Scilab Textbook Companion for Basics of Electrical, Electronics and Communication Engineering by N. Storey, E. Hughes and W. Tomasi[1]

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Book Description

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

Exa Example (Solved example)

Eqn Equation (Particular equation of the above book)

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

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

Contents

List of Scilab Codes

Chapter 1

DC circuits

Scilab code Exa 1.1 Current in the circuit

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

Scilab code Exa 1.2 Voltage across resistor

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

```
I=1.5; //A
R1=2; //ohm
R2=3; //ohm
R3=8; //ohm
V1=I*R1; //V
V2=I*R2; //V
V3=I*R3; //V
disp(V1,"Voltage across R1(V)");
disp(V2,"Voltage across R2(V)");
disp(V3,"Voltage across R3(V)");
V=V1+V2+V3; //V(Supply voltage)
disp(V,"Supply Voltage(V)");
```

Scilab code Exa 1.3 Circuit current

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

Scilab code Exa 1.4 Resistance R1

```
//Ex 1.4
clc;clear;close;
format('v',6);
Vo=10; //V(Output voltage)
Vin=30; //V(Input voltage)
```

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

Scilab code Exa 1.5 Supply Current

```
//Ex 1.5
clc;clear;close;
format('v',6);
V=110;//V
R1=22;//ohm
R2=44;//ohm
I1=V/R1;//A
I2=V/R2;//A
I=I1+I2;//A
disp(I,"Supply current(A)");
```

Scilab code Exa 1.6 Effective resistance and Supply current

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

Scilab code Exa 1.7 Current in the resistor

```
//Ex 1.7
clc;clear;close;
format('v',4);
I=8;//A
R2=2;//ohm
// Part (a)
R1=2;//ohm
I2=I*R1/(R1+R2);//A
disp(I2,"(a) Current in 2 ohm resistance(A)");
// Part (b)
R1=4;//ohm
I2=I*R1/(R1+R2);//A
disp(I2,"(b) Current in 2 ohm resistance(A)");
```

Scilab code Exa 1.8 Calculate current

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

Scilab code Exa 1.10 Calculate current

```
//Ex 1.10
clc;clear;close;
format('v',6);
I1=2.5;//A
I2=-1.5;//A
//I1+I2+I3=0//from KCL
I3=-I1-I2;//A
disp(I3,"Current I3(A)");
```

Scilab code Exa 1.11 Determine the currents

```
//Ex 1.11
clc;clear;close;
format('v',6);
I1=3;//A
I3=1;//A
I6=1;//A
//I1-I2-I3=0//from KCL at point a
I2=I1-I3;//A
//I2+I4-I6=0//from KCL at point b
I4=I6-I2;//A
//I3-I4-I5=0//from KCL at point c
I5=I3-I4;//A
disp(I2,"Current I2(A)");
disp(I4,"Current I4(A)");
disp(I5,"Current I5(A)");
```

Scilab code Exa 1.12 Determine I1 and I2

```
//Ex 1.12
clc;clear;close;
format('v',6);
R1=30;//ohm
```

```
R2=60;//ohm
R3=30;//ohm
I3=1;//A
I1=I3*(R2+R3)/R2;//A
I2=I1-I3;//A
disp(I1,"Current I1(A)");
disp(I2,"Current I2(A)");
```

Scilab code Exa 1.13 Determine V1 and V3

```
//Ex 1.13
clc;clear;close;
format('v',6);
E=12;//V
V2=8;//V
V4=2;//V
V1=E-V2;//V
//-V2+V3+V4=0;//for Loop B
V3=V2-V4;//V
disp(V1,"Voltage V1(V)");
disp(V3,"Voltage V3(V)");
```

Scilab code Exa 1.14 Calculate VAB

```
//Ex 1.14
clc;clear;close;
format('v',6);
V=20;//V
R1=25;//ohm
R2=40;//ohm
R3=15;//ohm
R4=10;//ohm
VAC=R3*V/(R1+R3);//V
```

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

Scilab code Exa 1.15 Voltage and emf

```
//Ex 1.15
clc;clear;close;
format('v',6);
E1=10;//V
V2=6;//V
V3=8;//V
//E1=V1+V2;//KCL for left loop
V1=E1-V2;//V
//-E2=-V2-V3;//KCL for right loop
E2=V2+V3;//V
disp(V1,"Voltage V1(V)");
disp(E2,"Voltage E2(V)");
```

Chapter 2

Magnetic Circuits

Scilab code Exa 2.1 field strength and flux

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

Scilab code Exa 2.2 Magnetomotive force

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

Scilab code Exa 2.3 Reluctance and current

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

Scilab code Exa 2.4 Coil Current

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

Scilab code Exa 2.5 Induced emf

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

Scilab code Exa 2.6 Flux and emf

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

Scilab code Exa 2.7 Inductance of coil

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

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

Scilab code Exa 2.8 Inductance

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

Scilab code Exa 2.10 Self and mutual inductance

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

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

Chapter 3

Single phase AC circuits

Scilab code Exa 3.1 Frequency Period and emf

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

Scilab code Exa 3.2 Peak values of current

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

Scilab code Exa 3.3 Voltage and frequency

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

Scilab code Exa 3.4 Ameter reading Form and Peak factor

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

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

Scilab code Exa 3.5 Circuit current and phase angle

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

Scilab code Exa 3.6 Supply voltage

```
//Ex 3.6
```

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

Scilab code Exa 3.7 Supply voltage and phase angle

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

Scilab code Exa 3.8 Reactance and current

```
//Ex 3.8
clc;clear;close;
format('v',6);
```

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

Scilab code Exa 3.9 Reactance Impedence Current and phase

```
//Ex 3.9
clc;clear;close;
format('v',5);
R=12;//ohm(Coil resistance)
L=0.1;//H(Coil Inductance)
V=100;//V
f=50;//Hz
XL=2*%pi*f*L;//ohm
Z=sqrt(R^2+XL^2);//ohm
disp(Z,XL,"(a) Reactance(ohm) & impedence(ohm) of
    the coil are");
I=V/Z;//A
disp(I,"(b) Current(A)");
fi=atand(XL/R);//degree
fi=round(fi);//degree
disp(fi,"Phase difference(degree)");
```

Scilab code Exa 3.10 Capacitance and phase angle

```
//Ex 3.10
clc;clear;close;
format('v',5);
Pr=750;//W(rated)
```

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

Scilab code Exa 3.11 Impedence current and voltage

```
//Ex 3.11
clc;clear;close;
format('v',5);
R=12;//ohm
L=0.15;//H
C=100;//micro F
V=100;//V
f=50;//Hz
XL=2*%pi*f*L;//ohm
XC=1/(2*%pi*f*C*10^-6);//ohm
Z=sqrt(R^2+(XL-XC)^2);//ohm
disp(Z,"(a) Impedence(ohm)");
I=V/Z;//A
disp(I,"(b) Current(A)");
VR=R*I;//V
VL=XL*I;//V
VC=XC*I;//V
disp(VC,VL,VR,"(b) Voltge(V) across R, L & C");
fi=acosd(VR/V);//degree
disp(fi,"(c) Phase difference(degree)");
```

Scilab code Exa 3.12 Curent Phase angle and power

```
//Ex 3.12
clc;clear;close;
format('v',5);
R=6; //ohm
L=0.03; //H
V=50; //V
f=60; //Hz
XL=2*%pi*f*L; //ohm
Z=sqrt(R^2+XL^2); //ohm
I=V/Z; //A
disp(I,"(a) Current(A)");
fi=atand(XL/R); //degree
disp(fi,"(b) Phase angle(degree)");
S=V*I; //VA(Apparent power)
disp(S,"(c) Apparent power(VA)")
P=S*cosd(fi); //W
P=round(P); //W
disp(P,"(d) Active power(W)")
```

Scilab code Exa 3.13 Power dissipated

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

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

Scilab code Exa 3.14 Resistance Inductance and Power factor

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

Chapter 5

Single Phase Transformers

Scilab code Exa 5.1 Curent Turns and flux

```
//Ex 5.1
clc;clear;close;
format('v',5);
kVA=250; //kVA
V1=11000; //V(Primary voltage)
V2=400; //V(secondary voltage)
f=50; //Hz
N2=80; //no. of turns in secondary
Ifl1=kVA*1000/V1; //A(Full load primay current)
Ifl2=kVA*1000/V2; //A(Full load secondary current)
disp("Part(a)");
disp(Ifl1,"Full load primary current(A)");
disp(Ifl2,"Full load secondary current(A)");
disp("Part(b)");
N1=N2*V1/V2; //no. of turns in secondary
disp(N1,"No. of turns in primary");
disp("Part(c)");
fi_m=V2/(4.44*N2*f); //Wb
disp(fi_m*1000,"Maximum value of flux(mWb)");
```

Scilab code Exa 5.2 Area Voltage ad current

```
//Ex 5.2
clc;clear;close;
format('v',7);
N1=480;//no. of turns in primary
N2=90;//no. of turns in secondary
lfp=1.8;//m(length of flux path)
ag=0.1;//mm(airgap)
Flux=1.1;//T(flux density)
MF=400;//A/m(Magnetic flux)
c_loss=1.7;//W/kg
f=50;//Hz
d=7800;//kg/m^3(density of core)
V=2200;//V(potential difference)
//Part (a)
fi_m=V/(4.44*N1*f);//Wb
A=fi_m/Flux;//m^2(Cross sectional area)
disp(A,"(a) Cross sectional area(m^2)");
//Part (b)
Vnl2=V*N2/N1;//V(2ndary voltage on no load)
Vnl2=round(Vnl2);//V(2ndary voltage on no load)
disp(Vnl2,"(b) 2ndary voltage on no load(V)");
//Part (c)
format('v',5);
Fm1=MF*lfp;//A(Magnetootive force for the core)
Fm2=Flux/(4*%pi*10^-7)*ag*10^-3;//A(Magnetootive
    force for airgap)
Fm=Fm1+Fm2;//A(Total magnetomotive force)
Imax=Fm/N1;//A(maximum value of magnetizing current)
Iom=Imax/sqrt(2);//A(rms current)
v=lfp*A;//m^3(Volume of core)
m=v*d;//kg(Mass of core)
coreLoss=c_loss*m;//W(Core Loss)
```

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

Scilab code Exa 5.3 Current and power factor

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

Chapter 6

DC Machines

Scilab code Exa 6.1 Generated emf

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

Scilab code Exa 6.2 Conductors per slot

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

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

Scilab code Exa 6.3 Generated emf

```
//Ex 6.3
clc;clear;close;
format('v',5);
Ra=0.1;//ohm(Armature resistance)
Vs=250;//V(supply voltage)
//part(a)
I=80;//A
Vdrop=Ra*I;//V
emf=Vs+Vdrop;//V(Generated emf)
disp(emf,"Part(a) Generated emf(V)");
//part(b)
I=60;//A(current taken by Motor)
Vdrop=Ra*I;//V
emf=Vs-Vdrop;//V(Generated emf)
disp(emf,"Part(b) Generated emf(V)");
```

Scilab code Exa 6.4 Calculate speed

```
//Ex 6.4
clc;clear;close;
```

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

Scilab code Exa 6.5 Approximate speed

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

Scilab code Exa 6.6 SPeed and gross torque

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

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

Scilab code Exa 6.7 Power generated

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

Chapter 7

Induction Machines

Scilab code Exa 7.1 Speed and frequency

```
//Ex 7.1
clc;clear;close;
format('v',5);
P=4;//no. of poles
f=50;//Hz
S=4/100;//slip
N=600;//rpm
p=P/2;//pair of poles
//(a)
Ns=60*f/p;//rpm(Synchronous speed)
disp(Ns,"(a) Synchronous speed(rpm)");
//(b)
Nr=Ns-S*Ns;//rpm(Rotor speed)
disp(Nr,"(b) Rotor speed(rpm)");
//(c)
Sdash=(Ns-N)/Ns;//per unot slip
fr=f*Sdash;//Hz(Rotor frequency)
disp(fr,"Rotor frequency(Hz)");
```

Scilab code Exa 7.2 Rotor emf and phase difference

```
//Ex 7.2
clc;clear;close;
format('v',5);
Zs=240;//no. of conductors in stator winding
Zr=48;//no. of conductors in rotor winding
Rr=0.013;//ohm/phase(resstance rotor windig)
XL=0.048;//ohm/phase(leakega reactance)
Vs=400;//V
//(a)
Eo=Vs*Zr/Zs;//V(rotor emf)
disp(Eo,"(a) Rotor emf(V)");
//(b)
S=4/100;//slip
Eo=Eo*S;//V(rotor emf for 4% slip)
disp(Eo,"(b) Rotor emf at 4% slip(V)");
Z=sqrt(Rr^2+(S*XL)^2);//ohm/phase(rotor impedence at
    4% slip)
Ir=Eo/Z;//A(Rotor curren at 4% slip)
disp(Ir,"(b) Rotor curren at 4% slip(A)");
//(c)
fi_r=atand(S*XL/Rr);//degree
disp(fi_r,"(c) Phase difference at 4% slip(degree)")
    ;
S=100/100;//100% slip
fi_r=atand(S*XL/Rr);//degree
disp(fi_r,"(c) Phase difference at 100% slip(degree)
    ");
```

Chapter 10

Amplifiers

Scilab code Exa 1.1 Output Voltage

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

Scilab code Exa 1.2 Voltage Gain

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

```
Av=10;//voltage gain
Ri=1;//kohm
Ro=10;//ohm
Vs=2;//V(Sensor voltage)
Rs=100;//ohm(Sensor resistance)
RL=50;//ohm
Vi=Vs*Ri*1000/(Rs+Ri*1000);//V
Vo=Av*Vi*RL/(Ro+RL);//V
Av=Vo/Vi;//voltage gain of circuit
disp(Av,"Voltage gain of circuit");
```

Scilab code Exa 1.3 Output Voltage

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

Scilab code Exa 1.4 Current Circuit

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

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

Scilab code Exa 1.5 Output Power

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

Scilab code Exa 1.6 Power gain of circuit

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

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

Scilab code Exa 1.7 Power gain in decibels

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

Scilab code Exa 1.8 Gain in dB

```
//Part B Ex 1.8
clc;clear;close;
format('v',4);
Ap1=5;//Power gain
Ap1_dB=10*log10(Ap1);//dB
disp(Ap1_dB,"Power gain of 5 in dB");
Ap2=50;//Power gain
Ap2_dB=10*log10(Ap2);//dB
disp(Ap2_dB,"Power gain of 50 in dB");
Ap3=500;//Power gain
Ap3_dB=10*log10(Ap3);//dB
disp(Ap3_dB,"Power gain of 500 in dB");
Av1=5;//Voltage gain
Av1_dB=20*log10(Av1);//dB
```

```
disp(Av1_dB,"Voltage gain of 5 in dB");
Av2=50;//Voltage gain
Av2_dB=20*log10(Av2);//dB
disp(Av2_dB,"Voltage gain of 50 in dB");
Av3=500;//Voltage gain
Av3_dB=20*log10(Av3);//dB
disp(Av3_dB,"Voltage gain of 500 in dB");
```

Scilab code Exa 1.9 Power gain and voltage gain

```
//Part B Ex 1.9
clc;clear;close;
format('v',6);
G1=20;//dB
G2=30;//dB
G3=40;//dB
Ap1=10^(G1/10);//Power Gain
disp(Ap1,"Power gain for 20 dB");
Av1=10^(G1/20);//Voltage Gain
disp(Av1,"Voltage gain for 20 dB");
Ap2=10^(G2/10);//Power Gain
disp(Ap2,"Power gain for 30 dB");
Av2=10^(G2/20);//Voltage Gain
disp(Av2,"Voltage gain for 30 dB");
Ap3=10^(G3/10);//Power Gain
disp(Ap3,"Power gain for 40 dB");
Av3=10^(G3/20);//Voltage Gain
disp(Av3,"Voltage gain for 40 dB");
```

Scilab code Exa 1.10 Time constant and frequency

```
//Part B Ex 1.10
clc;clear;close;
```

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

Scilab code Exa 1.11 Determine frequencies

```
//Part B Ex 1.11
clc;clear;close;
format('v',5);
//(a)
f=1;//kHz
n=1;//no. of octave(above)
f1=f*2^n;//Hz
disp(f1,"(a) An octave above 1 kHz (in kHz)= ");
//(b)
f=10;//Hz
n=3;//no. of octave(above)
f1=f*2^n;//Hz
disp(f1,"(b) Three octave above 10 Hz (in Hz)= ");
//(c)
f=100;//Hz
n=1;//no. of octave(below)
f1=f/2^n;//Hz
disp(f1,"(c) An octave below 100 Hz (in Hz)= ");
//(d)
f=20;//kHz
n=1;//no. of decade(above)
f1=f*10^n;//Hz
disp(f1,"(d) An decade above 20 Hz (in Hz) = ");
```

```
//(e)
f=1;//MHz
n=3;//no. of decade(below)
f1=f/10^n;//Hz
disp(f1*1000,"(e) Three decade below 1 MHz (in kHz) = ");
//(f)
f=50;//kHz
n=2;//no. of decade(above)
f1=f*10^n;//Hz
disp(f1/1000,"(f) Two decade above 50 Hz (in kHz) = ");
```

Scilab code Exa 1.12 Time constant and frequency

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

Scilab code Exa 1.13 SN ratio

```
//Part B Ex 1.13
clc;clear;close;
format('v',5);
format('v',5);
```

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

Scilab code Exa 1.13.1 Effect of overall gain

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

Scilab code Exa 1.14 Overall gain

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

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

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

Scilab code Exa 2.13 decimal to binary

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

Scilab code Exa 2.14 decimal to binary

```
//Part B Ex 2.14
clc;clear;close;
format('v',9);
dec=34.6875;//given decimal value
i=floor(dec);//integer part
f=dec-i;//fraction part
i_bin=dec2bin(i);//binary equivalent of integer part
f_bin=' ';//for initializing(string)
for n=1:4
    t=2*f;
    if t>=1 then
        p(n)=1;
        f=t-1;
     end
if t<1 then
    p(n)=0;
    f=t;
end
f_bin=f_bin+string(p(n));//binary equivalent of fraction part
end;
bin=i_bin+'.'+f_bin;//Binary equivalent of complete no.
disp(bin,"Binary equivalent of complete no. is ");
```

Scilab code Exa 2.15 Hexadecimal to decimal

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

Scilab code Exa 2.16 decimal to hexadecimal

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

Scilab code Exa 2.17 Hexadecimal to binary

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

Scilab code Exa 2.18 Binary to hexadecimal

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

Chapter 13

Radio Communication

Scilab code Exa 4.1 Frequency Limits and Bandwidth

```
//Ex 4.1
clc;clear;close;
format('v',6);
fc=100;//kHz
fm=5;//kHz
LSB=[fc-fm fc];//kHz
USB=[fc fc+fm];//kHz
disp("Part (a)");
disp("Lower sideband is from "+string(LSB(1))+" kHz
   to "+string(LSB(2))+" kHz");
disp("Upper sideband is from "+string(USB(1))+" kHz
   to "+string(USB(2))+" kHz");
B=2*fm;//kHz
disp(B,"(b) Bandwidth(kHz)");
disp("part (c)");
fm=3;//kHz
f_usf=fc+fm;//kHz
disp(f_usf,"Upper side frequency(kHz)");
f_lsf=fc-fm;//kHz
disp(f_lsf,"Lower side frequency(kHz)");
```

Scilab code Exa 4.2 Frequency and modulation coefficient

```
//Ex 4.2
clc;clear;close;
format('v',6);
fc=500;//kHz
fm=10;//kHz
//Am=7.5*Vp & Ac=20*Vc
Em=7.5;//times of Vp
Ec=20;//times of Vp(unmodulated carrier)
disp("Part (a)");
f_usf=fc+fm;//kHz
disp(f_usf,"Upper side frequency(kHz)");
f_lsf=fc-fm;//kHz
disp(f_lsf,"Lower side frequency(kHz)");
disp("Part (b)");
m=Em/Ec;//modulation coefficient
disp(m,"Modulation coefficient");
M=100*m;//% modulation
disp(M,"% Modulation");
disp("Part (c)");
Ec1=Ec;//times of Vp(modulated carrier)
Eusf=m*Ec/2;//times of Vp
Elsf=m*Ec/2;//times of Vp
disp("Peak amplitude of modulated carrier is "+
    string(Ec1)+"*Vp");
disp("Upper & lower side frequency voltages, Eusf =
    Elsf = "+string(Eusf)+"*Vp");
disp("Part (d)");
Vmax=Ec+Em;//times of Vp
Vmin=Ec-Em;//times of Vp
disp("Maximum amplitude of envelope is "+string(Vmax
    )+"*Vp");
disp("Minimum amplitude of envelope is "+string(Vmin
```

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

Scilab code Exa 4.3 Power and voltage

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

Scilab code Exa 4.4 Determine power

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

```
RL=10; //ohm
m=1; //modulation coefficient
Pc=Vc^2/2/RL; //W
Pusb=m^2*Pc/4; //W
Plsb=m^2*Pc/4; //W
disp("Part(a)");
disp(Pc,"Carrier power(W)");
disp(Pusb,"Upper side band power(W)");
disp(Plsb,"Lower side band power(W)");
disp("Part(b)");
Psbt=m^2*Pc/2; //W
disp(Psbt,"Total side band power(W)");
disp("Part(c)");
Pt=Pc*(1+m^2/2); //W
disp(Pt,"Total power of modulated wave(W)");
disp("Part(e)");
m=0.5; //modulation coefficient
Pusb=m^2*Pc/4; //W
Plsb=m^2*Pc/4; //W
disp(Pc,"Carrier power(W)");
disp(Pusb,"Upper side band power(W)");
disp(Plsb,"Lower side band power(W)");
Psbt=m^2*Pc/2; //W
disp(Psbt,"Total side band power(W)");
Pt=Pc*(1+m^2/2); //W
disp(Pt,"Total power of modulated wave(W)");
```

Scilab code Exa 4.5 Noise Figure improvement

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

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

Scilab code Exa 4.6 Peak frequency and phase deviation

```
//Ex 4.6
clc;clear;close;;
format('v',6)
//Part (a)
K1=5;//kHz/V
//vm(t)=2*cos(2*p*2000*t);
Vm=2;//V
fm=2000;//Hz
delta_f=K1*Vm;//kHz
disp(delta_f,"(a) Pak frequency deviation(kHz)");
m=delta_f*1000/fm;//modulation index
disp(m,"(a) Modulation index");
//Part (b)
K=2.5;//rad/V
//vm(t)=-cos(2*p*2000*t);
fm=2000;//Hz
m=K*Vm;//rad(Peak phase shift)
disp(m,"(b) Peak phase shift(rad)");
```

Scilab code Exa 4.7 Frequency Modulation Index

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

```
omega_c=6.28*10^6;//rad
omega_m=6.28*10^3;//rad
fc=omega_c/2/%pi/10^6;//MHz
fm=omega_m/2/%pi/10^3;//kHz
mp=10;//modulation index
delta_theta=mp;//radians
disp(fc,"(a) Carrier freuency(MHz)");
disp(fm,"(b) Modulating freuency(kHz)");
disp(mp,"(c) Modulation index(mp)");
disp(delta_theta,"(d) Peak phase deviation(radians)"
    );
```

Scilab code Exa 4.8 Minimum Bandwidth

```
//Ex 4.8
clc;clear;close;
format('v',5);
delta_f=10;//kHz
fm=10;//kHz
Vc=10;//V
fc=500;//kHz
m=delta_f/fm;//modulation index
//For m=1 we have 3 sidebands
B=2*(3*fm);//kHz
disp(B,"(a) Actual minimum bandwidh(kHz)");
B=2*(fm+delta_f);//kHz
disp(B,"(b) Approximate minimum bandwidh(kHz)");
A0=0.77*fm;//V
A1=0.44*fm;//V
A2=0.11*fm;//V
A3=0.02*fm;//V
//For frequency spectrum
A=[A3 A2 A1 A0 A1 A2 A3];//V(Amplitudes)
f=[fc+3*fm fc+2*fm fc+fm fc fc+fm fc+2*fm fc+3*fm];
    //kHz
```

```
plot(f,A);
title('Output frequency spectrum');
xlabel('Frequency(kHz)');
ylabel('Amplitudes(V)');
```

Scilab code Exa 4.9 Deviation ratio and bandwidth

```
//Ex 4.9
clc;clear;close;
format('v',6)
//Part (a)
delta_f=75;//kHz
fm=15;//kHz
DR=delta_f/fm;//Deviation ratio
disp(DR,"(a) Deviation ratio");
//For m or DR=5 we have 8 sidebands
B=2*(8*fm);//kHz
disp(B,"(a) Bandwidh for worst case(kHz)");
//Part (b)
delta_f=75/2;//kHz
fm=15/2;//kHz
DR=delta_f/fm;//Deviation ratio
disp(DR,"(b) Deviation ratio or modulation index");
//For m or DR=5 we have 8 sidebands
B=2*(8*fm);//kHz
disp(B,"(b) Bandwidh for worst case(kHz)");
```

Scilab code Exa 4.10 Frequency and deviation ratio

```
//Ex 4.10
clc;clear;close;
format('v',6);
//Part (a)
```

```
ft=88.8;//MHz
N1N2N3=20;//frequency multiplication
fc=ft/N1N2N3;//MHz
disp(fc,"(a) Master oscillator center frequency(MHz)
    ");
delta_ft=75;//kHz
delta_f=delta_ft*1000/N1N2N3;//Hz
disp(delta_f,"(b) Frequency deviation at the output(
    Hz)");
fm=15;//kHz
DR=delta_f/1000/fm;//Deviation ratio at output
disp(DR,"(c) Deviation ratio at the output");
DR=DR*N1N2N3;//Deviation ratio at antenna
disp(DR,"(d) Deviation ratio at the antenna");
```

Scilab code Exa 4.11 Reduction in frequency drift

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

```
disp(df2_reduced,"Reduced frequency drift(Hz)");
f2dash=f2*10^6+df2_reduced;//Hz(New transmit frequency of antenna)
ftnew=f2dash*N2;//Hz
disp(ftnew,"New transmit frequency of antenna(Hz)")
old_drift=ft*10^6-ft_old*10^6;//Hz
new_drift=ftnew-ft_old*10^6;//Hz
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

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

Scilab code Exa 6.2 No of channels

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

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

Scilab code Exa 6.3 No of cells and frequency

```
//Ex 6.3
clc;clear;close;
format('v',6);
Asys=1520;//km^2
Ch=1140;//no. of channels
Acell=4;//km^2
i=3;j=2;//For hexagon cells
N=i^2+i*j+j^2;//cells in a cluster
disp(N,"(a) No. of cells in a cluster");
Acluster=N*Acell;//km^2
cluster=Asys/Acluster;//no. of clusters
disp(cluster,"(b) Number of clusters");
disp(Acluster,"(c) Area of each cellular cluster(km^2)");
C=cluster*Ch;//system capacity
disp(C,"(d) Increased system capacity(No. of channels)");
//Without frequency reuse :-
c_sys=Asys/Acell;//No. of cell in a system
ch_cell=Ch/c_sys;//No. of channels/cell
disp(ch_cell,"(e_i) Without frequency reuse, No. of channels/cell");
//With frequency reuse :-
ch_cell=Ch/N;//No. of channels/cell
disp(ch_cell,"(e_ii) With frequency reuse, No. of channels/cell");
```