 731
3 // prob no 19.7
4 // In given problem a TV receiver is tuned to
    channel 6.
5 //All modern Rx uses a picture IF of 45.75 MHz with
    high-side injection of the signal into the cable.
6 // The picture carrier of channel 6 is at a
    frequency of 83.25MHz,so
7 ch=6;
8 Fc=83.25;// expressed in MHz
9 IF=45.75;//expressed in MHz
10 f_lo=Fc+IF;

```

```
11 a=f_lo+ch/2; b=f_lo-ch/2;
12 disp('band', 'MHz', a, 'to', 'MHz', b, 'The interference
    would in');
```

---

**Scilab code Exa 19.7.b** example 8

```
1  clc;
2  // page no 740
3  // prob no 19.8
4  Nh=640; Nv=480; // resolution of digital video signal
    as 640*480 pixels
5  Rf=30; //frame rate expressed in Hz
6  m=8; // bits per sample
7  // By using the product of Horizontal & vertical
    resolution, no of luminance pixels per frame are
8  Npl=Nh*Nv;
9  // since each of the color signals has one-fourth
    the total no of luma pixels
10 Npt=1.5*Npl;
11 //therefore bit rate is given as
12 fb=Npt*m*Rf;
13 disp('bps',fb,'The bit rate for the signal is');
```

---



# Chapter 20

## Satellite Communication

Scilab code Exa 20.1 example 1

```
1  clc;
2  // page no 754
3  // prob no 20.1
4  // part A)
5  d=500;
6  //By using the equation for velocity of a satellite
7  v=sqrt(4*10^11/(d+6400));
8  disp('m/s',v,'A) The velocity of a satellite is');
9  // The radius of orbit is
10 r=(6400+d)*10^3//in m
11 //The orbital period of satellite is
12 T=(2*%pi*r)/v;
13 disp('sec',T,'The orbital period of satellite is');
14 //part B)
15 d=36000;
16 //By using the equation for velocity of a satellite
17 v=sqrt(4*10^11/(d+6400));
18 disp('m/s',v,'B) The velocity of a satellite is');
19 //The radius of orbit is
20 r=(6400+d)*10^3//in m
21 //The orbital period of satellite is
```

```
22 T=(2*%pi*r)/v;
23 disp('sec',T,'The orbital period of satellite is');
```

---

#### Scilab code Exa 20.2 example 2

```
1 clc;
2 // page no 757
3 // prob no 20.2
4 R=6400;//Radius of earth
5 L=45;//earth station latitude
6 H=36000//Height of satellite above the earth;
7 ang=atand((6400*sind(45))/(36000+(6400*(1-cosd(45)))));
8 disp(ang);
```

---

#### Scilab code Exa 20.3 example 3

```
1 clc;
2 // page no 758
3 // prob no 20.3
4 //Determination of length of geostationary satellite
  with angle of elavation=30 degree
5 r=64*10^5;//Radius of earth
6 h=36*10^6;//height of satellite
7 theta=30;//angle of elevation
8 d=sqrt(((r+h)^2)-((r*cosd(theta))^2))-(r*sind(theta));
9 disp('km',d/1000,'The length of the path is');
```

---

#### Scilab code Exa 20.4 example 4

```

1  clc;
2  // page no 759
3  // prob no 20.4
4  //A satellite transmitter operates at 4GHz with 7W &
   antenna gain 40dBi
5  //Receiver antenna gain 30dBi & path length is
   4*107
6  Gt_dBi=40;Gr_dBi=30;Pt=7;d=40000; //in km
7  f=4000; //in MHz
8  Pr_Pt_dB=Gt_dBi+Gr_dBi-(32.44+(20*log10(d))+(20*
   log10(f)));
9  //Signal strength at transmitter
10 Pt_dBm=10*log10(Pt/10-3);
11 Pr_dBm=(Pt_dBm)+(Pr_Pt_dB);
12 disp('dBm',Pr_dBm,'The value of signal strength at
   receiver');

```

---

#### Scilab code Exa 20.5 example 5

```

1  clc;
2  // page no 760
3  // prob no 20.5
4  // In the given problem
5  G=40; // receiving antenna gain
6  T_sky=15; // noise temp
7  L=0.4; //loss between antenna and LNA input
8  T_eq =40; // noise temperature f LNA
9  // Fir-st we have to find G in dB
10 G_dB = G-L;
11 // For the calculation of T, we have to convert the
   feedhorn loss into a ratio as follows
12 L=10^(0.4/10);
13 Ta = ((L-1)*290 + T_sky )/ L;
14 // The receiver noise temperature is given wrt the
   chosen reference point ,therefore

```

```

15 Ratio= G -10*log10(Ta+T_eq);
16 disp('dB',Ratio,'The receiver noise temperature is')
    ;

```

---

#### Scilab code Exa 20.6 example 6

```

1  clc;
2  // page no 761
3  // prob no 20.6
4  NF_dB=1.5; // noise fig of a receiver
5  NF=10^(NF_dB/10);
6  // Equivalent noise temperature is giveb as
7  T_eq=290*(NF-1);
8  disp('K',T_eq,'Equivalent noise temperature is');

```

---

#### Scilab code Exa 20.7 example 7

```

1  clc;
2  // page no 761
3  // prob no 20.7
4  // refer prob no 20.5
5  d=38000; //distance of satellite from the Earth
    surface
6  P=50; //transmitter power
7  G=30; //antenna gain
8  f=12000; //frequency in MHz
9  B=10^6; // Bandwidth in MHz
10 //from problem no 2.5
11 G_T=21;
12 L_misc=0;
13 k_dBW=-228.6; //Boltzmann's constant in dBW
14 // There are no miscellaneous loss
15 //The stellite transmitting power in dBW is

```

```

16 Pt_dBW = 10*log10(P);
17 // The EIPR in dBW
18 EIRP_dBW=Pt_dBW + G;
19 //FSL in dB
20 FSL_dB= 32.44 + (20*log10(d)) + (20*log10(f));
21 // The carrier to noise ratio is
22 ratio=EIRP_dBW - FSL_dB - L_misc + G_T - k_dBW - 10*
    log10(B);
23 disp('dB',ratio,'The carrier to noise ratio at the
    receiver is ');

```

---

#### Scilab code Exa 20.8 example 8

```

1 clc;
2 // page no 762
3 // prob no 20.8
4 D=40000;// distance of satellite from the earth
    station
5 v=3*10^8;// velo of light
6 d=80000;// distance between two earth stations
7 // time delay is given as
8 t=d/v;
9 // total time delay will be twice that of calculated
    above
10 T=2*t;
11 disp('sec',T,'The total time delay is ');

```

---

#### Scilab code Exa 20.9 example 9

```

1 clc;
2 // page no 769
3 // prob no 20.9
4 f_down = 4*10^9;// downlink freq

```

```
5 D=3; //diameter
6 n=0.55; //efficiency
7 c=3*10^8; //velo of light
8 // The gain of a parabolic antenna is given as  $G=(n*\pi^2*D^2)/\lambda^2$ . Therefore wavelength is given as
9  $\lambda=c/f\_down$ 
10  $G=(n*\pi^2*D^2)/\lambda^2$ ;
11  $G\_dB = 10*\log_{10}(G)$ ;
12 disp('dB',G_dB,'The gain of TVRO is ');
13 // The beamwidth is given as
14  $bw = (70*\lambda)/D$ ;
15 disp('degree',bw,'The beamwidth is');
```

---

# Chapter 21

## Cellular Radio

Scilab code Exa 21.1 example 1

```
1  clc;
2  // page no 795
3  // prob no 21.1
4  v=100; //in km/hr
5  // first convert speed into m/sec
6  v1=(100*10^3)/3600; //in km/sec
7  //part a)
8  r=10^4; //in m
9  t=(2*r)/v1;
10 disp('sec',t,'Handoff time is');
11 //part b)
12 r=500; //in m
13 t=(2*r)/v1;
14 disp('sec',t,'Handoff time is');
```

---

Scilab code Exa 21.2 example 2

```
1  clc;
```

```

2 // page no 807
3 // prob no 21.2
4 N=12; m=120;
5 a=20000;
6 th=30; //in min/day this means
7 H=0.5;
8 tp=10;
9 //part a) Calculation of the average and peak traffic
    in erlangs for the whole system
10 // The average traffic is
11 T=a*H/24;
12 disp('E',T,'a) The average traffic is');
13 // The peak traffic is
14 T1=(a*tp)/60;
15 disp('E',T1,'The peak traffic is');
16 //part b) Calculation of the average and peak traffic
    in erlangs for one cell
17 // The average traffic per cell is
18 t=T/m;
19 disp('E',T,'b) The average traffic per cell is');
20 // The peak traffic per cell is
21 t=T1/m;
22 disp('E',T1,'The peak traffic per cell is');
23 // part c)
24 // For average traffic at 3.47E, the blocking
    probability is much less than 1%, since the
    average no of call is much less than the no of
    channels. However, the blocking probability
    increases to just over 5%

```

---

### Scilab code Exa 21.3 example 3

```

1 clc;
2 // page no 816
3 // prob no 21.3

```



```
4 tg=123*10^-6;
5 c=3*10^8;
6 //The maximum distance between base and mobile is
7 d=c*tg;
8 disp('m',d,'The maximum distance between base and
      mobile is');
```

---

# Chapter 22

## Personal Communication Systems

Scilab code Exa 22.1 example 1

```
1 clc;  
2 // page no 842  
3 // prob no 22.1  
4 PR = -100; //In dBm  
5 // The mobile transmitted power is  
6 PT_dBm = -76 - PR; //this is in dBm  
7 disp('or ', 'dBm', PT_dBm, 'The mobile transmitted power  
    in dBm is ');  
8 PT_mW = 10^(PT_dBm/10);  
9 disp('mW', PT_mW, 'The mobile transmitted power is ');
```

---

## Chapter 23

# Paging and Wireless Data Networking

Scilab code Exa 23.1 example 1

```
1  clc;  
2  // page no 863  
3  // prob no 23.1  
4  bit_rate = 512; //ib bps  
5  t=60; //in sec  
6  // preamble uses 576 bits  
7  preamble=576;  
8  bits_total = bit_rate * t;;  
9  usable_bits = bits_total - preamble;  
10 // each batch has one 32-bits synchronizing codeword  
    and sixteen 32-bit address codewords for a total  
    of 17*32=544bits. Therefore  
11 bits_per_batch= 17*32;  
12 batches_per_min = usable_bits / bits_per_batch;  
13 addr=16;  
14 addr_per_min = batches_per_min*addr;  
15 disp(addr_per_min, 'The no of pages transmitted in  
    one min are');
```

---

### Scilab code Exa 23.2 example 2

```
1 clc;  
2 // page no 864  
3 // prob no 23.2  
4 // For the given FLEX system  
5 Wc=25*103;  
6 bit_rate = 6400;//in bps  
7 efficiency = bit_rate/Wc;  
8 disp('b/s/Hz',efficiency,'The efficiency is ');
```

---

### Scilab code Exa 23.3 example 3

```
1 clc;  
2 // page no 871  
3 // prob no 23.3  
4 // for the Bluetooth system  
5 fh_max=1/(625*10-6);  
6 fh_min=1/(5*625*10-6);  
7 disp('Hz',fh_min,'The minimum hopping rate is ','Hz',  
      fh_max,'The maximum hopping rate is ');
```

---

# Chapter 24

## Fiber Optics

Scilab code Exa 24.3 example 1

```
1 clc;  
2 // page no 888  
3 // prob no 24.3  
4 NA=0.15;  
5 wl=820*10-9; //in m  
6 d_core=2*(0.383*wl/NA);  
7 disp('m',d_core,'The core diameter is');
```

---

Scilab code Exa 24.4 example 2

```
1 clc;  
2 // page no 890  
3 // prob no 24.4  
4 B1=500; //in MHz-km  
5 B=85; //in MHz  
6 // By using Bandwidth-distance product formula  
7 l=B1/B;  
8 disp('km',l,'The maximum distance that can be use  
    between repeaters is');
```

---

**Scilab code Exa 24.5** example 3

```
1 clc;  
2 // page no 891  
3 // prob no 24.5  
4 w10=1310; //in ns  
5 So=0.05; //in ps/(nm^2*km)  
6 l=50; //in km  
7 w1=1550; //in ns  
8 d=2; //in nm  
9 // Chromatic dispersion is given as  
10 Dc=(So/4)*[w1-(w10^4/w1^3)];  
11 // Dispersion is  
12 D=Dc*d;  
13 // Therefore total dispersion is  
14 dt=D*l;  
15 disp('ps',dt,'The total dispersion is');
```

---

**Scilab code Exa 24.6** example 6

```
1 clc;  
2 // page no 893  
3 // prob no 24.6  
4 //Refer problem 24.5  
5 dt=949*10^-12; //in sed  
6 l=50; //in km  
7 B=1/(2*dt);  
8 //By using Bandwidth-distance product formula  
9 B1= B*l;  
10 disp('Hz-km',B1,'The bandwidth distance product is')  
    ;
```

---

### Scilab code Exa 24.7 example 5

```
1 clc;  
2 // page no 899  
3 // prob no 24.7  
4 // refer table from the problem page no 899  
5 P_coupling1 =-3; P_coupling2 = -6; P_coupling3 =-40;  
   // in dB  
6 //Part a) The proportion of input power emerging at  
   port 2  
7 P2_Pin=10^(P_coupling1/10);  
8 disp('%',P2_Pin*100,'a) The proportion of input  
   power emerging at port 2');  
9 P3_Pin=10^(P_coupling2/10);  
10 disp('%',P3_Pin*100,' The proportion of input power  
   emerging at port 3');  
11 // Part b) In the reverse direction ,the signal is 40  
   dB down for all combinations , so  
12 directivity = 40;  
13 disp('dB',directivity,'Directivity is');  
14 Pin_total = P2_Pin + P3_Pin;  
15 // excess loss in dB  
16 loss=-10*log10(Pin_total);  
17 disp('dB',loss,'the excess loss is');
```

---

### Scilab code Exa 24.8 example 6

```
1 clc;  
2 // page no 901  
3 // prob no 24.8  
4 w1=1*10^-6;  
5 c= 3*10^8;
```

```
6 h=6.626*10^-34
7 f=c/wl;
8 E=h*f;// in Joule
9 //this energy can be converted into electron-volt.
  we know 1eV=1.6*10^-19 J
10 eV=1.6*10^-19 ;
11 E_ev=E/eV;
12 disp('eV',E_ev,'The energy of photon in eV is');
```

---

#### Scilab code Exa 24.9 example 9

```
1 clc;
2 // page no 909
3 // prob no 24_9
4 // refer fig 24.25
5 P_in=500;Responsivity=0.33;
6 I_d = P_in * Responsivity;
7 disp('nA',I_d,'The diode current is');
```

---



# Chapter 25

## Fiber Optic Systems

Scilab code Exa 25.1 example 1

```
1 clc;
2 // page no 919
3 // prob no 25_1
4 span_length=40;//in km
5 Pin_mW = 1.5;
6 signal_strength_dBm = -25; fiber_length = 2.5;//in
   km
7 loss_per_slice_dB=0.25;f_loss_dB_per_km =0.3;
8 loss_connector_dB=4;
9 Pin_dBm =10*log10(Pin_mW);
10 splices=span_length / fiber_length -1;
11 fiber_loss = span_length * f_loss_dB_per_km;
12 splice_loss = splices * loss_per_slice_dB;
13 T_loss = fiber_loss + splice_loss +
   loss_connector_dB;
14 P_out = Pin_dBm - T_loss;
15 sys_margin= P_out - signal_strength_dBm;
16 disp('dB',sys_margin,'The system margin is');
```

---

### Scilab code Exa 25.2 example 2

```
1 clc;  
2 // page no 921  
3 // prob no 25_2  
4 L=45; //in km  
5 dt=100; //in ns  
6 //The maximum permissible value for the pulse-  
   spreading constant is  
7 D=dt/L;  
8 disp('ns/km',D,'The maximum permissible value for  
   the pulse-spreading constant is');
```

---

### Scilab code Exa 25.3 example 3

```
1 clc;  
2 // page no 922  
3 // prob no 25_3  
4 L=45;  
5 T_Rtx=50; T_Rrx=75; T_Rf=100;  
6 T_RT=sqrt(T_Rtx^2 + T_Rrx^2 + T_Rf^2);  
7 // a) for NRZ  
8 fb=1/T_RT;  
9 disp('GHz',fb,'a) The maximum bit rate for NRZ');  
10 // b) for RZ  
11 fb=1/(2*T_RT);  
12 disp('GHz',fb,'b) The maximum bit rate for NRZ');
```

---

### Scilab code Exa 25.4 example 4

```
1 clc;  
2 // page no 924  
3 // prob no 25_4
```

```

4 B1=500;//in MHz-km
5 L=5;//in km
6 // using the bandwidth-distance product formula
   dispersion is given as
7 D=500/B1;
8 disp('ns/km',D,'Dispersion is ');
9 // Total rise time is given as
10 T_rt= D*L;
11 disp('ns',T_rt,'Total rise time is ');

```

---

#### Scilab code Exa 25.5 example 5

```

1 clc;
2 // page no 924
3 // prob no 25_5
4 T_Rrx=3*10^-9;
5 T_Rtx=2*10^-9;
6 fb=100*10^6;//in bps
7 L=25;//in km
8 T_RT = 1/(2*fb)
9 // we have to compute rise time therefore
10 T_rf= sqrt(T_RT^2 - T_Rtx^2 - T_Rrx^2)
11 // dispersion per km is
12 D= T_rf/L;
13 disp('ns/km',D/10^-9,'The maximum acceptable
   dispersion is ');
14 // using the bandwidth-distance product
15 B1=500/D;
16 disp('MHz-km',B1*10^-9,'The bandwidth-distance
   product is ');

```

---