

Scilab Textbook Companion for  
Basics of Electrical, Electronics and  
Communication Engineering  
by N. Storey, E. Hughes and W. Tomasi<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

## DC circuits

Scilab code Exa 1.1 Current in the circuit

```
1 //Ex 1.1
2 clc;clear;close;
3 format('v',4);
4 R=3;//kohm
5 V=220;//V
6 //First Case
7 I=V/R;//mA
8 disp(I,"1st case : Current in the circuit(mA)");
9 //Second Case
10 Req=R+R;//ohm(Equivalent resistance)
11 I=V/Req;//mA
12 disp(I,"2nd case : Current in the circuit(mA)");
```

---

Scilab code Exa 1.2 Voltage across resistor

```
1 //Ex 1.2
2 clc;clear;close;
3 format('v',5);
```



```

4 I=1.5; //A
5 R1=2; //ohm
6 R2=3; //ohm
7 R3=8; //ohm
8 V1=I*R1; //V
9 V2=I*R2; //V
10 V3=I*R3; //V
11 disp(V1," Voltage across R1(V)");
12 disp(V2," Voltage across R2(V)");
13 disp(V3," Voltage across R3(V)");
14 V=V1+V2+V3; //V(Supply voltage)
15 disp(V," Supply Voltage(V)");

```

---

#### Scilab code Exa 1.3 Circuit current

```

1 //Ex 1.3
2 clc;clear;close;
3 format('v',6);
4 Vs=100; //V(Supply voltage)
5 R1=40; //ohm
6 R2=50; //ohm
7 R3=70; //ohm
8 R=R1+R2+R3; //ohm(Equivalent resistance)
9 I=Vs/R; //A(Current in the circuit)
10 disp(I," Circuit current(A)");

```

---

#### Scilab code Exa 1.4 Resistance R1

```

1 //Ex 1.4
2 clc;clear;close;
3 format('v',6);
4 Vo=10; //V(Output voltage)
5 Vin=30; //V(Input voltage)

```

```
6 R2=100; //ohm
7 //V2/V=R2/(R1+R2) // Voltage divider rule
8 R1=(Vin*R2-Vo*R2)/Vo; //ohm
9 disp(R1,"Resistance of R1(ohm)");
```

---

#### Scilab code Exa 1.5 Supply Current

```
1 //Ex 1.5
2 clc;clear;close;
3 format('v',6);
4 V=110; //V
5 R1=22; //ohm
6 R2=44; //ohm
7 I1=V/R1; //A
8 I2=V/R2; //A
9 I=I1+I2; //A
10 disp(I,"Supply current (A)");
```

---

#### Scilab code Exa 1.6 Effective resistance and Supply current

```
1 //Ex 1.6
2 clc;clear;close;
3 format('v',5);
4 V=12; //V
5 R1=6.8; //ohm
6 R2=4.7; //ohm
7 R3=2.2; //ohm
8 R=1/(1/R1+1/R2+1/R3); //ohm(Effective resistance)
9 I=V/R; //A(Supply current)
10 disp(R,"Effective resistance(ohm)")
11 disp(I,"Supply current (A)");
```

---

### Scilab code Exa 1.7 Current in the resistor

```
1 //Ex 1.7
2 clc;clear;close;
3 format('v',4);
4 I=8;//A
5 R2=2;//ohm
6 // Part (a)
7 R1=2;//ohm
8 I2=I*R1/(R1+R2);//A
9 disp(I2,"(a) Current in 2 ohm resistance(A)");
10 // Part (b)
11 R1=4;//ohm
12 I2=I*R1/(R1+R2);//A
13 disp(I2,"(b) Current in 2 ohm resistance(A)");
```

---

### Scilab code Exa 1.8 Calculate current

```
1 //Ex 1.8
2 clc;clear;close;
3 format('v',6);
4 I1=3;//A
5 I2=-4;//A
6 I4=2;//A
7 //I1-I2+I3-I4=0//from KCL
8 I3=-I1+I2+I4;//A
9 disp(I3,"Current I3(A)");
```

---

### Scilab code Exa 1.10 Calculate current

```

1 //Ex 1.10
2 clc;clear;close;
3 format('v',6);
4 I1=2.5;//A
5 I2=-1.5;//A
6 //I1+I2+I3=0//from KCL
7 I3=-I1-I2;//A
8 disp(I3,"Current I3(A)");

```

---

**Scilab code Exa 1.11** Determine the currents

```

1 //Ex 1.11
2 clc;clear;close;
3 format('v',6);
4 I1=3;//A
5 I3=1;//A
6 I6=1;//A
7 //I1-I2-I3=0//from KCL at point a
8 I2=I1-I3;//A
9 //I2+I4-I6=0//from KCL at point b
10 I4=I6-I2;//A
11 //I3-I4-I5=0//from KCL at point c
12 I5=I3-I4;//A
13 disp(I2,"Current I2(A)");
14 disp(I4,"Current I4(A)");
15 disp(I5,"Current I5(A)");

```

---

**Scilab code Exa 1.12** Determine I1 and I2

```

1 //Ex 1.12
2 clc;clear;close;
3 format('v',6);
4 R1=30;//ohm

```

```

5 R2=60; //ohm
6 R3=30; //ohm
7 I3=1; //A
8 I1=I3*(R2+R3)/R2; //A
9 I2=I1-I3; //A
10 disp(I1," Current I1 (A)");
11 disp(I2," Current I2 (A)");

```

---

### Scilab code Exa 1.13 Determine V1 and V3

```

1 //Ex 1.13
2 clc;clear;close;
3 format('v',6);
4 E=12; //V
5 V2=8; //V
6 V4=2; //V
7 V1=E-V2; //V
8 //-V2+V3+V4=0; // for Loop B
9 V3=V2-V4; //V
10 disp(V1," Voltage V1(V)");
11 disp(V3," Voltage V3(V)");

```

---

### Scilab code Exa 1.14 Calculate VAB

```

1 //Ex 1.14
2 clc;clear;close;
3 format('v',6);
4 V=20; //V
5 R1=25; //ohm
6 R2=40; //ohm
7 R3=15; //ohm
8 R4=10; //ohm
9 VAC=R3*V/(R1+R3); //V

```

```
10 VBC=R4*V/(R2+R4); //V
11 //0=VAB+VBC-VAC; // from KVL
12 VAB=-VBC+VAC; //V
13 disp(VAB," Voltage VAB(V)");
```

---

### Scilab code Exa 1.15 Voltage and emf

```
1 //Ex 1.15
2 clc;clear;close;
3 format('v',6);
4 E1=10; //V
5 V2=6; //V
6 V3=8; //V
7 //E1=V1+V2; //KCL for left loop
8 V1=E1-V2; //V
9 //-E2=-V2-V3; //KCL for right loop
10 E2=V2+V3; //V
11 disp(V1," Voltage V1(V)");
12 disp(E2," Voltage E2(V)");
```

---

# Chapter 2

## Magnetic Circuits

Scilab code Exa 2.1 field strength and flux

```
1 //Ex 2.1
2 clc;clear;close;
3 format('v',6);
4 N=200;//turns
5 c=600;//mm(circumference)
6 A=500;//m^2(Cross section area)
7 I=4;//A(Current through coil)
8 H=I*N/(c*10^-3);//A/m(Magnetic field strength)
9 disp(H,"(a) Magnetic field strength(A/m)");
10 mu0=4*pi*10^-7;//constant
11 FD=mu0*H*10^6;//micro T(Flux density)
12 disp(FD,"(b) Flux density(micro T)");
13 Ft=FD*A*10^-6;//micro Wb(Total flux)
14 disp(Ft,"(c) Total flux(micro Wb)");
15 //Answer in the book is wrong.
```

---

Scilab code Exa 2.2 Magnetomotive force

```

1 //Ex 2.2
2 clc;clear;close;
3 format('v',6);
4 fi=0.015;//Wb(flux)
5 ag=2.5;//mm(airgap)
6 Ae=200;//cm^2(Effective area)
7 FD=fi/(Ae*10^-4);//T(Flux density)
8 mu0=4*%pi*10^-7;//constant
9 H=FD/mu0;//A/m(Magnetic field strength)
10 mmf=H*ag*10^-3;//A(magnetomotive force required)
11 disp(mmf,"Magnetomotive force required(A)");
12 //Answer in the book is not accurate.

```

---

### Scilab code Exa 2.3 Reluctance and current

```

1 //Ex 2.3
2 clc;clear;close;
3 format('e',9);
4 A=500;//mm^2(Cross sectional area)
5 c=400;//mm(circumference)
6 N=200;//turns
7 fi=800;//micro Wb(flux)
8 B=fi*10^-6/(A*10^-6);//T(Flux density)
9 mu0=4*%pi*10^-7;//constant
10 mur=380;//relative permeability
11 S=(c/1000)/(mur*mu0*A*10^-6);//A/Wb(Reluctance)
12 disp(S,"(a) Reluctance of the ring(A/Wb)");
13 mmf=fi*10^-6*S;//A
14 Im=mmf/N;//A(Magnetizing current)
15 format('v',5);
16 disp(Im,"(b) Required magnetizing current(A)");

```

---

### Scilab code Exa 2.4 Coil Current



```

1 //Ex 2.4
2 clc;clear;close;
3 format('v',5);
4 la=80; //mm
5 Aa=50; //mm^2(Cross sectional area)
6 lb=60; //mm
7 Ab=90; //mm^2(Cross sectional area)
8 lc=0.5; //mm(airgap)
9 Ac=150; //mm^2(Cross sectional area)
10 N=4000; //turns
11 Bc=0.30; //T(Flux density in airgap)
12 mu0=4*%pi*10^-7; //constant
13 mur=1300; //relative permeability
14 fi=Bc*Ac*10^-6; //Wb(flux)
15 Fa=fi*la*10^-3/(mu0*mur*Aa*10^-6); //At
16 Fb=fi*lb*10^-3/(mu0*mur*Ab*10^-6); //At
17 Fc=fi*lc*10^-3/(mu0*1*Ac*10^-6); //At
18 F=Fa+Fb+Fc; //At
19 I=F/N*1000; //mA
20 disp(I,"Coil current (mA)");

```

---

#### Scilab code Exa 2.5 Induced emf

```

1 //Ex 2.5
2 clc;clear;close;
3 format('v',6);
4 L=0.5; //H
5 deltaI=2-5; //A
6 deltaT=0.05; //sec
7 dIBYdT=deltaI/deltaT; //A/s
8 emf=L*dIBYdT; //V
9 disp(emf,"emf induced (V)");

```

---

### Scilab code Exa 2.6 Flux and emf

```
1 //Ex 2.6
2 clc;clear;close;
3 format('v',5);
4 N=300;//turns
5 L=10;//mH
6 I=5;//A
7 fi=L*10^-3/N*I*10^6;//micro Wb
8 disp(fi,"(a) Flux produced(micro Wb)");
9 //on reverse the current
10 delta_fi=2*fi;//micro Wb
11 //(as it goes to zero and increase to same value in
    reverse direction)
12 deltaT=8*10^-3;//seconds
13 dfiBYdT=delta_fi*10^-6/deltaT;//Wb/s
14 emf=N*dfiBYdT;//V(Average emf induced)
15 disp(emf,"(b) Average emf induced(V)");
```

---

### Scilab code Exa 2.7 Inductance of coil

```
1 //Ex 2.7
2 clc;clear;close;
3 format('v',6);
4 c=400;//mm(circumference)
5 A=500;//mm^2(Cross sectional area)
6 N=200;//turns
7 //Part (a)
8 I=2;//A
9 H=N*I/(c*10^-3);//A/m
10 B=1.13;//T(Corresponding Flux density)
11 fi=B*A*10^-6;//Wb(total flux)
12 L=N*fi/I*1000;//mH
13 disp(L,"(a) Inductance of coil(mH)");
14 //Part (a)
```

```

15 I=10; //A
16 H=N*I/(c*10^-3); //A/m
17 B=1.63; //T(Corresponding Flux density)
18 fi=B*A*10^-6; //Wb(total flux)
19 L=N*fi/I*1000; //mH
20 disp(L,"(b) Inductance of coil(mH)");

```

---

### Scilab code Exa 2.8 Inductance

```

1 //Ex 2.8
2 clc;clear;close;
3 format('v',5);
4 c=400; //mm(circumference)
5 A=500; //mm^2(Cross sectional area)
6 N=200; //turns
7 mu0=4*%pi*10^-7; //constant
8 L=mu0*A*10^-6*(N^2)/(c*10^-3)*10^6; //micro H
9 disp(L,"Inductance(micro H)");

```

---

### Scilab code Exa 2.10 Self and mutual inductance

```

1 //Ex 2.10
2 clc;clear;close;
3 format('v',6);
4 A=800; //mm^2(Cross sectional area)
5 r=170; //mm(radius)
6 N1=500; //turns
7 N2=700; //turns
8 mur=1200; //relative permeability
9 mu0=4*%pi*10^-7; //constant
10 S=2*%pi*r*10^-3/(mu0*mur*A*10^-6); //H
11 L1=N1^2/S; //H
12 disp(L1,"Self Inductance of coil 1(H)");

```

```
13 L2=N2^2/S; //H
14 disp(L2," Self Inductance of coil 2(H)");
15 k=1; //constant
16 M=k*sqrt(L1*L2); //H
17 disp(M," Mutual Inductance (H)");
```

---

# Chapter 3

## Single phase AC circuits

Scilab code Exa 3.1 Frequency Period and emf

```
1 //Ex 3.1
2 clc;clear;close;
3 format('v',5);
4 N=100;//turns
5 R=1500;//rpm(Rotation)
6 B=0.05;//T(Magnetic field)
7 A=40;//cm^2(Cross sectional area)
8 f=R/60;//Hz
9 theta=30;//degree
10 disp(f,"(a) Frequency(Hz)");
11 Period=1/f;//seconds
12 disp(Period,"(b) Period(seconds)");
13 Em=2*pi*B*(A/10^4)*N*f;//V
14 disp(Em,"(c) Maximum value of gnerated emf(V)");
15 e=%pi*sind(theta);//V
16 disp(e,"(d) Gnerated emf after rotation(V)");
```

---

Scilab code Exa 3.2 Peak values of current

```

1 //Ex 3.2
2 clc;clear;close;
3 format('v',6);
4 Irms=10; //A
5 Im=Irms*sqrt(2); //A
6 disp(-Im,+Im,"Peak values of current(A) are");

```

---

### Scilab code Exa 3.3 Voltage and frequency

```

1 //Ex 3.3
2 clc;clear;close;
3 format('v',6);
4 //v=141.4*sin(377*t)
5 Vm=141.4; //V
6 V=Vm/sqrt(2); //V(rms voltage)
7 disp(V,"(a) r.m.s. Voltage(V)");
8 omega=377; //rad/s
9 f=omega/2/%pi; //Hz
10 disp(f,"(b) Frequency(Hz)");
11 t=3*10^-3; //seconds
12 v=141.4*sin(377*t); //V
13 disp(v,"(c) Instantaneous Voltage(V)");

```

---

### Scilab code Exa 3.4 Ameter reading Form and Peak factor

```

1 //Ex 3.4
2 clc;clear;close;
3 format('v',5);
4 V=110; //V(Supply voltage)
5 R=50; //ohm
6 Vm=V*sqrt(2); //V(maximum voltage)
7 Im=Vm/R; //A(maximum current)

```

```

8 Iav1=0.637*Im; //A(average current Over +ve half
   cycle)
9 Iav2=0; //(average current Over -ve half cycle)
10 Iav=(Iav1+Iav2)/2; //A(average current Over whole
   cycle)
11 disp(Iav,"(a) Reading on moving coil ammeter(A)");
12 //For thermal ammeter :  $I^2R=1/4*Im^2R$ (thermal
   effect for complete cycle)
13 I=sqrt(1/4*Im^2); //A(reading on thermal ammeter)
14 disp(I,"(a) Reading on thermal ammeter(A)");
15 kf=I/Iav; //form factor
16 kp=Im/I; //peak factor
17 disp(kp,kf,"(b) Form factor & peak factor are");

```

---

### Scilab code Exa 3.5 Circuit current and phase angle

```

1 //Ex 3.5
2 clc;clear;close;
3 format('v',5);
4 V=100; //V
5 R=7; //ohm
6 L=31.8; //mH
7 f=50; //Hz
8 XL=2*pi*f*L/1000; //ohm
9 Z=sqrt(R^2+XL^2); //ohm
10 I=V/Z; //A(circuit current)
11 disp(I,"(a) Circuit current(A)");
12 fi=atand(XL/R); //degree(lag)
13 disp(fi,"(b) Phase angle(lag) in degree");

```

---

### Scilab code Exa 3.6 Supply voltage

```

1 //Ex 3.6

```

```

2  clc;clear;close;
3  format('v',5);
4  L=318; //mH
5  R=75; //ohm
6  VR=150; //V
7  f=50; //Hz
8  I=VR/R; //A
9  XL=2*%pi*f*L/1000; //ohm
10 VL=I*XL; //V
11 V=sqrt(VR^2+VL^2); //V
12 disp(V,"Supply Voltage (V)");

```

---

**Scilab code Exa 3.7** Supply voltage and phase angle

```

1  //Ex 3.7
2  clc;clear;close;
3  format('v',4);
4  ZLr=50; //ohm
5  fiLr=45; //degree(lag)(between current & Voltage)
6  R=40; //ohm
7  I=3; //A(Circuit current)
8  VR=I*R; //V
9  VLr=I*ZLr; //V
10 V=sqrt(VR^2+VLr^2+2*VR*VLr*cosd(fiLr)); //V
11 disp(V,"Supply voltage (V)");
12 fi=acosd((VR+VLr*cosd(fiLr))/V); //degree
13 disp(fi,"Circuit phase angle(lag in degree)");

```

---

**Scilab code Exa 3.8** Reactance and current

```

1  //Ex 3.8
2  clc;clear;close;
3  format('v',6);

```



```

4 C=30; //micro F
5 V=400; //V
6 f=50; //Hz
7 Xc=1/(2*%pi*f*C*10^-6); //ohm
8 disp(Xc,"(a) Reactance of capacitor(ohm)");
9 I=V/Xc; //A
10 disp(I,"(b) Current(A)");

```

---

### Scilab code Exa 3.9 Reactance Impedence Current and phase

```

1 //Ex 3.9
2 clc;clear;close;
3 format('v',5);
4 R=12; //ohm(Coil resistance)
5 L=0.1; //H(Coil Inductance)
6 V=100; //V
7 f=50; //Hz
8 XL=2*%pi*f*L; //ohm
9 Z=sqrt(R^2+XL^2); //ohm
10 disp(Z,XL,"(a) Reactance(ohm) & impedance(ohm) of
    the coil are");
11 I=V/Z; //A
12 disp(I,"(b) Current(A)");
13 fi=atand(XL/R); //degree
14 fi=round(fi); //degree
15 disp(fi,"Phase difference(degree)");

```

---

### Scilab code Exa 3.10 Capacitance and phase angle

```

1 //Ex 3.10
2 clc;clear;close;
3 format('v',5);
4 Pr=750; //W(rated)

```

```

5 Vr=100; //V(rated)
6 V=230; //V(Supply voltage)
7 f=60; //Hz
8 VC=sqrt(V^2-Vr^2); //V(Voltage across capacitor)
9 Ir=Pr/Vr; //A(Rated current)
10 C=Ir/(2*%pi*f*VC)*10^6; //micro F
11 disp(C,"(a) Capacitance required(micro F)");
12 fi=acosd(Vr/V); //degree
13 disp(fi,"(b) Phase angle(degree)");

```

---

### Scilab code Exa 3.11 Impedance current and voltage

```

1 //Ex 3.11
2 clc;clear;close;
3 format('v',5);
4 R=12; //ohm
5 L=0.15; //H
6 C=100; //micro F
7 V=100; //V
8 f=50; //Hz
9 XL=2*%pi*f*L; //ohm
10 XC=1/(2*%pi*f*C*10^-6); //ohm
11 Z=sqrt(R^2+(XL-XC)^2); //ohm
12 disp(Z,"(a) Impedance(ohm)");
13 I=V/Z; //A
14 disp(I,"(b) Current(A)");
15 VR=R*I; //V
16 VL=XL*I; //V
17 VC=XC*I; //V
18 disp(VC,VL,VR,"(b) Voltge(V) across R, L & C");
19 fi=acosd(VR/V); //degree
20 disp(fi,"(c) Phase difference(degree)");

```

---

### Scilab code Exa 3.12 Current Phase angle and power

```
1 //Ex 3.12
2 clc;clear;close;
3 format('v',5);
4 R=6;//ohm
5 L=0.03;//H
6 V=50;//V
7 f=60;//Hz
8 XL=2*pi*f*L;//ohm
9 Z=sqrt(R^2+XL^2);//ohm
10 I=V/Z;//A
11 disp(I,"(a) Current(A)");
12 fi=atand(XL/R);//degree
13 disp(fi,"(b) Phase angle(degree)");
14 S=V*I;//VA(Apparent power)
15 disp(S,"(c) Apparent power(VA)");
16 P=S*cosd(fi);//W
17 P=round(P);//W
18 disp(P,"(d) Active power(W)");
```

---

### Scilab code Exa 3.13 Power dissipated

```
1 //Ex 3.13
2 clc;clear;close;
3 format('v',5);
4 R=30;//ohm
5 V=230;//V
6 f=50;//Hz
7 VR=130;//V
8 VLr=180;//V
9 fiLr=acosd((V^2-VR^2-VLr^2)/(2*VR*VLr));//degree(lag
)
10 I=VR/R;//A
11 Pr=VLr*I*cosd(fiLr);//W
```

```
12 disp(Pr,"Power dissipated in the coil(W)");
```

---

**Scilab code Exa 3.14** Resistance Inductance and Power factor

```
1 //Ex 3.14
2 clc;clear;close;
3 format('v',5);
4 V=230;//V
5 f=50;//Hz
6 I=5;//A
7 P=750;//W
8 Z=V/I;//ohm
9 R=P/I^2;//ohm(Resistance)
10 XL=sqrt(Z^2-R^2);//ohm(reactance)
11 L=XL/2/%pi/f;//H(Inductance)
12 disp(R,"(a) Resistance(ohm)");
13 disp(L*1000,"(a) Inductance(mH)");
14 pf=P/(V*I);//power factor(lag)
15 disp(pf,"(b) Power factor(lag)");
```

---

# Chapter 5

## Single Phase Transformers

Scilab code Exa 5.1 Current Turns and flux

```
1 //Ex 5.1
2 clc;clear;close;
3 format('v',5);
4 kVA=250;//kVA
5 V1=11000;//V(Primary voltage)
6 V2=400;//V(secondary voltage)
7 f=50;//Hz
8 N2=80;//no. of turns in secondary
9 If11=kVA*1000/V1;//A(Full load primary current)
10 If12=kVA*1000/V2;//A(Full load secondary current)
11 disp("Part(a)");
12 disp(If11,"Full load primary current(A)");
13 disp(If12,"Full load secondary current(A)");
14 disp("Part(b)");
15 N1=N2*V1/V2;//no. of turns in primary
16 disp(N1,"No. of turns in primary");
17 disp("Part(c)");
18 fi_m=V2/(4.44*N2*f);//Wb
19 disp(fi_m*1000,"Maximum value of flux(mWb)");
```

---

## Scilab code Exa 5.2 Area Voltage ad current

```
1 //Ex 5.2
2 clc;clear;close;
3 format('v',7);
4 N1=480;//no. of turns in primary
5 N2=90;//no. of turns in secondary
6 lfp=1.8;//m(length of flux path)
7 ag=0.1;//mm(airgap)
8 Flux=1.1;//T(flux density)
9 MF=400;//A/m(Magnetic flux)
10 c_loss=1.7;//W/kg
11 f=50;//Hz
12 d=7800;//kg/m^3(density of core)
13 V=2200;//V(potential difference)
14 //Part (a)
15 fi_m=V/(4.44*N1*f);//Wb
16 A=fi_m/Flux;//m^2(Cross sectional area)
17 disp(A,"(a) Cross sectional area(m^2)");
18 //Part (b)
19 Vn12=V*N2/N1;//V(2ndary voltage on no load)
20 Vn12=round(Vn12);//V(2ndary voltage on no load)
21 disp(Vn12,"(b) 2ndary voltage on no load(V)");
22 //Part (c)
23 format('v',5);
24 Fm1=MF*lfp;//A(Magnetootive force for the core)
25 Fm2=Flux/(4*pi*10^-7)*ag*10^-3;//A(Magnetootive
    force for airgap)
26 Fm=Fm1+Fm2;//A(Total magnetomotive force)
27 Imax=Fm/N1;//A(maximum value of magnetizing current)
28 Iom=Imax/sqrt(2);//A(rms current)
29 v=lfp*A;//m^3(Volume of core)
30 m=v*d;//kg(Mass of core)
31 coreLoss=c_loss*m;//W(Core Loss)
```

```

32 Io1=coreLoss/V;//A(Core loss component of curent)
33 Io=sqrt(Iom^2+Io1^2);//A(no load current)
34 disp(Io,"(c) Primary current on no load(A)");
35 format('v',6);
36 pf=Io1/Io;//lagging pf on no load
37 disp(pf,"(c) Power factor(lagging) on no load");

```

---

### Scilab code Exa 5.3 Current and power factor

```

1 //Ex 5.3
2 clc;clear;close;
3 format('v',5);
4 N1=1000;//no. of turns in primary
5 N2=200;//no. of turns in secondary
6 I0=3;//A
7 pf0=0.2;//lagging power factor
8 I2=280;//A(2ndary current)
9 pf2=0.8;//lagging power factor
10 I2dash=I2*N2/N1;//A
11 cosfi0=pf0;cosfi2=pf2;sinfi0=sqrt(1-cosfi0^2);sinfi2
    =sqrt(1-cosfi2^2);
12 I1_cosfi1=I2dash*cosfi2+I0*cosfi0;//A
13 I1_sinfi1=I2dash*sinfi2+I0*sinfi0;//A
14 I1=sqrt(I1_cosfi1^2+I1_sinfi1^2);//A
15 disp(I1,"Primary current(A)");
16 fi1=atand(I1_sinfi1/I1_cosfi1);//degree
17 pf1=cosd(fi1);//lagging
18 disp(pf1,"Primary power factor(lagging)");

```

---

# Chapter 6

## DC Machines

Scilab code Exa 6.1 Generated emf

```
1 //Ex 6.1
2 clc;clear;close;
3 format('v',5);
4 P=4;//no. of poles
5 c=2;//no. of parallel paths
6 p=4/2;//no. of pair of poles
7 S=51;//no. of slots
8 C=12;//conductors per slot
9 N=900;//rpm(speed)
10 fi=25/1000;//Wb
11 Z=S*C;//total no. of conductors
12 E=2*Z/c*N*p/60*fi;//V
13 disp(E,"Generated emf(V)");
```

---

Scilab code Exa 6.2 Conductors per slot

```
1 //Ex 6.2
2 clc;clear;close;
```



```

3 format('v',5);
4 P=8;//no. of poles
5 c=8;//no. of parallel paths
6 p=8/2;//no. of pair of poles
7 E=260;//V(generated emf)
8 fi=0.05;//Wb
9 S=120;//no. of slots
10 N=350;//rpm(speed)
11 Z=E/(2/c*N*p/60*fi);//V
12 disp(round(Z),"No. of conductors per slot");

```

---

#### Scilab code Exa 6.3 Generated emf

```

1 //Ex 6.3
2 clc;clear;close;
3 format('v',5);
4 Ra=0.1;//ohm(Armature resistance)
5 Vs=250;//V(supply voltage)
6 //part(a)
7 I=80;//A
8 Vdrop=Ra*I;//V
9 emf=Vs+Vdrop;//V(Generated emf)
10 disp(emf,"Part(a) Generated emf(V)");
11 //part(b)
12 I=60;//A(current taken by Motor)
13 Vdrop=Ra*I;//V
14 emf=Vs-Vdrop;//V(Generated emf)
15 disp(emf,"Part(b) Generated emf(V)");

```

---

#### Scilab code Exa 6.4 Calculate speed

```

1 //Ex 6.4
2 clc;clear;close;

```

```

3 format('v',5);
4 P=4; //no. of poles
5 Vs=440; //V
6 c=2; //no. of parallel paths
7 p=4/2; //no. of pair of poles
8 Ia=50; //A
9 Ra=0.28; //ohm
10 Z=888; //conductors
11 fi=0.023; //Wb
12 emf=Vs-Ia*Ra; //V
13 N=emf/(2*Z/c*p/60*fi); //rpm
14 disp(round(N),"Speed in rpm");

```

---

#### Scilab code Exa 6.5 Approximate speed

```

1 //Ex 6.5
2 clc;clear;close;
3 format('v',5);
4 N=900; //rpm
5 Vs=460; //V
6 Vs_new=200; //V
7 fi_ratio=0.7; //ratio of new flux to original flux
8 kfi=Vs/N; //for original flux
9 Nnew=Vs_new/kfi/fi_ratio; //rpm(new speed)
10 disp(round(Nnew),"Speed in rpm");

```

---

#### Scilab code Exa 6.6 Speed and gross torque

```

1 //Ex 6.6
2 clc;clear;close;
3 format('v',5);
4 Ia=110; //A
5 Vs=480; //V

```

```

6 Ra=0.2; //ohm
7 P=6; //no. of poles
8 c=6; //no. of parallel paths
9 p=P/2; //no. of pair of poles
10 Z=864; //no. of conductors
11 fi=0.05; //Wb
12 emf=Vs-Ia*Ra; //V
13 N=emf/(2*Z/c*p/60*fi); //rpm
14 N=round(N); //rpm
15 disp(N,"(a) Speed in rpm");
16 Pm=Ia*emf; //W(Mechanical power developed)
17 M=Pm/(N/60)/(2*%pi); //Nm(Torque)
18 disp(M,"(b) Gross torque developed (Nm)");

```

---

#### Scilab code Exa 6.7 Power generated

```

1 //Ex 6.7
2 clc;clear;close;
3 format('v',6);
4 N=15; //rps
5 M=2*1000; //Nm(Torque required)
6 Loss=8*1000; //W
7 P=2*%pi*M*N; //W(Power required)
8 Pa=P-Loss; //W(Power generated in armature)
9 disp(Pa/1000,"Power generated in armature(kW)");

```

---

# Chapter 7

## Induction Machines

Scilab code Exa 7.1 Speed and frequency

```
1 //Ex 7.1
2 clc;clear;close;
3 format('v',5);
4 P=4;//no. of poles
5 f=50;//Hz
6 S=4/100;//slip
7 N=600;//rpm
8 p=P/2;//pair of poles
9 //(a)
10 Ns=60*f/p;//rpm(Synchronous speed)
11 disp(Ns,"(a) Synchronous speed(rpm)");
12 //(b)
13 Nr=Ns-S*Ns;//rpm(Rotor speed)
14 disp(Nr,"(b) Rotor speed(rpm)");
15 //(c)
16 Sdash=(Ns-N)/Ns;//per unot slip
17 fr=f*Sdash;//Hz(Rotor frequency)
18 disp(fr,"Rotor frequency(Hz)");
```

---

### Scilab code Exa 7.2 Rotor emf and phase difference

```
1 //Ex 7.2
2 clc;clear;close;
3 format('v',5);
4 Zs=240;//no. of conductors in stator winding
5 Zr=48;//no. of conductors in rotor winding
6 Rr=0.013;//ohm/phase(resistance rotor winding)
7 XL=0.048;//ohm/phase(leakage reactance)
8 Vs=400;//V
9 //(a)
10 Eo=Vs*Zr/Zs;//V(rotor emf)
11 disp(Eo,"(a) Rotor emf(V)");
12 //(b)
13 S=4/100;//slip
14 Eo=Eo*S;//V(rotor emf for 4% slip)
15 disp(Eo,"(b) Rotor emf at 4% slip(V)");
16 Z=sqrt(Rr^2+(S*XL)^2);//ohm/phase(rotor impedance at
    4% slip)
17 Ir=Eo/Z;//A(Rotor current at 4% slip)
18 disp(Ir,"(b) Rotor current at 4% slip(A)");
19 //(c)
20 fi_r=atand(S*XL/Rr);//degree
21 disp(fi_r,"(c) Phase difference at 4% slip(degree)")
    ;
22 S=100/100;//100% slip
23 fi_r=atand(S*XL/Rr);//degree
24 disp(fi_r,"(c) Phase difference at 100% slip(degree)
    ");
```

---

# Chapter 10

## Amplifiers

Scilab code Exa 1.1 Output Voltage

```
1 //Part B Ex 1.1
2 clc;clear;close;
3 format('v',5);
4 Av=10;//voltage gain
5 Ri=1;//kohm
6 Ro=10;//ohm
7 Vs=2;//V(Sensor voltage)
8 Rs=100;//ohm(Sensor resistance)
9 RL=50;//ohm
10 Vi=Vs*Ri*1000/(Rs+Ri*1000);//V
11 Vo=Av*Vi*RL/(Ro+RL);//V
12 disp(Vo,"Output voltage of amplifier(V)");
```

---

Scilab code Exa 1.2 Voltage Gain

```
1 //Part B Ex 1.2
2 clc;clear;close;
3 format('v',5);
```

```

4 Av=10; //voltage gain
5 Ri=1; //kohm
6 Ro=10; //ohm
7 Vs=2; //V(Sensor voltage)
8 Rs=100; //ohm(Sensor resistance)
9 RL=50; //ohm
10 Vi=Vs*Ri*1000/(Rs+Ri*1000); //V
11 Vo=Av*Vi*RL/(Ro+RL); //V
12 Av=Vo/Vi; //voltage gain of circuit
13 disp(Av,"Voltage gain of circuit");

```

---

### Scilab code Exa 1.3 Output Voltage

```

1 //Part B Ex 1.3
2 clc;clear;close;
3 format('v',5);
4 Av=10; //voltage gain
5 Ri=%inf; //ohm
6 Ro=0; //ohm
7 Vs=2; //V(Sensor voltage)
8 Rs=100; //ohm(Sensor resistance)
9 RL=50; //ohm
10 //Vi=Vs*Ri/(Rs+Ri) leads to Vi approximately equals
    to Vs as Ri=%inf
11 Vi=Vs; //V
12 Vo=Av*Vi*RL/(Ro+RL); //V
13 disp(Vo,"Output voltage of amplifier(V)");

```

---

### Scilab code Exa 1.4 Current Circuit

```

1 //Part B Ex 1.4
2 clc;clear;close;
3 format('v',5);

```

```

4 VOC=10; //V(open circuit voltage)
5 //VOC=source voltage here
6 R=1; //kohm
7 ISC=VOC/R; //mA
8 disp(ISC, "Current generated by the circuit (mA)");

```

---

#### Scilab code Exa 1.5 Output Power

```

1 //Part B Ex 1.5
2 clc; clear; close;
3 format('v',4);
4 Av=10; //voltage gain
5 Ri=1; //kohm
6 Ro=10; //ohm
7 Vs=2; //V(Sensor voltage)
8 Rs=100; //ohm(Sensor resistance)
9 RL=50; //ohm
10 Vi=Vs*Ri*1000/(Rs+Ri*1000); //V
11 Vo=Av*Vi*RL/(Ro+RL); //V
12 Po=Vo^2/RL; //W
13 disp(Po, "Output power (W)");

```

---

#### Scilab code Exa 1.6 Power gain of circuit

```

1 //Part B Ex 1.6
2 clc; clear; close;
3 format('v',5);
4 Av=10; //voltage gain
5 Ri=1; //kohm
6 Ro=10; //ohm
7 Vs=2; //V(Sensor voltage)
8 Rs=100; //ohm(Sensor resistance)
9 RL=50; //ohm

```



```

10 Vi=Vs*Ri*1000/(Rs+Ri*1000); //V
11 Vo=Av*Vi*RL/(Ro+RL); //V
12 Po=Vo^2/RL; //W
13 Pi=Vi^2/Ri; //mW
14 Ap=Po*1000/Pi; //Power gain
15 disp(Ap,"Power gain");
16 //Answer in the book is wrong.

```

---

#### Scilab code Exa 1.7 Power gain in decibels

```

1 //Part B Ex 1.7
2 clc;clear;close;
3 format('v',5);
4 Ap=1400; //Power gain
5 Ap_dB=10*log10(Ap); //dB
6 disp(Ap_dB,"Power gain (dB)");

```

---

#### Scilab code Exa 1.8 Gain in dB

```

1 //Part B Ex 1.8
2 clc;clear;close;
3 format('v',4);
4 Ap1=5; //Power gain
5 Ap1_dB=10*log10(Ap1); //dB
6 disp(Ap1_dB,"Power gain of 5 in dB");
7 Ap2=50; //Power gain
8 Ap2_dB=10*log10(Ap2); //dB
9 disp(Ap2_dB,"Power gain of 50 in dB");
10 Ap3=500; //Power gain
11 Ap3_dB=10*log10(Ap3); //dB
12 disp(Ap3_dB,"Power gain of 500 in dB");
13 Av1=5; //Voltage gain
14 Av1_dB=20*log10(Av1); //dB

```

```

15 disp(Av1_dB,"Voltage gain of 5 in dB");
16 Av2=50;//Voltage gain
17 Av2_dB=20*log10(Av2);//dB
18 disp(Av2_dB,"Voltage gain of 50 in dB");
19 Av3=500;//Voltage gain
20 Av3_dB=20*log10(Av3);//dB
21 disp(Av3_dB,"Voltage gain of 500 in dB");

```

---

#### Scilab code Exa 1.9 Power gain and voltage gain

```

1 //Part B Ex 1.9
2 clc;clear;close;
3 format('v',6);
4 G1=20;//dB
5 G2=30;//dB
6 G3=40;//dB
7 Ap1=10^(G1/10);//Power Gain
8 disp(Ap1,"Power gain for 20 dB");
9 Av1=10^(G1/20);//Voltage Gain
10 disp(Av1,"Voltage gain for 20 dB");
11 Ap2=10^(G2/10);//Power Gain
12 disp(Ap2,"Power gain for 30 dB");
13 Av2=10^(G2/20);//Voltage Gain
14 disp(Av2,"Voltage gain for 30 dB");
15 Ap3=10^(G3/10);//Power Gain
16 disp(Ap3,"Power gain for 40 dB");
17 Av3=10^(G3/20);//Voltage Gain
18 disp(Av3,"Voltage gain for 40 dB");

```

---

#### Scilab code Exa 1.10 Time constant and frequency

```

1 //Part B Ex 1.10
2 clc;clear;close;

```

```

3 format('v',5);
4 C=10; //micro F
5 R=1; //kohm
6 T=C*10^-6*R*1000; //seconds
7 disp(T,"Time constant(seconds)");
8 omega_c=1/T; //rads/s
9 disp(omega_c,"omega_c(rads/s)");
10 fc=1/2/%pi/T; //Hz
11 disp(fc,"fc(Hz)");

```

---

### Scilab code Exa 1.11 Determine frequencies

```

1 //Part B Ex 1.11
2 clc;clear;close;
3 format('v',5);
4 //(a)
5 f=1; //kHz
6 n=1; //no. of octave(above)
7 f1=f*2^n; //Hz
8 disp(f1,"(a) An octave above 1 kHz (in kHz)= ");
9 //(b)
10 f=10; //Hz
11 n=3; //no. of octave(above)
12 f1=f*2^n; //Hz
13 disp(f1,"(b) Three octave above 10 Hz (in Hz)= ");
14 //(c)
15 f=100; //Hz
16 n=1; //no. of octave(below)
17 f1=f/2^n; //Hz
18 disp(f1,"(c) An octave below 100 Hz (in Hz)= ");
19 //(d)
20 f=20; //kHz
21 n=1; //no. of decade(above)
22 f1=f*10^n; //Hz
23 disp(f1,"(d) An decade above 20 Hz (in Hz) = ");

```

```

24 // (e)
25 f=1; //MHz
26 n=3; //no. of decade(below)
27 f1=f/10^n; //Hz
28 disp(f1*1000,"(e) Three decade below 1 MHz (in kHz)
    = ");
29 // (f)
30 f=50; //kHz
31 n=2; //no. of decade(above)
32 f1=f*10^n; //Hz
33 disp(f1/1000,"(f) Two decade above 50 Hz (in kHz) =
    ");

```

---

#### Scilab code Exa 1.12 Time constant and frequency

```

1 //Part B Ex 1.12
2 clc;clear;close;
3 format('v',5);
4 C=10; //micro F
5 R=1; //kohm
6 T=C*10^-6*R*1000; //seconds
7 disp(T,"Time constant(seconds)");
8 omega_c=1/T; //rads/s
9 disp(omega_c,"omega_c(rads/s)");
10 fc=1/2/%pi/T; //Hz
11 disp(fc,"fc(Hz)");

```

---

#### Scilab code Exa 1.13 SN ratio

```

1 //Part B Ex 1.13
2 clc;clear;close;
3 format('v',5);
4 format('v',5);

```

```

5 Vs=2.5; //V
6 Vn=10; //mV
7 SNratio=20*log10(Vs/(Vn/1000)); //dB
8 disp(SNratio,"S/N ratio (dB)");

```

---

### Scilab code Exa 1.13.1 Effect of overall gain

```

1 //Part B Ex 1.13 at page 1.47
2 clc;clear;close;
3 format('v',6);
4 G=100; //stable voltage gain
5 A=100000:200000; //variable gain
6 B=1/G; //Unitless
7 disp("When the gain of amplifier(A) is 100000");
8 G1=min(A)/(1+min(A)*B); //overall gain
9 disp(G1,"The overall gain(G) is ");
10 disp("When the gain of amplifier(A) is 200000");
11 G2=max(A)/(1+max(A)*B); //overall gain
12 disp(G2,"The overall gain(G) is ");
13 change=(G2-G1)/G*100; // % Change in gain
14 disp("Effect of variable gain :");
15 disp(change,"Corresponding to 100% Change in gain of
    active amplifier , Change in overall gain is (%) "
    );

```

---

### Scilab code Exa 1.14 Overall gain

```

1 //Part B Ex 1.14
2 clc;clear;close;
3 format('v',5);
4 A=10000; //stable voltage gain
5 B=1/A; //unitless
6 //For A=100000; //gain

```

```
7 A=100000; //gain
8 G=A/(1+A*B); //overall gain
9 disp(G,"When the gain of amplifier is 100000,
    Overall gain will be");
10 A=200000; //gain
11 G=A/(1+A*B); //overall gain
12 disp(G,"When the gain of amplifier is 200000,
    Overall gain will be");
```

---

# Chapter 11

## Digital Systems

Scilab code Exa 2.12 Binary to decimal

```
1 //Part B Ex 2.12
2 clc;clear;close;
3 format('v',5);
4 binary='11010';//given binary value
5 decimal=bin2dec(binary);//equivalent decimal
6 disp(decimal,"Equivalent decimal value is");
```

---

Scilab code Exa 2.13 decimal to binary

```
1 //Part B Ex 2.13
2 clc;clear;close;
3 format('v',5);
4 decimal=26;//given decimal value
5 binary=dec2bin(decimal);//equivalent binary value
6 disp(binary,"Equivalent binary value is");
```

---

### Scilab code Exa 2.14 decimal to binary

```
1 //Part B Ex 2.14
2 clc;clear;close;
3 format('v',9);
4 dec=34.6875;//given decimal value
5 i=floor(dec);//integer part
6 f=dec-i;//fraction part
7 i_bin=dec2bin(i);//binary equivalent of integer part
8 f_bin=' ';//for initializing(string)
9 for n=1:4
10     t=2*f;
11     if t>=1 then
12         p(n)=1;
13         f=t-1;
14     end
15 if t<1 then
16     p(n)=0;
17     f=t;
18 end
19 f_bin=f_bin+string(p(n));//binary equivalent of
    fraction part
20 end;
21 bin=i_bin+'.'+f_bin;//Binary equivalent of complete
    no.
22 disp(bin,"Binary equivalent of complete no. is ");
```

---

### Scilab code Exa 2.15 Hexadecimal to decimal

```
1 //Part B Ex 2.15
2 clc;clear;close;
3 format('v',7);
4 hex='A013';//given hexadecimal value
5 dec=hex2dec(hex);//equivalent decimal value
6 disp(dec,"Equivalent decimal value is");
```



---

**Scilab code Exa 2.16** decimal to hexadecimal

```
1 //Part B Ex 2.16
2 clc;clear;close;
3 format('v',7);
4 dec=7046;//given decimal value
5 hex=dec2hex(dec);//equivalent hexadecimal value
6 disp(hex,"Equivalent hexadecimal value is");
```

---

**Scilab code Exa 2.17** Hexadecimal to binary

```
1 //Part B Ex 2.17
2 clc;clear;close;
3 format('v',7);
4 hex='F851';//given hexadecimal value
5 dec=hex2dec(hex);//equivalent decimal value
6 bin=dec2bin(dec);//equivalent binary value
7 disp(bin,"Equivalent binary value is");
```

---

**Scilab code Exa 2.18** Binary to hexadecimal

```
1 //Part B Ex 2.18
2 clc;clear;close;
3 format('v',7);
4 bin='111011011000100';//given binary value
5 dec=bin2dec(bin);//equivalent decimal value
6 hex=dec2hex(dec);//equivalent hexadecimal value
7 disp(hex,"Equivalent hexadecimal value is");
```

---

# Chapter 13

## Radio Communication

Scilab code Exa 4.1 Frequency Limits and Bandwidth

```
1 //Ex 4.1
2 clc;clear;close;
3 format('v',6);
4 fc=100;//kHz
5 fm=5;//kHz
6 LSB=[fc-fm fc];//kHz
7 USB=[fc fc+fm];//kHz
8 disp("Part (a)");
9 disp("Lower sideband is from "+string(LSB(1))+ " kHz
    to "+string(LSB(2))+ " kHz");
10 disp("Upper sideband is from "+string(USB(1))+ " kHz
    to "+string(USB(2))+ " kHz");
11 B=2*fm;//kHz
12 disp(B,"(b) Bandwidth(kHz)");
13 disp("part (c)");
14 fm=3;//kHz
15 f_usf=fc+fm;//kHz
16 disp(f_usf,"Upper side frequency(kHz)");
17 f_lsf=fc-fm;//kHz
18 disp(f_lsf,"Lower side frequency(kHz)");
```

---

#### Scilab code Exa 4.2 Frequency and modulation coefficient

```
1 //Ex 4.2
2 clc;clear;close;
3 format('v',6);
4 fc=500;//kHz
5 fm=10;//kHz
6 //Am=7.5*Vp & Ac=20*Vc
7 Em=7.5;//times of Vp
8 Ec=20;//times of Vp(unmodulated carrier)
9 disp("Part (a)");
10 f_usf=fc+fm;//kHz
11 disp(f_usf,"Upper side frequency(kHz)");
12 f_lsf=fc-fm;//kHz
13 disp(f_lsf,"Lower side frequency(kHz)");
14 disp("Part (b)");
15 m=Em/Ec;//modulation coefficient
16 disp(m,"Modulation coefficient");
17 M=100*m;//% modulation
18 disp(M,"% Modulation");
19 disp("Part (c)");
20 Ec1=Ec;//times of Vp(modulated carrier)
21 Eusf=m*Ec/2;//times of Vp
22 Elsf=m*Ec/2;//times of Vp
23 disp("Peak amplitude of modulated carrier is "+
      string(Ec1)+"*Vp");
24 disp("Upper & lower side frequency voltages, Eusf =
      Elsf = "+string(Eusf)+"*Vp");
25 disp("Part (d)");
26 Vmax=Ec+Em;//times of Vp
27 Vmin=Ec-Em;//times of Vp
28 disp("Maximum amplitude of envelope is "+string(Vmax
      )+"*Vp");
29 disp("Minimum amplitude of envelope is "+string(Vmin
```

```
)+"*Vp");
```

---

### Scilab code Exa 4.3 Power and voltage

```
1 //Ex 4.3
2 clc;clear;close;
3 format('v',6);
4 fc=1;//MHz
5 fm=5;//kHz
6 m=60/100;//Modulation
7 Pc=6;//kW
8 RL=50;//W
9 Pavg=Pc*(1+m^2/2);//kW(Average power delivered to
   load)
10 disp("Part(a)");
11 disp(Pavg,"Average power of modulated signal(kW)");
12 PdB=10*log10(Pavg*1000);//dB
13 disp(PdB,"Average power of modulated signal(dB)");
14 PdBm=10*log10(Pavg*10^6);//dBm
15 disp(PdBm,"Average power of modulated signal(dBm)");
16 disp("Part(b)");
17 VS_RMS=sqrt(2*RL*Pavg*1000)/1000;//kV
18 disp(VS_RMS,"RMS voltage of modulated signal(kV)");
19 Vp=sqrt(2)*VS_RMS;//V
20 disp(Vp,"Peak value of modulated signal(kV)");
21 //Answer is wrong in the book.
```

---

### Scilab code Exa 4.4 Determine power

```
1 //Ex 4.4
2 clc;clear;close;
3 format('v',7);
4 Vc=10;//times of Vp
```

```

5  RL=10; //ohm
6  m=1; //modulation coefficient
7  Pc=Vc^2/2/RL; //W
8  Pusb=m^2*Pc/4; //W
9  Plsb=m^2*Pc/4; //W
10 disp("Part (a)");
11 disp(Pc,"Carrier power(W)");
12 disp(Pusb,"Upper side band power(W)");
13 disp(Plsb,"Lower side band power(W)");
14 disp("Part (b)");
15 Psbt=m^2*Pc/2; //W
16 disp(Psbt,"Total side band power(W)");
17 disp("Part (c)");
18 Pt=Pc*(1+m^2/2); //W
19 disp(Pt,"Total power of modulated wave(W)");
20 disp("Part (e)");
21 m=0.5; //modulation coefficient
22 Pusb=m^2*Pc/4; //W
23 Plsb=m^2*Pc/4; //W
24 disp(Pc,"Carrier power(W)");
25 disp(Pusb,"Upper side band power(W)");
26 disp(Plsb,"Lower side band power(W)");
27 Psbt=m^2*Pc/2; //W
28 disp(Psbt,"Total side band power(W)");
29 Pt=Pc*(1+m^2/2); //W
30 disp(Pt,"Total power of modulated wave(W)");

```

---

#### Scilab code Exa 4.5 Noise Figure improvement

```

1 //Ex 4.5
2 clc;clear;close;
3 format('v',3);
4 RF=200; //kHz
5 IF=10; //kHz
6 BI=RF/IF; // unitless (Bandwidth Improvement)

```

```

7 NF=10*log10(BI); //dB
8 disp(NF,"Noise Figure improvement(dB)");

```

---

#### Scilab code Exa 4.6 Peak frequency and phase deviation

```

1 //Ex 4.6
2 clc;clear;close;;
3 format('v',6)
4 //Part (a)
5 K1=5; //kHz/V
6 //vm(t)=2*cos(2*p*2000*t);
7 Vm=2; //V
8 fm=2000; //Hz
9 delta_f=K1*Vm; //kHz
10 disp(delta_f,"(a) Pak frequency deviation(kHz)");
11 m=delta_f*1000/fm; //modulation index
12 disp(m,"(a) Modulation index");
13 //Part (b)
14 K=2.5; //rad/V
15 //vm(t)=-cos(2*p*2000*t);
16 fm=2000; //Hz
17 m=K*Vm; //rad(Peak phase shift)
18 disp(m,"(b) Peak phase shift(rad)");

```

---

#### Scilab code Exa 4.7 Frequency Modulation Index

```

1 //Ex 4.7
2 clc;clear;close;
3 format('v',5);
4 //v(t)=20*sin(6.28*10^6*t+10*sin(6.28*10^3*t));
5 //Comparing with VPM(t)=A*sin(omega_c*t+mp*sin(
   omega_m*t))
6 A=20;

```

```

7 omega_c=6.28*10^6; //rad
8 omega_m=6.28*10^3; //rad
9 fc=omega_c/2/%pi/10^6; //MHz
10 fm=omega_m/2/%pi/10^3; //kHz
11 mp=10; //modulation index
12 delta_theta=mp; //radians
13 disp(fc,"(a) Carrier frequency (MHz)");
14 disp(fm,"(b) Modulating frequency (kHz)");
15 disp(mp,"(c) Modulation index (mp)");
16 disp(delta_theta,"(d) Peak phase deviation (radians)");

```

---

#### Scilab code Exa 4.8 Minimum Bandwidth

```

1 //Ex 4.8
2 clc;clear;close;
3 format('v',5);
4 delta_f=10; //kHz
5 fm=10; //kHz
6 Vc=10; //V
7 fc=500; //kHz
8 m=delta_f/fm; //modulation index
9 //For m=1 we have 3 sidebands
10 B=2*(3*fm); //kHz
11 disp(B,"(a) Actual minimum bandwidth (kHz)");
12 B=2*(fm+delta_f); //kHz
13 disp(B,"(b) Approximate minimum bandwidth (kHz)");
14 A0=0.77*fm; //V
15 A1=0.44*fm; //V
16 A2=0.11*fm; //V
17 A3=0.02*fm; //V
18 //For frequency spectrum
19 A=[A3 A2 A1 A0 A1 A2 A3]; //V (Amplitudes)
20 f=[fc+3*fm fc+2*fm fc+fm fc fc+fm fc+2*fm fc+3*fm];
    //kHz

```

```

21 plot(f,A);
22 title('Output frequency spectrum');
23 xlabel('Frequency (kHz)');
24 ylabel('Amplitudes (V)');

```

---

#### Scilab code Exa 4.9 Deviation ratio and bandwidth

```

1 //Ex 4.9
2 clc;clear;close;
3 format('v',6)
4 //Part (a)
5 delta_f=75;//kHz
6 fm=15;//kHz
7 DR=delta_f/fm;//Deviation ratio
8 disp(DR,"(a) Deviation ratio");
9 //For m or DR=5 we have 8 sidebands
10 B=2*(8*fm);//kHz
11 disp(B,"(a) Bandwidth for worst case(kHz)");
12 //Part (b)
13 delta_f=75/2;//kHz
14 fm=15/2;//kHz
15 DR=delta_f/fm;//Deviation ratio
16 disp(DR,"(b) Deviation ratio or modulation index");
17 //For m or DR=5 we have 8 sidebands
18 B=2*(8*fm);//kHz
19 disp(B,"(b) Bandwidth for worst case(kHz)");

```

---

#### Scilab code Exa 4.10 Frequency and deviation ratio

```

1 //Ex 4.10
2 clc;clear;close;
3 format('v',6);
4 //Part (a)

```



```

5 ft=88.8; //MHz
6 N1N2N3=20; //frequency multiplication
7 fc=ft/N1N2N3; //MHz
8 disp(fc,"(a) Master oscillator center frequency(MHz)
   ");
9 delta_ft=75; //kHz
10 delta_f=delta_ft*1000/N1N2N3; //Hz
11 disp(delta_f,"(b) Frequency deviation at the output(
   Hz)");
12 fm=15; //kHz
13 DR=delta_f/1000/fm; //Deviation ratio at output
14 disp(DR,"(c) Deviation ratio at the output");
15 DR=DR*N1N2N3; //Deviation ratio at antenna
16 disp(DR,"(d) Deviation ratio at the antenna");

```

---

#### Scilab code Exa 4.11 Reduction in frequency drift

```

1 //Ex 4.11
2 clc;clear;close;
3 format('v',11);
4 VCO=200; //ppm(VCO stability)
5 fc=5.1; //MHz
6 ft_old=91.8; //MHz
7 k0=10; //kHz/V
8 kd=2; //V/kHz
9 f2=30.6; //MHz
10 fc=fc*10^6+(VCO*10^-6*fc*10^6); //Hz(with feedback
   loop open)
11 N1=2;N2=3;
12 f2_new=N1*N2*fc; //Hz
13 df2=f2_new-f2*10^6; //Hz(Frequency drift)
14 ft=N2*f2_new/10^6; //MHz(Transmit frequency)
15 df2_reduced=df2/(1+N1*N2*kd*k0); //Hz(reduced
   frequency drift)
16 df2_reduced=round(df2_reduced); //Hz

```

```
17 disp(df2_reduced,"Reduced frequency drift(Hz)");
18 f2dash=f2*10^6+df2_reduced;//Hz(New transmit
    frequency of antenna)
19 ftnew=f2dash*N2;//Hz
20 disp(ftnew,"New transmit frequency of antenna(Hz)")
21 old_drift=ft*10^6-ft_old*10^6;//Hz
22 new_drift=ftnew-ft_old*10^6;//Hz
23 disp("The frequency drift at the antenna has been
    reduced from "+string(old_drift)+" Hz to "+string
    (new_drift)+" Hz. This fulfill the FCC
    requirements.")
```

---

# Chapter 15

## Communication systems

Scilab code Exa 6.1 Angle of refraction

```
1 //Ex 6.1
2 clc;clear;close;
3 format('v',6);
4 theta1=30;//degree(Angle of incidence)
5 n1=1.5;//(refractive index for glass)
6 n2=1.36;//(refractive index for ethyl alcohol)
7 theta2=asind(n1*sind(theta1)/n2);//degree(Angle of
   refraction)
8 disp(theta2,"Angle of refraction(degree)");
```

---

Scilab code Exa 6.2 No of channels

```
1 //Ex 6.2
2 clc;clear;close;
3 format('v',6);
4 clusters=10;//no. of clusters
5 cells=7;//no. of cells in a cluster
6 channels=10;//no. of channels in a cell
```

```

7 F=cells*channels;//no. of full duplex channels/
  cluster
8 disp(F,"Number of channels per cluster");
9 C=clusters*cells*channels;//total no. of channels
10 disp(C,"Total channel capacity");

```

---

### Scilab code Exa 6.3 No of cells and frequency

```

1 //Ex 6.3
2 clc;clear;close;
3 format('v',6);
4 Asys=1520;//km^2
5 Ch=1140;//no. of channels
6 Acell=4;//km^2
7 i=3;j=2;//For hexagon cells
8 N=i^2+i*j+j^2;//cells in a cluster
9 disp(N,"(a) No. of cells in a cluster");
10 Acluster=N*Acell;//km^2
11 cluster=Asys/Acluster;//no. of clusters
12 disp(cluster,"(b) Number of clusters");
13 disp(Acluster,"(c) Area of each cellular cluster(km
  ^2)");
14 C=cluster*Ch;//system capacity
15 disp(C,"(d) Increased system capacity(No. of
  channels)");
16 //Without frequency reuse :-
17 c_sys=Asys/Acell;//No. of cell in a system
18 ch_cell=Ch/c_sys;//No. of channels/cell
19 disp(ch_cell,"(e_i) Without frequency reuse , No. of
  channels/cell");
20 //With frequency reuse :-
21 ch_cell=Ch/N;//No. of channels/cell
22 disp(ch_cell,"(e_ii) With frequency reuse , No. of
  channels/cell");

```

---