Scilab Textbook Companion for A Textbook of Electronic Circuits by R. S. Sedha[1]

Created by
Neelam Ramchandra Jadhav
pursuing B.E (EXTC)
Others
Anjuman-I-Islam's kalsekar Technical campus
College Teacher
Chaya
Cross-Checked by
Not Applicable

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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 3

SEMICONDUCTORS

Scilab code Exa 3.1 length of wire and current density

```
clc;
//Ex3.1
R=1000;
sigma=5.8*10**7;
d=0.001;
//l is length of the cu wire
l=R*sigma*%pi*(d*d/4);//R=l/(sigma*%pi*(d*d/4))
disp ('km',l*10**-3,"l=");
E=10*10**-3;
J=sigma*E;//current density
disp('A/m^2',J*1,"J=");
```

Scilab code Exa 3.2 charge density of free electrons current density current flowi

```
clc;
//ex3.2
d=2*10**-3;
sigma=5.8*10**7;
```

```
mu=0.0032;
E=20*10**-3;
q=1.6*10**-19;
n=sigma/(q*mu);//sigma=q*n*mu
disp('/m^3',n*1,"n=");
J=sigma*E;//current density
disp('A/m^2',J*1,"J=");
A=%pi*d*d/4;//area of cross-section of wire
disp('m^2',A*1,"A=");
I=J*A;//current flowing in the wire
disp('A',I*1,"I=");
V=mu*E;//electron drift velocity
disp('m/s',V*1,"V=");//answer printed in the book is
    wrong
```

Scilab code Exa 3.3 mobility and relaxation time of electrons

```
clc;
//ex3.3
p=1.54*10**-8;
n=5.8*10**28;
q=1.6*10**-19;
sigma=1/p;//p=1/sigma..conductivity
disp('S/m',sigma*1,"sigma=");
mu=sigma/(q*n*10^-2);//mobility
disp('m^2/vs',mu*1,"mu=");
m=9.1*10**-31;
t=(m*mu)/q;//relaxation time
disp('ps',t*10^12,"t=");
```

Scilab code Exa 3.4 intrinsic conductivity

```
clc;
```

```
//ex 3.4
mun=0.38;
mup=0.18;
n=2.5*10**19;
a=0.13;
b=0.05;
n2=1.5*10**16;
q=1.6*10**-19;
sigma=q*n*(mun+mup);// intrinsic coductivity for
    germanium
disp('ohm-mu^-1',sigma*1,"sigma=");
sigma1=q*n2*(a+b);//intrinsic coductivity for
    silicon
disp('ohm-m^-1',sigma1*1,"sigma1");
```

Scilab code Exa 3.5 intrinsic conductivity

```
clc;
//ex3.5
n=1.41*10**16;
mun=0.145;
mup=0.05;
q=1.6*10**-19;
//sigma=q*n*(mun+mup);
e=q*n*mun;//contribution by electrons
h=q*n*mup;//contribution by holes
disp('ohm-m^-1',e*1,"e=");
disp('ohm-m^-1',h*1,"h=");
```

Scilab code Exa 3.6 concentration of free electrons and drift velocity

```
clc;
//ex3.6
```

```
q=1.60*10**-19;
l=0.2*10**-3;
a=0.04*10**-6;
v=1;
i=8*10**-3;
mun=0.13;
//concentration of free electrons
R=v/i;//resistance
disp('ohm',R*1,"R=");
rho=(R*a)/l;
disp('ohm-m',rho*1,"rho=");
sigma=1/rho;//conductivity
n=sigma/(q*mun);//concentration of free electrons
disp('/m^3',n*1,"n=")
//Drift velocity
j=i/a;
disp('amp/m^2',j*1,"j=");
v=j/(n*q);
disp('m/sec',v*1,"v=");
```

Scilab code Exa 3.7 intrinsic carrier concentration

```
clc;
//ex3.7
rho=0.47;
q=1.6*10**-19;
mun=0.39;
mup=0.19;
sigma=1/rho;//conductivity of intrinsic
   semiconductor
disp('ohm-m^-1',sigma*1,"sigma=");
n=sigma/(q*(mun+mup));//intrinsic carrier
   concentration of germanium
disp('/m^3',n*1,"n=");
```

Scilab code Exa 3.8 conductivity

```
clc;
//e.g 3.8
ND=10**21;
NA=5*10**20;
q=1.6*10**-19;
mun=0.18;
ND1=ND-NA;//number of free electrons
disp('/m^3',ND1*1,"ND1=");
SIGMA=ND1*q*mun;//conductivity of silicon
disp('ohm-m^-1',SIGMA*1,"SIGMA=");
```

Scilab code Exa 3.9 donor concentration

```
clc;
//ex3.9
rho=100;
q=1.6*10**-19;
mun=0.36;
sigma=1/rho;
disp('(ohm-m)^-1',sigma*1,"sigma=");
ND= sigma/(q*mun);//donar concentration
disp('atoms/m^3',ND*1,"ND=");
```

Scilab code Exa 3.10 concentration of electrons and holes

```
clc;
//e.g 3.10
```

```
ND=2*10**14;
NA=3*10**14;
ni=2.3*10**19;
n=(ni^2)/NA;
disp('electrons/cm^3',n*1,"n=");
p=(ni^2)/ND;
disp('holes/cm^3',p*1,"p=");
```

Scilab code Exa 3.11 minority electron and hole density

```
clc;
//e.g 3.11
ND=5*10**8;
NA=6*10**16;
ni=1.5*10**10;
n=(ni^2)/NA;//number of electons
p=(ni^2)/ND;//number of holes
disp(n*1,"n=");
disp(p*1,"p=");
```

Scilab code Exa 3.12 length

```
clc;
//ex3.12
d=0.001;
q=1.6*10**-19;
ND=10**20;
R=1000;
mun=0.1;
n=ND;//number of free electrons
sigma=q*n*mun;//conductivity
disp('S/m',sigma*1,"sigma=");
a=(1/sigma)*(1/(%pi*(0.001^2)/4));
```

```
l=R/a;
disp('mm',l*10**3,"l=");
```

Scilab code Exa 3.13 concentration of holes and electrons

```
clc;
//ex3.13
sigma=100;
rho=0.1;
ni=1.5*10**10;
mun=1300;
mup=500;
ni1=2.5*10**13;
mun1=3800;
mup1=1800;
q=1.602*10**-19;
//concentration of p type germanium
p=sigma/(q*mup1);
disp('/cm^3',p*1,"p=");
n=(ni1^2)/p;
disp('/cm^3',n*1,"n=");
//concentration of n type silicon
n=rho/(mun*q);
disp('/cm^3',n*1,"n=");
p=(ni^2)/n;
disp('/cm^3',p*1,"p=");
```

Scilab code Exa 3.14 resistivity of germanium sample

```
clc;
mun=3800;
mup=1800;
ni=2.5*10**13;
```

```
Nge=4.41*10**22;
q=1.602*10**-19;
ND=Nge/10**8;
disp('/cm^3',ND*1,"ND=");
p=(ni^2)/ND;
disp('/cm^3',p*1,"p=");
n=ND;
sigma=q*n*mun;
disp('(ohm-cm^)-1',sigma*1,"sigma=");
rho=1/sigma;
disp('ohm-cm',rho*1,"rho=");
```

Scilab code Exa 3.15 resistivity of intrinsic silicon

```
clc;
//ex3.15
Nsi=4.96*10**22;
ni=1.52*10**10;
q=1.6*10**-19;
mun=1350;
mup=480;
//resistivity of intrinsic silicon
sigma=q*ni*(mun+mup)
disp('(ohm-cm)^-1',sigma*1,"sigma=");
rho=1/sigma;
disp('ohm-cm',rho*1,"rho=");
//resistivity of doped silicon
ND=Nsi/(50*10^6);
disp('/cm^3',ND*1,"ND=");
n=ND;
p=(ni**2)/n;
disp('/cm**3',p*1,"p=");
sigma=q*n*mun;
disp('(ohm-cm)^-1',sigma*1,"sigma=");
rho=1/sigma;
```

```
disp('ohm-cm',rho*1,"rho=");
```

Scilab code Exa 3.16 conductivity of silicon

```
clc;
mup=0.048;
mun=0.135;
q=1.602*10**-19;
Nsi=5*10**28;
ni=1.5*10**16;
sigma=q*ni*(mun+mup);
disp('ohm-m^-1',sigma*1,"sigma=");
NA=Nsi/10**7;
P=NA;
n=ni^2/P;
sigma=q*P*mup;
disp('ohm-m^-1',sigma*1,"sigma=");
alpha=0.05;
T=34-20;
sigma20=0.44*10**-3;
sigma34=sigma20*(1+alpha*T);
disp('ohm-m^-1',sigma34*1,"sigma34=");
```

Scilab code Exa 3.17 diffusion coefficients of holes and electrons

```
clc;
//e.g 3.17
mun=3600;
mup=1700;
k=1.38*10**23;
T=300;
DP=mup*(T/11600);//answer given in the book is wrong
disp('m^2/s',DP*1,"DP=");
```

```
Dn=mun*(T/11600);//answer given in the book is wrong
disp('m^2/s',Dn*1,"Dn=");
```

Scilab code Exa 3.18 `electron mobility`

```
clc;
//e.g 3.18
RH=160;
rho=0.16;
mun=(1/rho)*RH;
disp('cm^2/volt-sec',mun*1,"mu=");
```

Scilab code Exa 3.19 `conduction electrons`

```
clc;
//ex3.19
I=50;
B=1.2;
t=0.5*10**-3;
Vh=100;
q=1.6*10**-19;
n=(B*I)/(Vh*q*t);
disp('/m^3',n*1,"n=");
```

Scilab code Exa 3.20 `number of electrons`

```
clc;
rho=20*10**-2;
mu=100*10**-4;
q=1.6*10**-19;
```

```
n=1/(rho*q*mu);
disp('/m^3',n*1,"n=");
```

Scilab code Exa 3.21 mobility and density of charge carrier

```
clc;
Rh=3.66*10**-4;
rho=8.93*10**-3;
mu=Rh/rho;
disp('m^2/V-s',mu*1,"mu=");
q=1.6*10^-19;
n=1/(q*Rh);
disp('/m^3',n*1,"n=");
```

Scilab code Exa 3.22 resistivity

```
clc;
//e.g 3.22
rho=9*10**-3;
mup=0.003;
sigma=1/rho;
disp('S/m',sigma*1,"sigma=");
RH= mup/sigma;
disp('m^3*C',RH*1,"RH=");
```

Chapter 5

PN JUNCTION DIODE

Scilab code Exa 5.1 `Current`

```
clc;
//e.g 5.1
I0=2*10**-7;
Vf=0.1;
I=I0*(exp (40*Vf)-1);
disp('uA',I*10**6,"I=");
```

Scilab code Exa 5.2 `find current`

```
clc;
//e.g 5.2
I0=1*10**-3;
Vf=0.22;
T=298;
n=1
VT=T/11600
disp('mV',VT*10**3,"VT=");
I=I0*(exp (Vf/(n*VT))-1);
disp('A',I*1,"I=");
```

Scilab code Exa 5.3 value of n

```
clc;
I1=0.5*10**-3;
V1=340*10**-3;
I2=15*10**-3;
V2=440*10**-3;
kTbyq=25*10**-3;
a=V1/kTbyq;
b=V2/kTbyq;
//log(I1/I2)==log(exp((b-a)/n));
n=(a-b)/(log(I1/I2));
disp(n);
```

Scilab code Exa 5.4 saturation current

```
clc;
I300=10*10**-6;
T1=300;
T2=400;
I400=I300*(2^((T2-T1)/10));
disp('mA',I400*10**3,"I400=");
```

Scilab code Exa 5.5 value of VF for the device

```
clc;
rB=2;
IF=12*10**-3;
VF=0.7+IF*rB;
```

```
disp('V',VF*1,"VF=");
```

Scilab code Exa 5.8 `dc current and PDmax`

```
clc;
PD=0.5;
VF=1;
VBR=150;
IF=(PD/VF);
disp('A',IF*1,"IF=");
IR=(PD/VBR);
disp('mA',IR*10**3,"IR=");
```

Scilab code Exa 5.9 `voltage drop and current`

```
clc;
R=330;
VS=5;
VD=VS;
disp('V',VD*1,"VD=VS=");
VR=0;
disp(VR,"VR=");
I=0;
disp(I,"I=");
```

Scilab code Exa 5.10 `VD VR I`

```
clc;
VS=12;
R=470;
```

```
VD=0;
disp(VD);
VR=VS;
disp('V',VR*1,"VR=");
I=(VS/R);
disp('mA',I*10**3,"I=");
```

Scilab code Exa 5.11 current

```
clc;
VS=6;
R1=330;
R2=470;
VD=0.7;
RT=R1+R2;
I=(VS-0.7)/RT;
disp('mA',I*10**3,"I=");
```

Scilab code Exa 5.12 voltage across resistor and current

```
clc;
VS=5;
R=510;
VF=0.7;
VR=VS-0.7;
disp('V',VR*1,"VR=");
I=VR/R;
disp('mA',I*10**3,"I=");
```

Scilab code Exa 5.13 total current

```
clc;
VS=6;
VD1=0.7;
VD2=0.7;
VR=1.5*10**3;
I=(VS-VD1-VD2)/VR;
disp('mA',I*10**3,"I=");
```

Scilab code Exa 5.14 `total current`

```
clc;
VS=12;
R1=1.5*10**3;
R2=1.8*10**3;
VD1=0.7;
VD2=0.7;
I=(VS-VD1-VD2)/(R1+R2);
disp('mA',I*10**3,"I=");
```

Scilab code Exa 5.15 `output voltage`

```
clc;
V1=0;
V2=0;
VO=0;
disp('V',VO*1,"VO=");
V1=0;
V2=5;
VO=V2-0.7;
disp('V',VO*1,"VO=");
V1=5;
V2=0;
VO=V1-0.7;
```

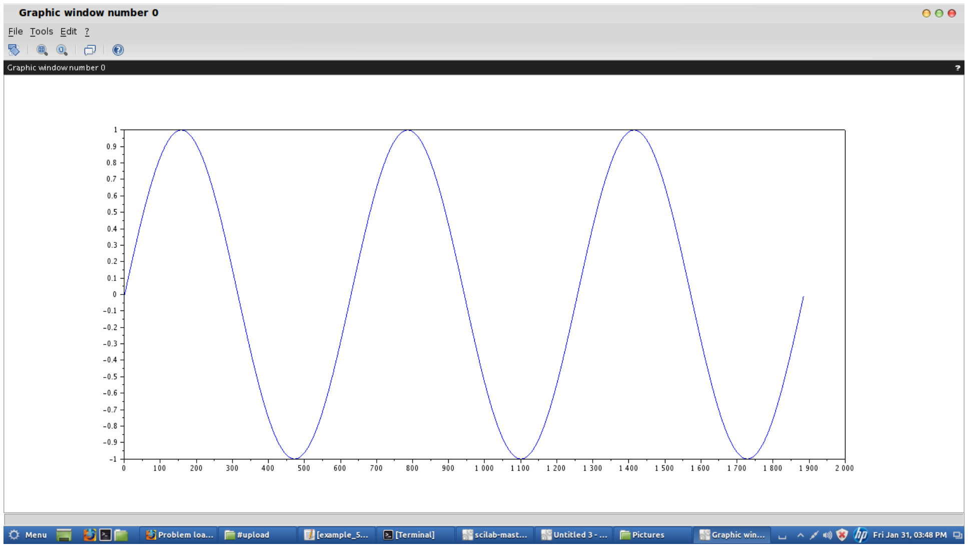

Figure 5.1: waveform of voltage

```
disp('V',VO*1,"VO=");
V1=5;
V2=5;
VO=V2-0.7;
disp('V',VO*1,"VO=");
```

Scilab code Exa 5.16 `waveform of voltage`

```
clc;
R=20*10**3;
I=(R-0.7)/R;
disp('mA',I*1,"I=");
rj=50;
rB=1;
re=rB+rj;
R1=(R*re)/(re+R);
```

```
disp(R1);
V=10*(re/(re+1000));
disp('mV',V*1,"V=");
i=0:0.01:6*%pi;
plot(sin(i));
```

Chapter 7

SPECIAL PURPOSE DIODES AND OPTO ELECTRONIC DEVICES

Scilab code Exa 7.1 value of Izm

```
clc;
//ex7.01
pzm=500*10**-3;
vz=6.8;
Izm=pzm/vz;
disp('mA',Izm*10**3,"Izm=");
```

Scilab code Exa 7.2 maximum power dissipation

```
clc;
//pg no. 117
pzm=500*10**-3;
d=3.33*10**-3;
a=75;
```

```
b=50;
Td=d*(a-b);
disp('mW',Td*10**3,"Td=");
pz=pzm-Td ;
disp('mW',pz*10**3,"pz=");
```

Scilab code Exa 7.3 `resistance of device`

```
clc;
//pg n0 120
IZ=10*10**-3;
vz=0.05;
rz=vz/IZ;
disp('ohm',rz*1,"rz=");
```

Scilab code Exa 7.4 `terminal voltage`

```
clc;
Vz=4.7;
rz=15;
Iz=20*10**-3;
VZ1= Vz+(rz*Iz);
disp('V',VZ1*1,"VZ1=");
```

Scilab code Exa 7.5 `tuning range`

```
clc;
//e.g7.5
C1=5*10**-12;//min
C2=5*10**-12;//min
```

```
L=10*10**-3;
CT=(C1*C2)/(C1+C2);//CTmax
disp('F',CT*1,"CT=");
fo=1/(2*%pi*sqrt(L*CT));
disp('MHZ',fo*10**-6,"fo=");
C1=50*10**-12;//max
C2=50*10**-12;//max
CT=(C1*C2)/(C1+C2);//CTmin
disp('F',CT*1,"CT=");
fo=1/(2*%pi*sqrt(L*CT));
disp('kHZ',fo*10**-3,"fo=");
```

Scilab code Exa 7.6 frequency of 5th harmonic

```
clc;
//e.g 7.6
T=0.04*10**-6;
f=1/T;
disp('MHz',f*10**-6,"f=");
disp('MHz',f*5*10**-6,"f=");//frequency of 5th
    harmonic
```

Scilab code Exa 7.7 resistor

```
clc;
//e.g 7.7
Vs=8;
VDmin=1.8;
VDmax=2;
Ifmax=16*10**-3;
Rs=(Vs-VDmin)/Ifmax;
disp('ohm',Rs*1,"Rs=");
Rsmax=(Vs-VDmax)/Ifmax;
```

```
disp('ohm',Rsmax*1,"Rsmax=");
```

Scilab code Exa 7.8 minimum and maximum value of current

```
clc;
//e.g 7.8
VDmin=1.5;
VDmax=2.3;
Vs=10;
R1=470;
Imax=(Vs-VDmin)/R1;
disp('mA',Imax*10**3,"Imax=");
Imin=(Vs-VDmax)/R1;
disp('mA',Imin*10**3,"Imin=")
```

Scilab code Exa 7.9 Imin and Imax

```
clc;

//e.g 7.9
VDmin=1.8;
VDmax=3;
Vs1=24;
Rs1=820;
Vs2=5;
Rs2=120;
Imin=(Vs2-VDmax)/Rs2;
disp('mA',Imin*10**3,"Imin=");
Imax=(Vs1-VDmin)/Rs1;
disp('mA',Imax*10**3,"Imax=");
Imin=(Vs2-VDmax)/Rs2;
disp('mA',Imin*10**3,"Imin=");
Imax=(Vs2-VDmin)/Rs2;
```

```
disp('mA',Imax*10**3,"Imax=");
```

Scilab code Exa 7.10 `resistance and current`

```
clc;
r=1*10**3;
I=10*10**-3;
V=30;
//I=30/(R+r)
R=(V/I)-r;//when dark
disp('Kohm',R*10**-3,"R=");
R=100*10**3;//when illuminated
Id=(V/(r+R));
disp('mA',Id*10**3,"Id=");
```

Chapter 8

BIPOLAR JUNCTION TRANSISTORS

Scilab code Exa 8.1 base current

```
clc;
//e.g 8.1
Ie=10*10**-3;
Ic=9.8*10**-3;
//Ie=Ib+Ic
Ib=Ie-Ic;
disp('mA',Ib*10**3,"Ib=");
```

Scilab code Exa 8.2 current gain

```
clc;
//e.g 8.2
Ie=6.28*10**-3;
Ic=6.20*10**-3;
a=Ic/Ie;
disp(a);
```

Scilab code Exa 8.3 base current

```
clc;
//e.g8.3
a=0.967;
Ie=10*10**-3;
Ic=Ie*a;//a=Ic/Ie
disp('mA',Ic*10**3,"Ic=");
Ib=Ie-Ic;
disp('mA',Ib*10**3,"Ib=");
```

Scilab code Exa 8.4 IC and IB

```
clc;
//e.g 8.4
Ie=10*10**-3;
alpha=0.987;
Ic=Ie*alpha;//alpha=Ic/Ie
disp('mA',Ic*10**3,"Ic=");
Ib=Ie-Ic;
disp('mA',Ib*10**3,"Ib=");
```

Scilab code Exa 8.5 alpha and beta

```
clc;
//e.g 8.5
alpha=0.975;
beta=200;
beta=(alpha/(1-alpha));
```

```
disp(beta);
alpha=(beta/(1+beta));
disp(alpha);
```

Scilab code Exa 8.6 emitter current

```
clc;
//e.g 8.6
BETA=100;
IC=40*10**-3;
IB=IC/BETA;
IE=IC+IB;
disp('mA',IE*10**3,"IE=");
```

Scilab code Exa 8.7 current

```
clc;
//e.g 8.7
beta=150;
Ie=10*10**-3;
alpha=beta/(1+beta)
Ic=alpha*Ie;//as alpha=(Ic/Ie)
disp('mA',Ic*10**3,"Ic=");
Ib=Ie-Ic;//as  Ie=Ib+Ic
disp('mA',Ib*10**3,"Ib=");
```

Scilab code Exa 8.8 IB and IE

```
clc;
//e.g 8.8
```

```
beta=170;
Ic=80*10**-3;
Ib=Ic/beta;//beta=(Ic/Ib)
disp('mA',Ib*10**3,"Ib=");
Ie=Ic+Ib;
disp('mA',Ie*10**3,"Ie=");
```

Scilab code Exa 8.9 IC and IE

```
clc;
//e.g 8.9
Ib=125*10**-6;
beta=200;
Ic=beta*Ib;
disp('mA',Ic*10**3,"Ic=");
Ie=Ib+Ic;
disp('mA',Ie*10**3,"Ie=");
```

Scilab code Exa 8.10 IC and IB

```
clc;
//e.g 8.10
Ie=12*10**-3;
beta=140;
Ib=Ie/(1+beta);
disp('mA',Ib*10**3,"Ib=");
Ic=Ie-Ib;
disp('mA',Ic*10**3,"Ic=");
```

Scilab code Exa 8.11 beta emitter current and new value of beta

```
clc;
IB=105*10**-6;
IC=2.05*10**-3;
BETA=IC/IB;
disp(BETA);
ALPHA=BETA/(1+BETA);
disp(ALPHA);
IE=IC+IB;
disp('mA',IE*10**3,"IE=");
DELTA_IB=27*10**-6;
DELTA_IC=0.65*10**-3;
IBn=IB+DELTA_IB;
ICn=IC+DELTA_IC;
BETAn=ICn/IBn;
disp(BETAn);
```

Scilab code Exa 8.12 collector and emitter current

```
clc;
//e.g 8.12
alpha=0.98;
Ico=5*10**-6;
Ib=100*10**-6;
Ic=((alpha*Ib)/(1-alpha))+(Ico/(1-alpha));
disp('mA',Ic*10**3,"Ic=");
Ie=Ib+Ic;
disp('mA',Ie*10**3,"Ie=");
```

Scilab code Exa 8.13 collector current

```
clc;
//e.g 8.13
Icbo=10*10**-6;
```

```
beta=50;
//Value of collector current when Ib=0.25*10**-3;
 Ib=0.25*10**-3;
 Ic=(beta*Ib)+(1+beta)*Icbo;
 disp('mA',Ic*10**3,"Ic=");
 //Value of new collector current if temperature
    rises to 50 degree
 t1=27;
 t2=50;
 Icbo50=Icbo*2^((t2-t1)/10);
 disp('microA',Icbo50*10**6,"Icbo50=");
 //collector current at 50 degree
 Ic=beta*Ib+(1+beta)*Icbo50;
 disp('mA',Ic*10**3,"Ic=");
```

Chapter 9

BJT CHARACTERISTICS

Scilab code Exa 9.1 PDmax

```
clc;
//e.g 9.1
Pdmax=500*10**-3;
DF=2.28*10**-3;
T=70;
Pdmax70=Pdmax-DF*(T-25);
disp('w',Pdmax70*1,"Pdmax70=");
```

Chapter 10

BJT LOW AND HIGH FREQUENCY MODELS

Scilab code Exa 10.1 hybrid pi parameters

```
clc;
//e.g 10.1
Ic=10;
Vce=10;
hie=500;
hoe=10**-5;
hfe=100;
hre=10**-4;
gm=Ic/25;
disp('ohm',gm*1,"gm=");
rbe=hfe/gm;
disp('ohm',rbe*1,"rbe=");
rbb=hie-rbe;
disp(rbb);
gbc=hre/rbe;
disp('*10^-7',gbc*10**7,"gbc=");
rce=-1/((hoe-(1+hfe)*gbc));
disp('kohm',rce*10**-3,"rce=");
```

Chapter 11

BJT LOW AND HIGH FREQUENCY MODELS

Scilab code Exa 11.1 drain current

```
clc
//e.g 11.1
Idss=15*10**-3;
Vgso=-5;
//Id=Idss*(1-(Vgs/Vgso))^2
Vgs=0;
Id=Idss*(1-(Vgs/Vgso))^2;
disp('mA',Id*10**3,"Id=");
Vgs1=-1;
Id=Idss*(1-(Vgs1/Vgso))^2;
disp('mA',Id*10**3,"Id=");
Vgs2=-4;
Id=Idss*(1-(Vgs2/Vgso))^2;
disp('mA',Id*10**3,"Id=");
```

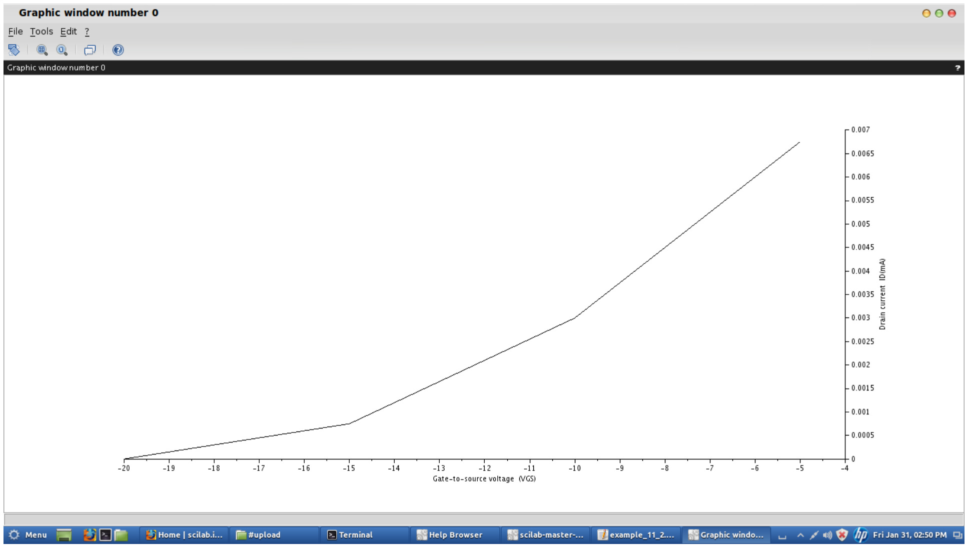

Figure 11.1: transconductance curve

Scilab code Exa 11.2 `transconductance curve`

```
clc;
Vgs=-5:-5:-20;//Id=Idss*(1-(Vgs/Vgso))^2
Vgso=-20;
Idss=12*10**-3;
Id=Idss*(1-(Vgs/Vgso))^2;
disp('mA',Id*10**3,"Id=");
y=0:1:12;
x=0:-5:-20;
a=gca() //get the current axes
a.box="off";
a.y_location="right";
plot2d(Vgs,Id);
xlabel("Gate-to-source voltage (VGS)");
ylabel("Drain current ID(mA)");
```

Scilab code Exa 11.4 `DRAIN CURRENT AND TRANSCONDUCTANCE`

```
clc;
//e.g 11.4
Idss=20*10**-3;
vp=-8;
gmo=5000*10**-6;
vgs=-4;
//Id=Idss*(1-(Vgs/Vgso))^2
Id=Idss*(1-(vgs/vp))^2;
disp('mA',Id*10**3,"Id=");
gm=gmo*(1-(vgs/vp));
disp('microsec',gm*10**6,"gm=");
```

Scilab code Exa 11.5 value og ID

```
clc;
//e.g 11.5
Idon=10*10**-3;
vgs=-12;
vgsth=-3;
//Id=K*(vgs-vgsth)^2
//Idon=K*(vgs-vgsth)^2
k=Idon/((vgs-vgsth)^2);
disp('mA',k*10**3,"k=");
vgs1=-6;
Idon=k*(vgs1-vgsth)^2;
disp('mA',Idon*10**3,"Idon=");
```

Chapter 12

THYRISTORS

Scilab code Exa 12.1 destroy the device or not

```
clc;
//e.g 12.1
I=40;
t=15*10**-3;
SCR=(I^2)*t;
disp('A^2s',SCR*1,"SCR=");
```

Scilab code Exa 12.2 max allowable duration

```
clc;
//e.g 12.2
a=75;
Is=100;
tmax=a/Is**2;
disp('ms',tmax*10**3,"tmax=");
```

Scilab code Exa 12.3 voltage

```
clc;
//e.g 12.3
VD=0.7;
n=0.75;
Vbb=12;
Vp=n*Vbb+VD;
disp('V',Vp*1,"Vp=");
```

Scilab code Exa 12.4 intrinsic stand off ratio and peak point voltage

```

clc;
//e.g 12.4
rb1=4*10**3;
rb2=2.5*10**3;
Vbb=15;
Vd=0.7;
n=rb1/(rb1+rb2);
disp(n,"n=");//intrinsic standoff ratio
Vp=n*Vbb+Vd;
disp('V',Vp*1,"Vp=");//peak point voltage
```

Scilab code Exa 12.5 rB1 and rB2

```
clc;
//e.g 12.5
n=0.60;
rbb=7*10**3;
rb1=rbb*n;
disp('kohm',rb1*10**-3,"rb1=");
rb2=rbb-rb1;
```

```
disp('kohm',rb2*10**-3,"rb2=");
```

Chapter 13

PASSIVE CIRCUITS DEVICES

Scilab code Exa 13.4 tolerance

```
clc;
R1min=2.7;
R2min=5.1;
Rmin=R1min+R2min;
R1max=3.3;
R2max=6.9;
Rmax=R1max+R2max;
a=9-Rmin;
b=Rmax-9;
tolerance=b/9;
Reqmin=(R1min*R2min)/(R1min+R2min);
disp('ohm',Reqmin*1,"Reqmin=");
Reqmax=(R1max*R2max)/(R1max+R2max);
disp('ohm',Reqmax*1,"Reqmax=");
R1N=3;
R2N=6;
Req=(R1N*R2N)/(R1N+R2N);
disp('ohm',Req*1,"Req=");
minval=Reqmin;
```

```
maxval=Reqmax;
maxchng=0.235;
t=(maxchng/2)*100;
disp('%',t*1,"t=");
```

Scilab code Exa 13.5 coil inductance

```
clc;
//e.g 13.5
N=150;
mur=3540;
mu0=4*%pi*10**-7;
l=0.05;
A=5*10**-4;
L=(mur*mu0*A*N*N)/l;
disp('H',L*1,"L=");
```

Scilab code Exa 13.6 coefficient of Coupling

```
clc;
//e.g 13.6
L1=40*10**-6;
L2=80*10**-6;
M=11.3*10**-6;
k=M/sqrt(L1*L2);
disp(k);
```

Scilab code Exa 13.7 Q factor of coil

```
clc;
```

```
//e.g 13.7
Q=90;
L=15*10**-6;
f=10*10**6;
R0=(2*%pi*f*L)/Q;
disp('ohm',R0*1,"R0=");
```

Scilab code Exa 13.8 capacitance

```
clc;
//e.g 13.8
A=0.04;
d=0.02;
e0=8.85*10**-12;
er=5.0;
C=(e0*er*A)/d;
disp('pF',C*10**12,"C=");//answer printed in the
   book is wrong.
```

Scilab code Exa 13.9 thickness of dielectric

```
clc;
//e.g 13.9
A=0.2;
C=0.428*10**-6;
e0=8.85*10**-12;
er=1200;
d=(e0*er*A)/C;//ans printed in the book is wrong
disp('mm',d*10**3,"d=");
```

Chapter 16

PN JUNCTION DIODE APPLICATIONS RECTIFIERS AND FILTERS

Scilab code Exa 16.1 dc output voltage and PIV

```
clc;
//e.g 16.1
V1=230;
//a=(N2/N1)
b=(1/10);
V2=V1*b;
disp('V',V2*1,"V2=");
Vm=sqrt(2)*V2;
disp('V',Vm*1,"Vm=");
Vdc=0.318*Vm;
disp('V',Vdc*1,"Vdc=");
PIV=Vm;
disp('V',PIV*1,"PIV=");
```

Scilab code Exa 16.2 dc load current

```
clc;
//e.g 16.2
RL=20*10**3;
V2=24;
Vm=sqrt(2)*V2;
disp('V',Vm*1,"Vm=");
Im=Vm/RL;
disp('mA',Im*10**3,"Im=");
Idc= 0.318*Im;
disp('mA',Idc*10**3,"Idc=");
```

Scilab code Exa 16.3 maximum and average power

```
clc;
//e.g 16.3
V1=230;
//a=(N2/N1)
b=(1/2);
RL=200;
V2=V1*b;
disp('V',V2*1,"V2=");
Vm=sqrt(2)*V2;
disp('V',Vm*1,"Vm=");
Im=Vm/RL;
disp('A',Im*1,"Im=");
Pm=(Im**2)*RL;
disp('W',Pm*1,"Pm=");
Vdc=0.318*Vm;
disp('V',Vdc*1,"Vdc=");
Idc=(Vdc/RL);
disp('A',Idc*1,"Idc=");
Pdc=(Idc**2)*RL;
disp('W',Pdc*1,"Pdc=");
```

Scilab code Exa 16.4 `maximum ac voltage`

```
clc;
//e.g 16.4
Vdc=30;
RL=600;
Rf=25;
Idc=(Vdc/RL);
disp('A',Idc*1,"Idc=");
Im=%pi*Idc;
disp('A',Im*1,"Im=");
Vin=Im*(Rf+RL);
disp('V',Vin*1,"Vin=");
```

Scilab code Exa 16.5 `dc output voltage`

```

clc;
V2=30;
RL=5.1*10**3;
VS=V2/2;
Vm=sqrt(2)*VS;
Vdc=0.636*Vm;
disp('V',Vdc*1,"Vdc=");
Vdc=Vdc/RL;
disp('mA',Vdc*10**3,"Vdc=");
```

Scilab code Exa 16.6 `dc output voltage and PIV and output frequency`

```
clc;
V1=230;
fin=50;
//let a=N1/N2
a=1/4;
V2=V1*a;
Vm=sqrt(2)*V2;
Vdc=0.636*Vm;
disp('V',Vdc*1,"Vdc=");
PIV=Vm;
disp('V',PIV*1,"PIV=");
fout=2*fin;
disp('HZ',fout*1,"fout=");
```

Scilab code Exa 16.7 dc output voltage PIV and rectification efficiency

```
clc;
V1=230;
//LET a=N2/N1
a=1/5;
RL=100;
V2=V1*a;
Vs=V2/2;
Vm=sqrt(2)*Vs;
Vdc=2*Vm/%pi;
disp('V',Vdc*1,"Vdc=");
PIV=2*Vm;
disp('V',PIV*1,"PIV=");
n=0.812//rectifier efficiency of full wave rectifier
```

Scilab code Exa 16.8 load resistor dc load voltage and PIV

```
clc;
```

```
Vs=200;
Imax=700*10**-3;
Iavg=250*10**-3;
Imax=0.8*Imax;
disp('mA',Imax*10**3,"Imax=");
Vm=sqrt(2)*Vs;
RL=Vm/Imax;
disp('ohm',RL*1,"RL=");
Vdc=2*Vm/%pi;
disp('V',Vdc*1,"Vdc=");
Idc=Vdc/RL;
disp('A',Idc*1,"Idc=");
PIV=2*Vm;
disp(PIV);
```

Scilab code Exa 16.9 inductance

```
clc;
f=50;
y=0.05;
RL=100;
L=RL/(y*3*sqrt(2)*2*%pi*f);
disp('H',L*1,"L=");
f=400;
y=0.05;
L=RL/(y*3*sqrt(2)*2*%pi*f);
disp('H',L*1,"L=");
```

Scilab code Exa 16.10 capacitance

```
clc;
Vdc=30;
RL=1*10**3;
```

```
y=0.01;
C=2890/(y*RL);
disp('microF',C*1,"C=");
```

Scilab code Exa 16.11 size of capacitor

```
clc;
Vdc=12;
Idc=100*10**-3;
y=0.01;
L=1;
C=1.195/(L*y);
disp('microF',C*1,"C=");
```

Scilab code Exa 16.12 ripple facctor

```
clc;
Idc=0.2;
Vdc=30;
C1=100;
C2=100;
L=5;
f=50;
RL=Vdc/Idc;
y=5700/(L*C1*C2*RL);
disp('%',y*100,"y=");
```

Scilab code Exa 16.13 Vdc peak and average current and average power delivered

```
clc;
```

```
Vs=150;
Idc=2;
Vdc=2.34*Vs;
disp('V',Vdc*1,"Vdc=");
I=Idc/0.955;
disp('A',I*1,"I=");
Iavg=2/3;
disp('A',Iavg*1,"Iavg=");
Pdc=Vdc*Idc;
disp('W',Pdc*1,"Pdc=");
```

Chapter 17

CONTROLLED RECTIFIERS

Scilab code Exa 17.1 angular firing required

```
clc;
//e.g 17.1
RL=100;
Vm=300;
//load power P= Vdc*Idc
a=(Vm/(2*%pi))^2*(1/RL);
disp(a);
p=25;
//1+cosb=sgrt(25/a)
b=a*1+cos(sqrt(p/a));
cosalpha=(sqrt(p/a))-1;
disp(cosalpha);
p=80;
cosalpha=(sqrt(p/a))-1;
disp(cosalpha,"cosalpha=");
//or;
alpha=acosd(cosalpha);
disp('degree',alpha,"alpha=");
```

Scilab code Exa 17.2 `power`

```
clc;
//e.g 17.2
vm=200;
Rl=1*10**3;
//ALPHA=0degree
Vdc=vm*0.318;
Idc=Vdc/Rl;
P=Vdc*Idc;
disp('mW',P*10**3,"P=");"OR";disp('W',P*1,"P=");
//alpha=45 degree
Vdc=vm*0.27;
Idc=Vdc/Rl;
P=Vdc*Idc;
disp('mW',P*10**3,"P=");"OR";disp('W',P*1,"P=");
//alpha=90 degree
Vdc=vm*0.159;
Idc=Vdc/Rl;
P=Vdc*Idc;
disp('mW',P*10**3,"P=");"OR";disp('W',P*1,"P=");
//alpha=135 degree
Vdc=vm*0.04660;
Idc=Vdc/Rl;
P=Vdc*Idc;
disp('mW',P*10**3,"P=");"OR";
```

Scilab code Exa 17.3 `voltage`

```
clc;
//e.g 17.3
Vrms=220;
a=60;
Vm=sqrt (2)*Vrms;
disp('V',Vm*1,"Vm=");
```

```
Vdc=(Vm/(2*%pi))*(1+cosd(60));
disp('V',Vdc*1,"Vdc=");
```

Scilab code Exa 17.4 resistance

```
clc;
//e.g 17.4
Vrms=100;
a=45;
Idc=0.5;
Vm=sqrt (2)*Vrms;
disp('V',Vm*1,"Vm=");
//Idc=(Vm/(2*%pi*RL))*(1+cosd(a));
RL=(Vm/(2*%pi*Idc))*(1+cosd(a));
disp('ohm',RL*1,"RL=");
```

Scilab code Exa 17.5 chopper duty cycle and chopping frequency

```
clc;
//e.g 17.5
Ton=30*10**-6;
Toff=10*10**-6;
//consider duty cycle=a
a=Ton/(Ton+Toff);
disp(a);
f=(1/(Ton+Toff))
disp('kHZ',f*10**-3," f=");
```

Scilab code Exa 17.6 dc output voltage

```
clc;
//e.g 17.6
Ton=30*10**-3;
Toff=10*10**-3;
Vdc=200;
a=Ton/(Ton+Toff);
disp(a);
Vl=Vdc*a;
disp('V',Vl*1,"Vl=");
```

Chapter 18

BJT BIASING AND STABILISATION

Scilab code Exa 18.1 `sturation current and cutoff voltage`

```

clc;
//e.g 18.1
Vbb=10;
Rb=47*10**3;
Vcc=20;
Rc=10*10**3;
B=100;
Ic=Vcc/Rc;//saturation current
disp('mA',Ic*10**3,"Ic=");
Vce=Vcc;//cut-off voltage
disp('V',Vce*1,"Vce=");
i=2:-0.1:0;
plot2d(i);
a=gca() //get the current axes
a.box="off";
xlabel("VCE");
```

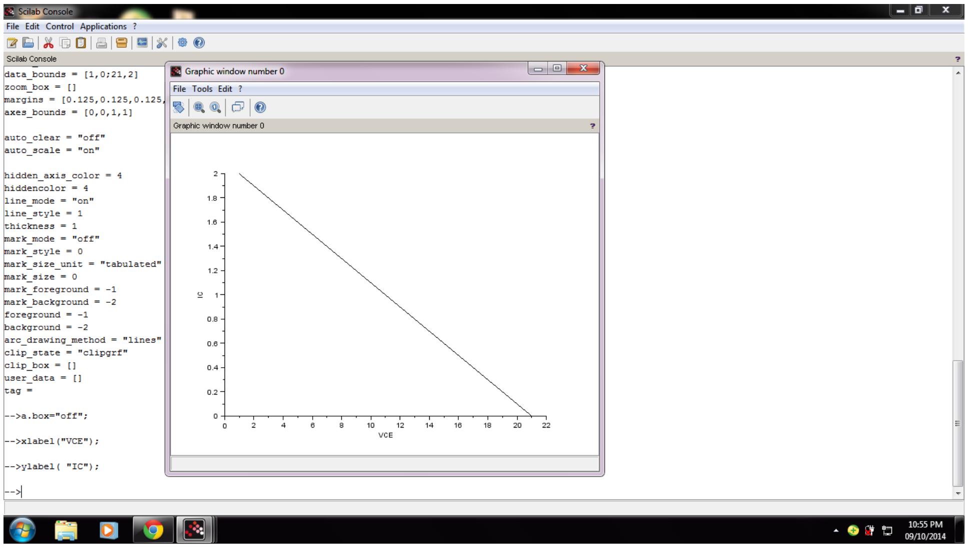

Figure 18.1: sturation current and cutoff voltage

```
ylabel( "IC");
```

Scilab code Exa 18.2 `upper and lower ends of load line`

```

clc;
//e.g 18.2
Vbb=10;
Rb=50*10**3;
Vcc=20;
Rc=300;
beta=200;
Ic=Vcc/Rc;//saturation current
```

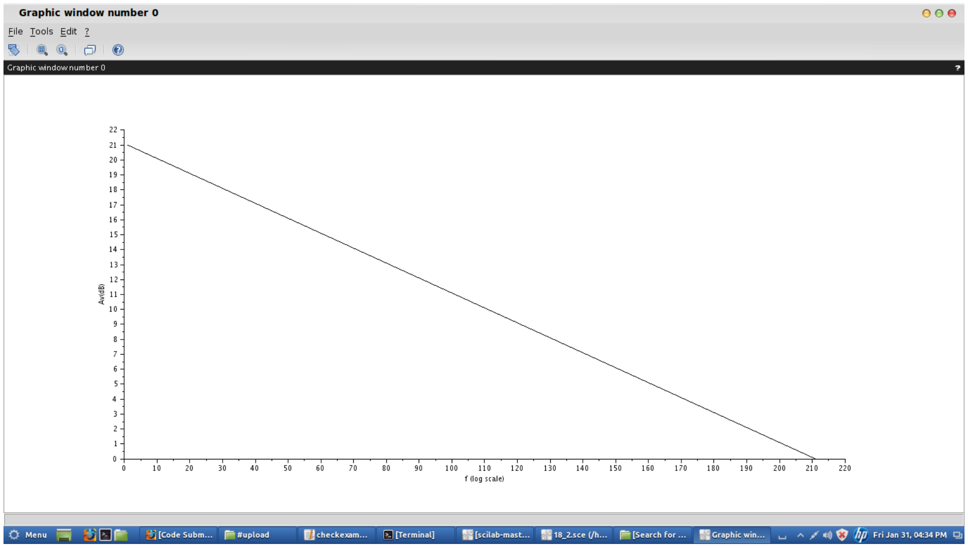

Figure 18.2: upper and lower ends of load line

```
disp('mA',Ic*10**3,"Ic=");
Vce=Vcc;//cut-off voltage
disp('V',Vce*1,"Vce=");
Ib=(Vbb-0.7)/Rb;
 disp('10^-3A',Ib*10**3,"Ib=");
 Ic=beta*Ib;
  disp('10^-3A',Ic*10**3,"Ic=");
Vce=Vcc-Ic*Rc;
disp('V',Vce*1,"Vce=");
i=21:-0.1:0;
plot2d(i);
a=gca() //get the current axes
a.box="off";
xlabel("VCE");
ylabel( "IC");
```

Scilab code Exa 18.3 `base and collector current and VCE`

```
clc;
//e.g 18.3
Rb=180*10**3;
Vcc=25;
Rc=820;
beta=80;
Ib=Vcc/Rb;//saturation current
disp('mA',Ib*10**3,"Ib=");
Ic=beta*Ib;
disp('mA',Ic*10**3,"Ic=");
Vce=Vcc-(Ic*Rc);//cut-off voltage
disp('V',Vce*1,"Vce=");
```

Scilab code Exa 18.4 RB and VCE

```
clc;
//e.g 18.4;
Vcc=12;
Rc=330;
Ib=0.3*10**-3;
beta=100;
//Ib=Vcc/Rb;//saturation current
Rb=Vcc/Ib;
disp('Kohm',Rb*10**-3,"Rb=");
S=1+beta;
disp(S);
Ic=beta*Ib;
disp('10^-3A',Ic*10**3,"Ic=");
Vce=Vcc-(Ic*Rc);//cut-off voltage
disp('V',Vce*1,"Vce=");
```

Scilab code Exa 18.5 voltage and current

```

clc;
//e.g 18.5
Rb=400*10**3;
Vcc=20;
Rc=2*10**3;
Re=1*10**3;
beta=100;
Ib=Vcc/(Rb+(beta*Re));//saturation current
disp('mA',Ib*10**3,"Ib=");
Ic=beta*Ib;
disp('mA',Ic*10**3,"Ic=");
Vce=Vcc-(Ic*(Rc+Re));//cut-off voltage
disp('V',Vce*1,"Vce=");
```

Scilab code Exa 18.6 find Ic and Vce

```
clc;
//e.g 18.1
Vcc=12;
Rc=2.2*10**3;
Rb=240;
B=50;
Vbe=0.7;
RE=0;
Ic=(Vcc-Vbe)/(RE+(Rb/B));//collector current
disp('mA',Ic,"Ic=");
Vce=Vcc-(Ic*10**-3)*Rc;//CE voltage
disp('V',Vce*1,"Vce=");
Icsat=Vcc/Rc;
disp('mA',Icsat*10**3,"Icsat=");
```

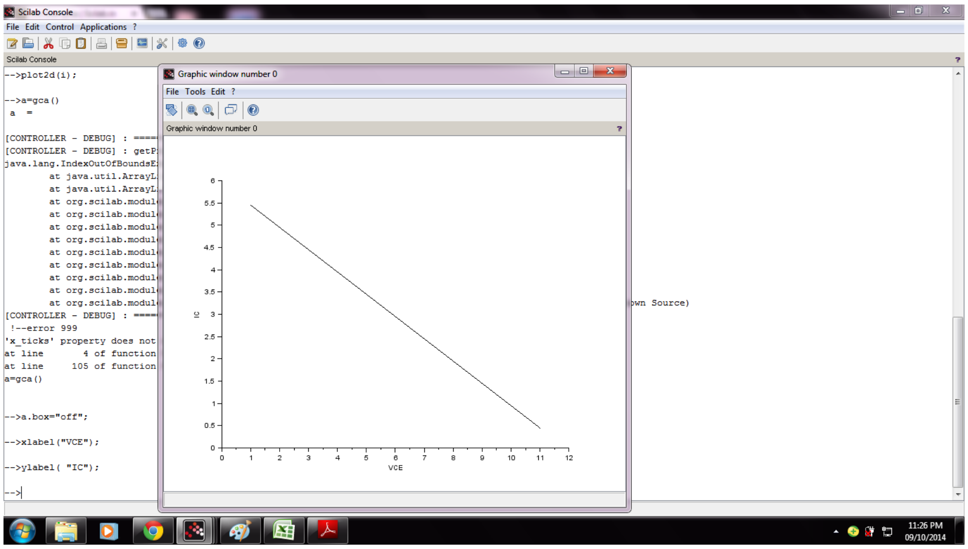

Figure 18.3: find Ic and Vce

```
Vcec=Vcc;//cutoff voltage
i=5.45:-0.5:0;
plot(i);
a=gca() //get the current axes
a.box="off";
xlabel("VCE");
ylabel( "IC");
```

Scilab code Exa 18.7 `load line`

```
clc;
//e.g 18.7
Vcc=30;
```

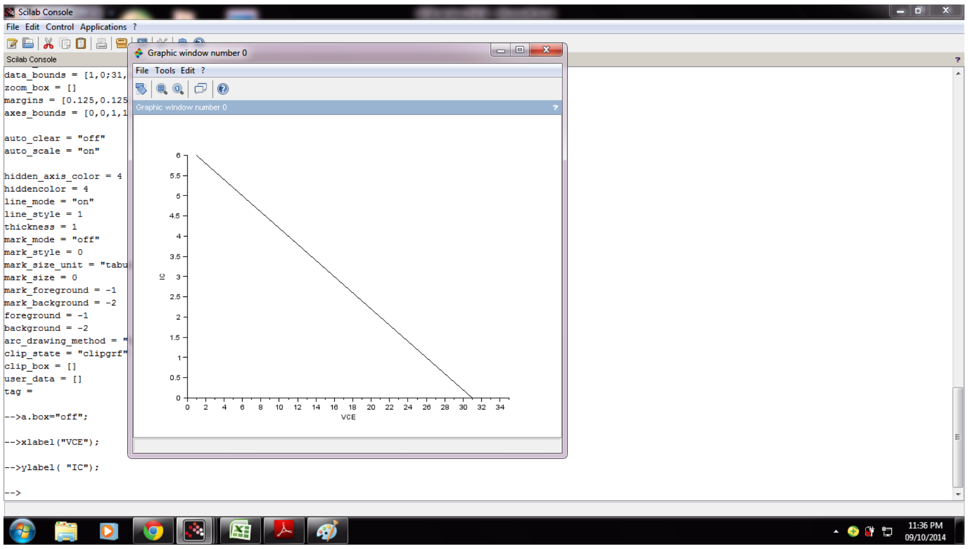

Figure 18.4: load line

```
Rb=1.5*10**6;
Rc=5*10**3;
beta=100;
Ic=Vcc/Rc;//saturation current
disp('mA',Ic*10**3,"Ic=");
Vce=Vcc;//cut-off voltage
disp('V',Vce*1,"Vce=");
Ib=Vcc/Rb;//base current
disp('microA',Ib*10**6,"Ib=");
 Ic=beta*Ib;
  disp('mA',Ic*10**3,"Ic=");
  Vce=Vcc-Ic*Rc;
  disp('V',Vce*1,"Vce=");
i=6:-0.2:0;
plot2d(i);
a=gca() //get the current axes
a.box="off";
```

```
xlabel("VCE");
ylabel( "IC");
```

Scilab code Exa 18.9 current voltage and stability factor

```


clc;
//e.g 18.9
Rb=180*10**3;
Vcc=25;
Rc=820;
Re=200;
beta=80;
Vbe=0.7;
Ic=(Vcc-Vbe)/(Re+(Rb/beta));//collector current
disp('mA',Ic*10**3,"Ic=");
Vce=Vcc-(Ic*Rc);//collector to emitter voltage
disp('V',Vce*1,"Vce=");
S=(1+beta)/(1+beta*(Re/(Re+Rb)));
disp(S,"S=");//stability factor
```

Scilab code Exa 18.10 Q point

```

clc;
//e.g 18.10
Vbe=0.7;
Rb=100*10**3;
Vcc=10;
Rc=10*10**3;
beta=100;
Ic=(Vcc-Vbe)/(Rc+(Rb/beta));//collector current
```

```
disp('mA',Ic*10**3,"Ic=");
Vce=Vcc-(Ic*Rc);//collector to emitter voltage
disp('V',Vce*1,"Vce=");
Ic=Vcc/Rc;
disp('mA',Ic*10**3,"Ic=");
Vce=Vcc;
disp('V',Vce*1,"Vce=");
```

Scilab code Exa 18.11 IB IC AND IE

```


clc;
//e.g 18.11
Rb=100*10**3;
Vcc=10;
Rc=2*10**3;
beta1=50;
Vbe=0.7;
Ib=(Vcc-Vbe)/(Rb+(beta1*Rc));
disp('mA',Ib*10**3,"Ib=");
Ic=beta1*Ib;
disp('mA',Ic*10**3,"Ic=");
Ie=Ic;
disp('mA',Ie*10**3,"Ie=");
```

Scilab code Exa 18.12 possible causes

```

clc;
//e.g 18.12
VCC=9;
RB=220*10**3;
```

```
RC=3.3*10**3;
VBE=0.3;
B=100;
//if vc=0
IB=(VCC-VBE)/(RB+(B*RC));
disp('microA',IB*10**6,"IB=");
IC=B*IB;
disp('microA',IC*10**6,"IC=");//CORRECTION IN BOOK
//if VC=9
VC=9;
IC=B*IB;
disp('mA',IC*10**3,"IC=");
//IC*RC=0,which means collector resistance is short
    circuited
```

Scilab code Exa 18.13 find R1

```

clc;
//e.g 18.13
Vcc=12;
Rc=3.3*10**3;
Re=100;
Ie=2*10**-3;
Vbe=0.7;
alpha=0.98;
Ic=alpha*Ie;
disp('mA',Ic*10**3,"Ic=");
Vb=Vbe+(Ie*Re);
disp('V',Vb*1,"Vb=");
Vc=Vcc-(Ic*Rc);//collector to emitter voltage
disp('V',Vc*1,"Vc=");
R2=20*10**3;
IR2=Vc/R2;
disp('mA',IR2*10**3,"IR2=");
```

```
Ib=Ie-Ic;
disp('mA',Ib*10**3,"Ib=");
IR1=IR2+Ib;
disp('mA',IR1*10**3,"IR1=");
R1=(Vc-Vb)/IR1;
disp('kohm',R1*10**-3,"R1=");
```

Scilab code Exa 18.14 base resistance

```
clc;
VCC=24;
RC=10*10**3;
RE=270;
VBE=0.7;
B=45;
VCE=5;
IC=(VCC-VCE)/RC;
disp('mA',IC*10**3,"IC=");
RB=(2.6*10^3)*B;
disp('kohm',RB*10**-3,"RB=")
```

Scilab code Exa 18.15 dc bias current and voltage

```

clc;
//e.g 18.15
Rb=33*10**3;
Vcc=3;
Rc=1.8*10**3;
beta=90;
Vbe=0.7;
Ib=(Vcc-Vbe)/(Rb+(Rc*beta));//collector current
disp('mA',Ib*10**3,"Ib=");
```

```
Ic=beta*Ib;
disp('mA',Ic*10**3,"Ic=");
Vce=Vcc-(Ic*Rc);//collector to emitter voltage
disp('V',Vce*1,"Vce=");
S=(1+beta)/(1+beta*(Rc/(Rc+Rb)))//stability factor
```

Scilab code Exa 18.16 `current and voltage`

```

clc;
//e.g 18.16
Vbe=0.7;
Vcc=10;
Rc=1*10**3;
beta=100;
R1=10*10**3;
R2=5*10**3;
Re=500;
Vb=Vcc*(R2/(R1+R2));
disp('V',Vb*1,"Vb=");
Ve=Vb-Vbe;
disp('V',Ve*1,"Ve=");
Ie=Ve/Re;
disp('mA',Ie*10**3,"Ie=");
Ic=Ie;
disp('mA',Ic*10**3,"Ic=");
Vce=Vcc-(Rc+Re);
disp('V',Ve*1,"Ve=");
```

Scilab code Exa 18.17 `OPERATING POINT`

```

clc;
```

```
//e.g 18.17
Vcc=9;
Rc=1*10**3;
Re=680;
beta=100;
R1=33*10**3;
R2=15*10**3;
Vb=Vcc*(R2/(R1+R2));
disp('V',Vb*1,"Vb=");
Vbe=0.7;
Ve=Vb-Vbe;
disp('V',Ve*1,"Ve=");
Ie=Ve/Re;
disp('mA',Ie*10**3,"Ie=");
Ic=Ie;
disp('mA',Ic*10**3,"Ic=");
VRc=Ic*Rc;
disp('V',VRc*1,"VRc=");
Vc=Vcc-VRc;
disp('V',Vc*1,"Vc=");
Vce=Vc-Ve;
disp('V',Vce*1,"Vce=");
```

Scilab code Exa 18.18 R1 and RC

```

clc;
VCC=5;
RE=0.3*10**3;
IC=1*10**-3;
VCE=2.5;
B=100;
VBE=0.7;
ICO=0;
R2=10*10**3;
```

```
IE=IC;
RC=((VCC-VCE)/IC)-RE;
disp('ohm',RC*1,"RC=");
VE=IE*RE;
VB=VE+VBE;
R1=VCC*R2-R2;
disp('Kohm',R1*10**-3,"R1=");
```

Scilab code Exa 18.19 IE and VCE

```

clc;
Vcc=20;
RC=1*10**3;
RE=5*10**3;
R1=10*10**3;
R2=10*10**3;
B=462;
VBE=0.7;
VB=Vcc*R2/(R1+R2);
disp('V',VB*1,"VB=");
VE=VB-VBE;
IE=VE/RE;
disp('mA',IE*10**3,"IE=");
IC=IE;
VCE=Vcc-IC*RC;
disp('V',VCE*1,"VCE=");
```

Scilab code Exa 18.20 base current

```

clc;
VCC=8;
```

```
VRC=0.5;
RC=800;
a=0.96;
VCE=VCC-VRC;//VRC=IC*RC
IC=VRC/RC;
disp('mA',IC*10**3,"IC=");
IE=IC/a;
disp('mA',IE*10**3,"IE=");
IB=IE-IC;
disp('microA',IB*10**6,"IB=");
```

Scilab code Exa 18.21 change in collector current

```

clc;
VCC=12;
RC=1*10**3;
RE=100;
R1=25*10**3;
R2=5*10**3;
B=50;
VBE=0.6;
VTH=VCC*R2/(R1+R2);
RTH=R1*R2/(R1+R2);
IE50=(VTH-VBE)/(RE+RTH/B);
B=150;
IE150=(VTH-VBE)/(RE+RTH/B);
ICdiff=(IE150-IE50)/IE50;
disp('%',ICdiff*100,"ICdiff=")
```

Scilab code Exa 18.24 value of resistors

```
clc;
```

```
B=50;
VBE=0.7;
VCC=22.5;
RC=5.6*10**3;
VCE=12;
IC=1.5*10**-3;
S=3;
RE=(VCC-IC*RC-VCE)/IC;
disp('kohm',RE*10^-3,"RE=");
RTH=(4375)-RE;
disp('kohm',RTH*10^-3,"RTH=");
R2=0.1*B*RE;
disp('kohm',R2*10^-3,"R2=");
R1=(-RTH*R2)/(RTH-R2);
disp('kohm',R1*10^-3,"R1=");
```

Scilab code Exa 18.25 CURRENT AND VOLTAGE

```

clc;
VCC=10;
VEE=10;
RC=1*10**3;
RE=5*10**3;
RB=50*10**3;
VBE=0.7;
VE=-VBE;
IE=(VEE-VBE)/RE;
disp('mA',IE*10**3,"IE=");
IC=IE;
disp('mA',IC*10**3,"IC=");
VC=VCC-IC*RC;
VCE=VC-VE;
disp('volts',VCE*1,"VCE=");
```

Scilab code Exa 18.26 change in Q point

```
clc;
VCC=20;
VEE=20;
RC=5*10**3;
RE=10*10**3;
RB=10*10**3;
B1=50;
B2=100;
VBE1=0.7;
VBE2=0.6;
IE1=(VEE-VBE1)/(RE+RB/B1);
disp('mA',IE1*10**3,"IE1=");
IC1=IE1;
VC1=VCC-IC1*RC;
disp('V',VC1,"VC1=");
VE=-VBE1;
VCE1=VC1-VE;
disp('V',VCE1,"VCE1=");
IE2=(VEE-VBE2)/(RE+RB/B2);
disp('mA',IE2*10**3,"IE2=");
IC2=IE2;
VC2=VCC-IC2*RC;
disp('V',VC2,"VC2=");
VE=-VBE2;
VCE2=VC2-VE;
disp('V',VCE2,"VCE2=");
delIc=(IC2-IC1)/IC1;
disp('%',delIc*100,"delIc=");
delVCE=(VCE1-VCE2)/VCE2;
disp('%',delVCE*100,"delVCE=");
```

Scilab code Exa 18.27 VOLTAGE AND CURRENT

```

clc;
VCC=12;
RC=2*10**3;
RE=1*10**3;
R1=100*10**3;
R2=20*10**3;
B=100;
VBE=-0.2;
VB=-VCC*R2/(R1+R2);
disp('V',VB*1,"VB=");
VE=VB-VBE;
disp('V',VE*1,"VE=");
IE=-VE/RE;
IC=IE;
disp('mA',IC*10**3,"IC=");
VC=-(VCC-IC*RC);
disp('V',VC*1,"VC=");
VCE=VC-(VE);
disp('V',VCE*1,"VCE=");
```

Scilab code Exa 18.28 Quiescent points

```
clc;
VCC=4.5;
RC=1.5*10**3;
RE=0.27*10**3;
R2=2.7*10**3;
R1=27*10**3;
B=44;
```

```
VBE=-0.3;
VB=-VCC*R2/(R1+R2);
disp('V',VB*1,"VB=");
VE=VB-VBE;
disp('V',VE*1,"VE=");
IE=-VE/RE;
IC=IE;
disp('mA',IC*10**3,"IC=");
VRC=IC*RC;
disp('V',VRC*1,"VRC=");
VC=-[VCC-VRC]
disp('V',VC*1,"VC=");
VCE=VC-(VE);
disp('V',VCE*1,"VCE=");
```

Chapter 19

SINGLE STAGE BJT AMPLIFIERS

Scilab code Exa 19.1 resistance and voltage gain

```
clc;
//e.g 19.1
Vcc=10;
Rc=10*10**3;
Rb=1*10**6;
beta=100;
Vbe=0.7;
Ib=(Vcc-Vbe)/Rb;
disp('microA',Ib*10**6,"Ib=");
Ic=beta*Ib;
disp('mA',Ic*10**3,"Ic=");
Ie=Ic;
re=25/(Ie*10**3);
disp('ohm',re*1,"re=");
Ri=beta*re;
disp('kohm',Ri*10**-3,"Ri=");
Ris=(Rb*beta*re)/(Rb+beta*re);
disp('kohm',Ris*10**-3,"Ris=");
R0=Rc;
```

```
disp('kOhm',R0*10**-3,"R0=");
Av=Rc/re;
disp(Av);
```

Scilab code Exa 19.2 current and gain

```
clc;
//e.g 19.2
Ri=2.5*10**3;
Av=200;
Vs=5*10**-3;
beta=50;
ib=(Vs/Ri)
disp('microA',ib*10**6,"ib=");
ic=beta*ib;
disp('microA',ic*10**6,"ic=");
Ai=beta;
Ap=Ai*Av;
disp(Ap);
Gp=10*log10(Ap);
disp('dB',Gp*1,"Gp=");
```

Scilab code Exa 19.3 resistance and gain

```
clc;
//e.g 19.3
Vcc=20;
Rc=5*10**3;
Re=1*10**3;
Rb=100*10**3;
beta=150;
Vbe=0.7;
Ic=Vcc/(Re+(Rb/beta));
```

```
disp('mA',Ic*10**3,"Ic=");
Ie=Ic;
re=25/(Ie*10**3);
disp('ohm',re*1,"re=");
Ri=beta*(re+Re);
disp('kohm',Ri*10**-3,"Ri=");
Ris=(Rb*Ri)/(Rb+Ri);
disp('kohm',Ris*10**-3,"Ris=");
Av=Rc/Re;
disp(Av);
Gp=10*log10(Av);
disp('dB',Gp*1,"Gp=");
```

Scilab code Exa 19.4 voltage gain and resistance

```
clc;
//e.g 19.4
Vcc=12;
Rc=10*10**3;
Re=1*10**3;
Rb=500*10**3;
beta=50;
Ic=Vcc/(Re+(Rb/beta));
disp('mA',Ic*10**3,"Ic=");
Ie=Ic;
re=25/(Ie*10**3);
disp('ohm',re*1,"re=");
Ri=beta*re;
disp('ohm',Ri*1,"Ri=");
Ris=(Rb*Ri)/(Rb+Ri);
disp('ohm',Ris*1,"Ris=");
R0=Rc;
Av=R0/re;
disp(Av);
Av=Rc/Re;
```

```
disp(Av);
```

Scilab code Exa 19.5 `voltage and impedance`

```
clc;
//e.g 19.5
Vcc=30;
Rc=10*10**3;
RL=3.3*10**3;
R1=47*10**3;
R2=15*10**3;
Re=8.2*10**3;
beta=200;
Vs=5*10**-3;
Vbe=0.7;
Vth=(Vcc*R2)/(R1+R2);
disp('V',Vth*1,"Vth=");
Rth=(R1*R2)/(R1+R2);
disp('10^3ohm',Rth*10**-3,"Rth=");
Ie=(Vth-Vbe)/(Re+(Rth/beta));
disp('mA',Ie*10**3,"Ie=");
re=25/(Ie*10**3);
disp('ohm',re*1,"re=");
rl=(Rc*RL)/(Rc+RL);
disp('Kohm',rl*10**-3,"rl=");
Av=rl/re;
disp(Av);
Vin=5;
V0=Av*Vin
disp('mV',V0*1,"V0=");
Ri=beta*re;
disp('Kohm',Ri*10**-3,"Ri=");
Ris=(Rth*Ri)/(Rth+Ri);
disp('Kohm',Ris*10**-3,"Ris=");
```

Scilab code Exa 19.6 output voltage and output gain

```
clc;
//e.g 19.6
Vcc=10;
Rc=5*10**3;
Re=1*10**3;0
RL=50*10**3;
R1=50*10**3;
R2=10*10**3;
Rs=600;
beta=50;
Vs=10*10**-3;
Vbe=0.7;
Vth=(Vcc*R2)/(R1+R2);
disp('V',Vth*1,"Vth=");
Rth=(R1*R2)/(R1+R2);
disp('10^3ohm',Rth*10**-3,"Rth=");
Ie=(Vth-Vbe)/(Re+(Rth/beta));
disp('mA',Ie*10**3,"Ie=");
re=25/(Ie*10**3);
disp('ohm',re*1,"re=");
Ri=beta*re;
Ris=(Rth*Ri)/(Rth+Ri);
disp('ohm',Ris*1,"Ris=");
rl=(Rc*RL)/(Rc+RL);
disp('Kohm',rl*10**-3,"rl=");
Av=rl/re;
disp(Av);
Vin=(Vs*Ris)/(Ris+Rs);
disp('mV',Vin*10**3,"Vin=");
V0=Av*Vin;
disp('mV',V0*1,"V0=");
Avs=(Av*Vin)/Vs;
```

```
disp(Avs);
```

Scilab code Exa 19.7 `voltage and impedance`

```
clc;
//e.g 19.7
Vcc=-18;
Rc=4.3*10**3;
Re=1*10**3;0
RL=3*10**3;
R1=39*10**3;
R2=8.2*10**3;
beta1=200;
Vbe=-0.7;
Vth=(Vcc*R2)/(R1+R2);
disp('V',Vth*1,"Vth=");
Rth=(R1*R2)/(R1+R2);
disp('kohm',Rth*10**-3,"Rth=");
Ie=(Vth-Vbe)/(Re+(Rth/beta1));
disp('mA',Ie*10**3,"Ie=");
re1=(30*10**-3)/(-Ie);
disp('ohm',re1*1,"re1=");
re=(Rc*RL)/(Rc+RL);
Ri=beta1*re;
Ris=(Rth*Ri)/(Rth+Ri);
disp('kohm',Ris*10**-3,"Ris=");
disp('Kohm',re*10**-3,"re=");
Av=re/re1;
disp(Av);
```

Scilab code Exa 19.8 `Av Ri Ro and Avs`

```
clc;
```

```
//e.g 19.8
Vs = 200
Vcc=20;
Rc=5.7*10**3;
Re=1*10**3;
R1=100*10**3;
R2=10*10**3;
Rs=100;
beta1=100;
Vbe=0.7;
Vth=(Vcc*R2)/(R1+R2);
disp('V',Vth*1,"Vth=");
Rth=(R1*R2)/(R1+R2);
disp('Kohm',Rth*10**-3,"Rth=");
Ie=(Vth-Vbe)/(Re+(Rth/beta1));
disp('mA',Ie*10**3,"Ie=");
re=25/(Ie*10**3);
disp('ohm',re*1,"re=");
Ri=beta1*re;
Ris=(Rth*Ri)/(Rth+Ri);
disp('ohm',Ris*1,"Ris=");
rl=Rc;
Av=rl/re;
disp(Av);
Vin=(Vs*Ris)/(Ris+Rs);
disp('mV',Vin*1,"Vin=");
V0=Av*Vin;
disp('V',V0*10**-3,"V0=");
Avs=(Av*Vin)/Vs;
disp(Avs);
```

Scilab code Exa 19.9 GAIN VOLTAGE AND RESISTANCE

```
clc;
//e.g 19.9
```

```
Vcc=10;
Rc=5*10**3;
RE1=500;
R1=50*10**3;
R2=10*10**3;
Rs=600;
rE=500;
beta1=50;
Vbe=0.7;
vs=100*10**-3;
Rl=50*10**3;
Vth=(Vcc*R2)/(R1+R2);
disp('V',Vth*1,"Vth=");
Rth=(R1*R2)/(R1+R2);
disp('10^3ohm',Rth*10**-3,"Rth=");
RE=RE1+rE;
disp('ohm',RE*1,"RE=");
Ie=(Vth-Vbe)/(RE+(Rth/beta1));
disp('mA',Ie*10**3,"Ie=");
re=25/(Ie*10**3);
disp('ohm',re*1,"re=");
Ri=beta1*(re+rE);
disp('Kohm',Ri*10**-3,"Ri=");
Ris=(Rth*Ri)/(Rth+Ri);
disp('ohm',Ris*1,"Ris=");
rl=(Rc*Rl)/(Rc+Rl)
disp('kohm',rl*10**-3,"rl=");
Av=rl/(re+rE);
disp(Av);
VinBYVs=(Ris)/(Ris+Rs);
disp('V',VinBYVs*1,"VinBYVs=");
Avs=Av*VinBYVs;
disp(Avs);
V0=Avs*vs;
disp('mV',V0*10^3,"V0=");//answer printed in the
    book is wrong(variation in decimal point)
```

Scilab code Exa 19.10 `resistance voltage gain current gain power gain`

```
clc;
VS=10*10**-3;
a=0.98;
VBE=0.7;
VCC=10;
RC=10*10**3;
RL=5.1*10**3;
RE=20*10**3;
VEE=10;
IE=(VEE-VBE)/RE;
re=25/IE*10**-3;
Ri=re;
Ris=(RE*re)/(RE+re);
disp('ohm',Ris,"Ris=");
Ai=a;
disp(Ai);
rL=(RC*RL)/(RC+RL);
Av=rL/re;
disp(Av);
Ap=Av*Ai;
disp(Ap);
Gp=10*log10(Ap);
disp('dB',Gp,"Gp=");
Vin=VS;
Vo=Av*Vin;
disp('mV',Vo*10**3,"Vo=");
```

Scilab code Exa 19.11 `VOLTAGE GAIN`

```
clc;
```

```
Rs=50;
IE=0.465*10**-3;
re1=53.8;
Ri=53.8;
Ris=52.4;
rL=3.38*10**3;
Avs=rL/(Rs+re1);
disp(Avs);
Av=rL/re1;
disp(Av);
Vs=10;
vo=Avs*Vs;
vin=vo/Av;
disp('mV',vin,"vin=");
```

Scilab code Exa 19.12 `resistance and voltage gain`

```
clc;
VEE=10;
RE=10*10**3;
RB=100*10**3;
B=50;
VBE=0.7;
IE=(VEE-VBE)/(RE+(RB/B));
re=25/IE*10**-3;
Ri=B*(RE+re);
disp('Kohm',Ri*10**-3,"Ri=");
Ris=(RB*Ri)/(RB+Ri);
Rs=0;
Ro=re+((RB*Rs)/(RB+Rs))/B;
disp('ohm',Ro,"Ro=");
Av=RE/(re+RE);
disp(Av);
```

Scilab code Exa 19.13 `resistance and voltage`

```
clc;
B=80;
VBE=0.7;
VCC=15;
R1=20*10**3;
R2=20*10**3;
RS=2*10**3;
VS=5*10**-3;
RE=8.2*10**3;
RL=1.5*10**3;
VTH=VCC*R2/(R1+R2);
RTH=(R1*R2)/(R1+R2);
IE=(VTH-VBE)/(RE+(RTH/B));
disp('mA',IE*10**3,"IE=");
re=25/IE*10**-3;
rL=(RE*RL)/(RE+RL);
Ri=B*(rL+re);
Ris=(RTH*Ri)/(RTH+Ri);
disp('kohm',Ris*10**-3,"Ris=");
Ro=re+((RS*RTH)/(RS+RTH))/B;
disp('ohm',Ro,"Ro=");
Vin=VS*Ris/(RS+Ris);
disp('mV',Vin*10**3,"Vin=");
```

Chapter 20

HYBRID PARAMETERS

Scilab code Exa 20.2 Impedance voltage and current gain

```
clc;
hie=1.0*10**3;
hre=1*10**-4;
hoe=100*10**-6;
RC=1000;
RS=1000;
rL=RC;
hfe=50;
Ai=-hfe/(1+hoe*rL);
Ri=hie+hre*Ai*rL;
Ris=Ri;
disp('Ohm',Ris*1,"Ris=");
delh=hie*hoe-hre*hfe;
his=1000;
Ro=(RS+his)/(RS*hoe+delh);
disp('kOhm',Ro*10**-3,"Ro=");
Ros=(Ro*rL)/(Ro+rL);
disp('Ohm',Ros*1,"Ros=");
Ais=(Ai*RS)/(RS+Ris);
disp(Ais);
Av=(Ai*rL)/Ri;
```

```
Avs=(Av*Ris)/(RS+Ris);
disp(Avs);
```

Scilab code Exa 20.3 `impedance current and voltage gain`

```
clc;
hie=1.1*10**3;
hre=2.5*10**-4;
hfe=50;
hoe=25*10**-6;
rs=1*10**3;
rL=1*10**3;
Ai=hfe/(1+hoe*rL);
disp(Ai);
Ri=hie+hre*Ai*rL;
disp('Ohm',Ri*1,"Ri=");
Av=(Ai*rL)/Ri;
disp(Av);
```

Scilab code Exa 20.4 `voltage gain and resistance`

```
clc;
RC=4*10**3;
RB=40*10**3;
RS=10*10**3;
hie=1100;
hfe=50;
hre=0;
hoe=0;
RB2=40*10**3;
rL=(RC*RB2)/(RC+RB2);
Ai=-hfe/(1+hoe*rL);
Ri=hie+hre*Ai*rL;
```

```
Av=(Ai*rL)/Ri;
RB1=40*10**3/(1-Av);
Ris=(Ri*RB1)/(Ri+RB1);
disp('ohm',Ris*1,"Ris=");
Ros=rL;//Ro=infinity
disp('Ohm',Ros*1,"Ros=");
Avs=(Av*Ris)/(RS+Ris);
disp(Avs);
```

Scilab code Exa 20.5 resistance voltage and current gain

```
clc;
hib=28;
hfb=-0.98;
hrb=5*10**-4;
hob=0.34*10**-6;
rL=1.2*10**3;
Rs=0;
Ai=-hfb/(1+hob*rL);
disp(Ai);
Ri=hib+hrb*Ai*rL;
disp('Ohm',Ri*1,"Ri=");
delh=hib*hob-hrb*hfb;
Ro=(Rs+hib)/(Rs*hib+delh);
disp('kOhm',Ro*10**-3,"Ro=");
Av=(Ai*rL)/Ri;
disp(Av);
```

Scilab code Exa 20.6 resistance voltage and current gain

```
clc;
hic=2*10**3;
hfc=-51;
```

```
hrc=1;
hoc=25*10**-6;
rL=5*10**3;
RE=5*10**3;
Rs=1000;
R1=10*10**3;
R2=10*10**3;
Ai=-hfc/(1+hoc*rL);
disp(Ai);
Ri=hic+hrc*Ai*rL;
disp('kOhm',Ri*10**-3,"Ri=");
a=(R1*R2)/(R1+R2);
Ris=(Ri*a)/(Ri+a);
disp('Ohm',Ris*1,"Ris=");
Ro=-(Rs+hic)/hfc;
Ros=(Ro*RE)/(Ro+RE);
disp('Ohm',Ros*1,"Ros=");
Ais=(Ai*Rs)/(Rs+Ris);
disp(Ais);
Av=(Ai*rL)/Ri;
disp(Av);
Avs=(Av*Ris)/(Rs+Ris);
disp(Avs);
```

Scilab code Exa 20.7 `resistance voltage and current gain`

```
clc;
hie=1500;
hfe=50;
hre=50*10**-4;
hoe=20*10**-6;
RC=5*10**3;
RL=10*10**3;
R1=20*10**3;
R2=10*10**3;
```

```
rL=(RC*RL)/(RC+RL);
Ai=-hfe;
Ri=hie;
a=(R1*R2)/(R1+R2);
Ris=(Ri*a)/(Ri+a);
disp('kOhm',Ris*10**-3,"Ris=");
Ro=1/hoe;
Ros=(Ro*rL)/(Ro+rL);//correction
disp('kOhm',Ros*10**-3,"Ros=");
Avs=(Ai*rL)/Ri;
disp(Avs);
Ais=Ai;//correction
disp(Ais);
```

Scilab code Exa 20.8 `voltage and impedance`

```

clc;
RC=12*10**3;
RL=4.7*10**3;
R1=33*10**3;
R2=4.7*10**3;
IC=1*10**-3;
hiemin=1*10**3;
hiemax=5*10**3;
hfemin=70;
hfemax=350;
hie=sqrt(hiemin*hiemax);
disp('kOhm',hie*10**-3,"hie=");
hfe=sqrt(hfemin*hfemax);
disp('Ohm',hfe*1,"hfe=");//answer printed in the
   book is wrong
Ri=hie;
a=(R1*R2)/(R1+R2);
Ris=(Ri*a)/(Ri+a);
```

```
disp('kOhm',Ris*10**-3,"Ris=");
Ai=hfe;
rc=(RC*RL)/(RC+RL);
Avs=(Ai*rc)/Ri;
disp(Avs,"Avs=");
```

Scilab code Exa 20.9 `resistance voltage and current gain`

```
clc;
RB=330*10**3;
RC=2.7*10**3;
hfe=120;
hie=1.175*10**3;
hoe=20*10**-6;
Ri=hie;
Ris=(hie*RB)/(hie+RB);
disp('kohm',Ris*10**-3,"Ris=");
Ro=1/hoe;
Ros=(Ro*RC)/(Ro+RC);
disp('kohm',Ros*10**-3,"Ros=");
Ai=hfe;
disp(Ai);
Av=(hfe*RC)/Ri;
disp(Av);
```

Scilab code Exa 20.10 `hfb and hfc`

```
clc;
hfe=50;
hfb=-hfe/(1+hfe);
disp(hfb);
hfc=-(1+hfe);
disp(hfc);
```

Scilab code Exa 20.11 gain and input resistance

```
clc;
hie=1100;
hre=2.5*10**-4;
hfe=50;
hoe=24*10**-6;
rL=10*10**3;
RS=1*10**3;
hic=hie;
hrc=1-hre;
hfc=-(1+hfe);
Ai=hfc/(1+hoe*rL);
disp(Ai);
Ri=hie+hrc*-Ai*rL;
disp('kOhm',Ri*10**-3,"Ri=");
Av=(-Ai*rL)/Ri;
disp(Av);
```

Chapter 21

MULTISTAGE BJT AMPLIFIERS

Scilab code Exa 21.1 total voltage gain

```
clc;
Av1=10;
Av2=20;
Av3=40;
Av=Av1*Av2*Av3;
disp(Av);
GV1=20*log10(Av1);
GV2=20*log10(Av2);
GV3=20*log10(Av3);
GV=GV1+GV2+GV3;//CORRECTION
disp('dB',GV*1,"GV=");
```

Scilab code Exa 21.2 voltage gain and input voltage of 2nd stage

```
clc;
vin1=0.05;
```

```
vout3=150;
Av1=20;
vin3=15;
Av=vout3/vin1;
disp(Av);
Av3=vout3/vin3;
disp(Av3);
Av2=Av/(Av3*Av1);
disp(Av2);
vin2=Av2/vin3;
disp('Vpk-pk',vin2*1,"vin2=");
```

Scilab code Exa 21.3 input resistance output resitance current and voltage gain

```
clc;
VCC=10;
Rc=5*10**3;
RB=1*10**6;
RE=1*10**3;
RL=10*10**3;
B1=100;
B2=100;
B=B1;
IE=VCC/(RE+(RB/B1));
re=25/(IE*10**3);
Ri1=B*re;
disp('ohm',Ri1*1,"Ri1=");
Ri2=B*re;
disp('ohm',Ri2*1,"Ri2=");
Ro1=(Rc*Ri2)/(Rc+Ri2);
disp('ohm',Ro1*1,"Ro1=");
Ro2=(Rc*RL)/(Rc+RL);
disp('ohm',Ro2*1,"Ro2=");
Av1=Ro1/re;
disp(Av1);
```

```
Av2=Ro2/re;
disp(Av2);
Av=Av1*Av2;
disp(Av);
Gv=20*log10(Av);
disp('dB',Gv*1,"Gv=");
```

Scilab code Exa 21.4 voltage gain

```
clc;
VCC=15;
Rc=3.3*10**3;
RE=1000;
R1=33*10**3;
R2=8.2*10**3;
RL=10*10**3;
B=100;
VBE=0.7;
VTH=VCC*(R2/(R1+R2));
RTH=(R1*R2)/(R1+R2);
IE=(VTH-VBE)/(RE+(RTH/B));
re=25/(IE*10**3);
Ri2=B*re;
disp('ohm',Ri2*1,"Ri2=");//the answer of Ri2 varies
    from the answer printed in the book with slight
    difference(11.7 in book & 11.65 here),but this
    affects some answers further.
Ro1=(Rc*Ri2)/(Rc+Ri2);
disp('ohm',Ro1*1,"Ro1=");
Ro2=(Rc*RL)/(Rc+RL);
disp('ohm',Ro2*1,"Ro2=");
Av1=Ro1/re;
disp(Av1);
Av2=Ro2/re;
disp(Av2);
```

```
Av=Av1*Av2;
disp(Av);
Gv=20*log10(Av);
disp('dB',Gv*1,"Gv=");
```

Scilab code Exa 21.5 cutoff frequency and voltage gain

```
clc;
bw=500*10**3;
Avmax=120;
f1=25;
f2=bw+f1;
disp('kHZ',f2*10**-3,"f2=");
Av=Avmax/(sqrt(2))
disp(Av);//ans printed in the book is  wrong
```

Scilab code Exa 21.6 individual stage gains and voltage gain

```
clc;
VCC=10;
RB=470*10**3;
RE=1*10**3;
RL=1*10**3;
a=4;
B=50;
IE=VCC/(RE+(RB/B));
re=25/(IE*10**3);
Ri1=(RB*(B*re))/(RB+(B*re));
disp('ohm',Ri1*1,"Ri1=");
Ri2=(RB*(B*re))/(RB+(B*re));
disp('ohm',Ri2*1,"Ri2=");
RI2=(a^2)*Ri2;
RO1=RI2;
```

```
RI2=(a^2)*RL;
Av1=RO1/re;
disp(Av1);
RO2=RI2;
Av2=RO2/re;
disp(Av1);
Av=Av1*Av2;
disp(Av);
Gv=20*log10(Av);
disp('dB',Gv*1,"Gv=");
```

Scilab code Exa 21.7 `voltage gain`

```
clc;
VCC=12;
R1=100*10**3;
R2=20*10**3;
R3=10*10**3;
R4=2*10**3;
R5=10*10**3;
R6=2*10**3;
B=100;
B2=100;
VTH=VCC*(R2/(R1+R2));
IE1=VTH/R4;
re1=25/IE1*10**-3;
VR6=VCC-IE1*R3;
IE2=VR6/R6;
re2=25/IE2*10**-3;
Ri2=B2*(re2+R6);
RO1=(R3*Ri2)/(R3+Ri2);
RO2=R5;
Av1=RO1/(re1+R4);
disp(Av1);
Av2=RO2/(re2+R6);
```

```
disp(Av2);
Av=Av1*Av2;
disp(Av);
```

Scilab code Exa 21.8 collector current VCE and ac voltage gain

```
clc;
VCC=10;
R1=800;
R2=200;
R3=600;
R4=200;
R5=100;
R6=1*10**3;
B=100;
B2=B;
VBE=0.7;
RE=200;
VR2=VCC*(R2/(R1+R2));
IE1=(VR2-VBE)/RE;
IC1=IE1;
disp('mA',IC1*10**3,"IC1=");
VC1=VCC-IC1*R3;
VE1=IE1*R4;
VCE1=VC1-VE1;
disp('V',VCE1*1,"VCE1=");
VE2=VC1-(-VBE);
IE2=(VCC-VE2)/R6;
IC2=IE2;
VC2=IC2*R5;
VCE2=VC2-VE2;
disp('V',VCE2*1,"VCE2=");
re1=25/IE1*10**-3;
re2=25/IE2*10**-3;
Ri2=B2*(re2+R6);
```

```
R01=(R3*Ri2)/(R3+Ri2);
Av1=R01/(re1+R4);
disp(Av1*1,"Av1=");
Av2=1;
disp(Av2*1,"Av2=");
Av=Av1*Av2;
disp(Av*1,"Av=");
```

Scilab code Exa 21.9 gain emitter diode resistance

```
clc;
VCC=10;
R1=30*10**3;
R2=20*10**3;
RE=1.5*10**3;
B1=150;
B2=100;
VBE=0.7;
Ai=B1*B2;
disp(Ai);
VR2=VCC*(R2/(R1+R2));
VB2=VR2-VBE;
VE2=VB2-VBE;
IE2=VE2/RE;
re2=25/(IE2*10**3);
disp('ohm',re2*1,"re2=");
Ib2=IE2/B2;
IE1=Ib2;
re1=25/(IE1*10**3);
disp('ohm',re1*1,"re1=");
Ri1=(R1*R2)/(R1+R2);
disp('Kohm',Ri1*10**-3,"Ri1=");
Av=RE/((re1/B2)+(re2+RE));
disp(Av);
```

Chapter 22

FET AMPLIFIERS

Scilab code Exa 22.1 `vdc vgs`

```
clc;
//e.g 22.1
ID=5*10**-3;
VDD=10;
RD=1*10**3;
RS=500;
VS=ID*RS;
disp('V',VS*1,"VS=");
VD=VDD-ID*RD;
disp('V',VD*1,"VD=");
VDS=VD-VS;
disp('V',VDS*1,"VDS=");
VGS=-VS;
disp('V',VGS*1,"VGS=");
```

Scilab code Exa 22.2 `R1`

```
clc;
```

```
//e.g 22.2
RD=56*10**3;
RG=1*10**6;
IDSS=1.5*10**-3;
VP=-1.5;
VD=10;
VDD=20;
ID=VD/RD;
disp('mA',ID*10**3,"ID=");
//ID=IDSS*(1-(VGS/VP))**2
VGS=VP*(1-sqrt(ID/IDSS));
disp('V',VGS*1,"VGS=");
VS=VGS;
R1=(-VS/ID)-4*10**3;
disp('kohm',R1*10**-3,"R1=");
```

Scilab code Exa 22.3 RS and RD

```
clc;
//e.g 22.3
ID=1.5*10**-3;
VDS=10;
IDSS=5*10**-3;
VP=-2;
VDD=20;
//ID=IDSS*(1-(VGS/VP))**2
VGS=VP*(1-(ID/IDSS));
VS=-VGS;
RS=(VS/ID);
disp('ohm',RS*1,"RS=");
RD=((VDD-VDS)/ID)-RS;
disp('Kohm',RD*10**-3,"RD=");
```

Scilab code Exa 22.5 RD and RS

```
clc;
//e.g22.5
VP=5;
IDSS=12*10**-3;
VDD=12;
ID=4*10**-3;
VDS=6;
VGS=VP*(1-sqrt(ID/IDSS));
VS=VGS;
RS=VS/ID;
disp('ohm',RS*1,"RS=");
RD=VDS/ID;
disp('Kohm',RD*10**-3,"RD=")
```

Scilab code Exa 22.6 self bias operation point

```
clc;
//e.g 22.6
IDSS=10*10**-3;
VDD=20;
IDQ=IDSS/2;
disp('mA',IDQ*10**3,"ID=");
VDSQ=VDD/2;
disp('V',VDSQ*1,"VDS=");
VGS=-2.2;
RD=(VDD-VDSQ)/IDQ;
disp('Kohm',RD*10**-3,"RD=");
RS=-VGS/IDQ;
disp('ohm',RS*1,"RS=");
```

Scilab code Exa 22.7 VGS and VDS

```
clc;
//e.g 22.7
VDD=20;
RD=2.5*10**3;
RS=1.5*10**3;
R1=2*10**6;
R2=250*10**3;
ID=4*10**-3;
VG=(R2*VDD)/(R1+R2);
VS=ID*RS;
VGS=VG-VS;
disp('V',VGS*1,"VGS=");
VD=VDD-ID*RD;
VDS=VD-VS;
disp('V',VDS*1,"VDS=");
```

Scilab code Exa 22.8 voltage gain

```
clc;
//e.g22.8
gm=4*10**-3;
RD=1.5*10**3;
AV=-gm*RD;
disp(AV);
```

Scilab code Exa 22.9 voltage gain

```
clc;
//e.g 22.9
gm=2.5*10**-3;
rd=500*10**3;
RD=10*10**3;
rL=(RD*rd)/(rd+RD);
```

```
disp('10^3 ohm',rL*10**-3,"rL=");
AV=-gm*rL;
disp(AV);
```

Scilab code Exa 22.10 voltage gain

```
clc;
//e.g 22.10
gm=2*10**-3;
rd=40*10**3;
RD=20*10**3;
RG=100*10**6;
rL=(RD*rd)/(RD+rd);
Av=-gm*rL;
disp(Av);
Ri=RG;
disp('Mohm',Ri*10**-6,"Ri=");
Ro=rL;
disp('Kohm',Ro*10**-3,"Ro=");
```

Scilab code Exa 22.11 voltage gain

```
clc;
//e.g 22.11
gm=2*10**-3;
rd=10*10**3;
RD=50*10**3;
rl=(rd*RD)/(rd+RD);
Av=-gm*rl;
disp(Av);
```

Scilab code Exa 22.12 voltage gain

```
clc;
//e.g 22.12
RD=100*10**3;
gm=1.6*10**-3;
rd=44*10**3;
Cgs=3*10**-12;
Cds=1*10**-12;
Cgd=2.8*10**-12;
rl=(RD*rd)/(RD+rd);
Av=-gm*rl;
disp(Av);
```

Scilab code Exa 22.13 rms output voltage

```
clc;
//e.g 22.13
gm=4500*10**-6;
RD=3*10**3;
RL=5*10**3;
vin=100*10**-3;
ID=2*10**-3;
rl=(RD*RL)/(RD+RL);
VO=gm*rl*vin;
disp('V',VO*1,"VO=");
```

Scilab code Exa 22.14 voltage gain

```
clc;
//e.g 22.14;
gm=4*10**-3;
RD=1.5*10**3;
```

```
RG=10*10**6;
rs=500;
rl=RD;
AV=-(gm*rl)/(1+gm*rs);
disp(AV);
RL=100*10^3;
rL=(RD*RL)/(RD+RL);
AV=-(gm*rL)/(1+gm*rs);
disp(AV);
```

Scilab code Exa 22.15 voltage gain

```
clc;
// e.g 22.15
RD=1.5*10**3;
RS=750;
RG=1*10**6;
IDSS=10*10**-3;
VP=-3.5;
IDQ=2.3*10**-3;
VGSQ=-1.8;
gmo=-2*IDSS/VP;
gm=gmo*(1-(VGSQ/VP));
rL=RD;
AV=-(gm*rL)/(1+gm*RS);
disp(AV);
AV=-gm*rL;
disp(AV);
```

Scilab code Exa 22.16 voltage gain and input output resistance

```
clc;
//e.g 22.16
```

```
gm=8000*10**-6;
RS=10*10**3;
RG=100*10**6;
(1/gm);
AV=RS/(RS+(1/gm));
disp(AV);
Ri=RG;
Ro=1/gm;
disp('ohm',Ro*1,"Ro=");
```

Scilab code Exa 22.17 voltage gain and resistance

```
clc;
//e.g 22.17
vin=2*10**-3;
gm=5500*10**-6;
R1=1*10**6;
R2=1*10**6;
RS=5000;
RL=2000;
(1/gm);
AV=RS/(RS+(1/gm));
disp(AV);
Ri=(R1*R2)/(R1+R2);
disp('Mohm',Ri*10**-6,"Ri=");
Ro=(RS/gm)/(RS+1/gm);
disp('ohm',Ro*1,"Ro=");
Vo=(RL/(RL+Ro))*(AV*vin);
disp('mV',Vo*10**3,"Vo=");
```

Scilab code Exa 22.18 voltage gain and input resistance

```
clc;
```

```
//e.g 22.18
gm=2500*10**-6;
Ri=2000;
RD=10000;
AV=gm*RD;
disp(AV);
Ri1=(Ri/gm)/(Ri+1/gm);
disp('ohm',Ri1*1,"Ri1=");
```

Scilab code Exa 22.19 output resistance

```
clc;
//e.g 22.19
gm=2*10**-3;
rd=50*10**3;
Rs=1*10**3;
Ro=(Rs/gm)/(Rs+1/gm);
disp('ohm',Ro*1,"Ro=");
```

Scilab code Exa 22.20 input resistance and ac voltage gain

```
clc;
//e.g 22.20
gmo=5*10^-3;
RD=1*10**3;
Rs=200;
ID=5*10**-3;
Ri1=(Rs/gmo)/(Rs+1/gmo);
disp('ohm',Ri1*1,"Ri1=");
Vs=ID*Rs;
disp('V',Vs*1,"Vs=");
VGS=Vs;
IDSS=2*ID;
```

```
VGSo=(-2*IDSS)/ID;
gm=gmo*(1-VGS/-VGSo);
Av=gm*RD;
disp(Av);
```

Chapter 23

AMPLIFIERS WITH COMPOUND CONFIGURATION

Scilab code Exa 23.1 voltage gain and impedance

```
clc;
ID=4*10**-3;
IDSS=2*ID;
RS=390;
VGSQ=-ID*RS;
VP=-4.5;
RD=2.2*10**3;
gm0=(2*IDSS)/(-VP);
gm=gm0*(1-(VGSQ/VP));
Av1=-gm*RD;
Av2=-gm*RD;
Av=Av1*Av2;
disp(Av);
vi=20*10**-3;
vo=Av*vi;
disp('mV',vo*10**3,"vo=");
Zi=10*10**6;
```

```
RG=10*10**6;
disp('Mohm',Zi*10**-6,"Zi=RG=");
Z0=2.2*10**3;
RD=2.2*10**3;
disp('Kohm',Z0*10**-3,"Z0=RD=");
RL=10*10**3;
VL=(RL/(Z0+RL))*vo;
disp('V',VL*10**3,"VL=");
```

Scilab code Exa 23.3 `voltage gain`

```
clc;
VCC=18;
R1=7.5*10**3;
R2=6.2*10**3;
R3=3.9*10**3;
RC=1.5*10**3;
B1=200;
B2=200;
RE=1*10**3;
CE=100*10**-6;
VB1=VCC*(R2+R3)/(R1+R2+R3);
disp('V',VB1*1,"VB1=");
VB2=VCC*(R3)/(R1+R2+R3);
disp('V',VB2*1,"VB2=");
IE2=(VB2-0.7)/RE;
IC2=IE2;
IE1=IC2;
IE=IE1;
re1=26*10**-3/IE;
AV1=-re1/re1;
AV2=-RC/re1;
AV=AV1*AV2;
disp(AV);//ans given in book has -ve sign which is
    wrong
```

Scilab code Exa 23.4 current gain

```
clc;
B1=160;
B2=160;
BD=B1*B2;
disp(BD);
```

Scilab code Exa 23.5 CURRENT GAIN

```
clc;
BD=6000;
B1=BD;
B2=B1;
B=sqrt(BD);
disp(B);
```

Scilab code Exa 23.6 VE2 IE2 voltage gain

```
clc;
Vcc=15;
RB=2.4*10**6;
BD=6000;
RE=510;
Vi=120*10**-3;
VBE=1.6;
IB=(Vcc-VBE)/(RB+BD*RE);
disp('microA',IB*10**6,"IB=");
IE=BD*IB;
```

```
disp('mA',IE*10**3,"IE=");
IE2=IE
VE2=IE2*RE;
disp('V',VE2*1,"VE2=");
```

Scilab code Exa 23.7 zmatrix

```
clc;
hfe=100;
B=100;
BD=100**2;
RE=1*10**3;
hie=1*10**3;
ri=10**3;
Ri=ri+BD*RE;
disp('Mohm',Ri*10**-6,"Ri=");
Ro=ri/BD;
disp('ohm',Ro*1,"Ro=");
```

Scilab code Exa 23.8 dc bias currents and voltages

```
clc;
VCC=16;
B1=160;
B2=200;
RB=1.5*10**6;
Vi=120*10**-3;
VEB1=0.7;
RC=100;
IB1=(VCC-VEB1)/(RB+B1*B2*RC);
IB2=B1*IB1;
IC2=B2*IB2;
IE1=IB2;
```

```
IC=IE1+IC2;
Vodc=VCC-IC*RC;
VBE=0.7;
Vidc=Vodc-VBE;
disp('V',Vidc*1,"Vidc=");
```

Scilab code Exa 23.9 `load current and output voltage`

```
clc;
VDD=18;
RD=2*10**3;
IDSS=6*10**-3;
VP=-3;
ID=IDSS;
disp('mA',ID*10**3,"ID=");
Vo=VDD-ID*RD;
disp('V',Vo*1,"Vo=");
```

Scilab code Exa 23.10 `calculate the value of constant current`

```
clc;
VEE=-18;
R1=4.3*10**3;
R2=4.3*10**3;
RE=1.8*10**3;
B=100;
VB=-(-VEE*R2)/(R1+R2);
VE=VB-0.7
IE=(VE-(VEE))/RE;
disp('mA',IE*10**3,"IE=");
```

Scilab code Exa 23.11 current

```
clc;
VZ=5.1;
VBE=0.7;
RE=1.2*10**3;
B=200;
I=(VZ-VBE)/RE;
disp('mA',I*10**3,"I=");
```

Scilab code Exa 23.12 current

```
clc;
VCC=18;
Rx=2*10**3;
VBE=0.7;
Ix=(VCC-VBE)/Rx;
I=Ix;
disp('mA',I*10**3,"I=");
```

Scilab code Exa 23.13 value of current

```
clc;
VC=5;
Re=2*10**3;
VCC=6;
R=2.2*10**3;
VBE=0.7;
B=100;
I="IO";
I=(VCC-2*VBE)/Re;
disp('mA',I*10**3,"I=");
Re=1*10**3;
```

```
I=(VCC-2*VBE)/Re;
disp('mA',I*10**3,"I=");
Re=4*10**3;
I=(VCC-2*VBE)/Re;
disp('mA',I*10**3,"I=");
```

Scilab code Exa 23.14 `dc voltage and current`

```
clc;
VCC=15;
VEE=15;
RE=3.9*10**3;
RC=4.7*10**3;
IE=(VEE-0.7)/RE;
disp('mA',IE*10**3,"IE=");
IC=IE/2;
disp('mA',IC*10**3,"IC=");
VC=VCC-IC*RC;
disp('V',VC*1,"VC=");
```

Scilab code Exa 23.15 `IC AV VO1`

```
clc;
VCC=12;
VEE=12;
RE=33*10**3;
RC1=36*10**3;
RC2=36*10**3;
B1=150;
B2=150;
vi1=2*10**-3;
IE=(VEE-0.7)/RE;
disp('mA',IE*10**3,"IE=");
```

```
IC=IE/2;
disp('mA',IC*10**3,"IC=");
RC=36*10**3;
VC=VCC-IC*RC;
disp('V',VC*1,"VC=");
re1=25*10**-3/IE;
Av=RC/(2*re1);
disp(Av);
vo1=Av*vi1;
disp('V',vo1*1,"vo1=");
```

Scilab code Exa 23.16 common mode voltage gain

```
clc;
B=200;
ri=20*10**3;
RC=47*10**3;
RE=43*10**3;
Ac=(B*RE)/(ri+2*(B+1)*RE);
disp(Ac);
```

Chapter 24

FREQUENCY RESPONSE OF BJT AND JFET AMPLIFIERS

Scilab code Exa 24.1 power gain

```

clc;
Pi=5;
Po=100;
G=10*log10(Po/Pi);
disp('dB',G*1,"G=");
```

Scilab code Exa 24.2 power gain

```

clc;
Pi=5*10**-3;
Po=1;
G=10*log10(Po/Pi);
disp('dB',G*1,"G=");//ans given in the book is wrong
```

Scilab code Exa 24.3 power gain

```

clc;
Pi=20*10**-6;
Po=100*10**-6;
G=10*log10(Po/Pi);
disp('dB',G*1,"G=");
```

Scilab code Exa 24.4 power gain

```

clc;
Po=25;
G=10*log10(Po/(1*10**-3));
disp('dB',G*1,"G=");
```

Scilab code Exa 24.5 gain

```

clc;
V2=100;
V1=25;
G=10*log10(V2/V1);
disp('dB',G*1,"G=");
```

Scilab code Exa 24.8 frequency response

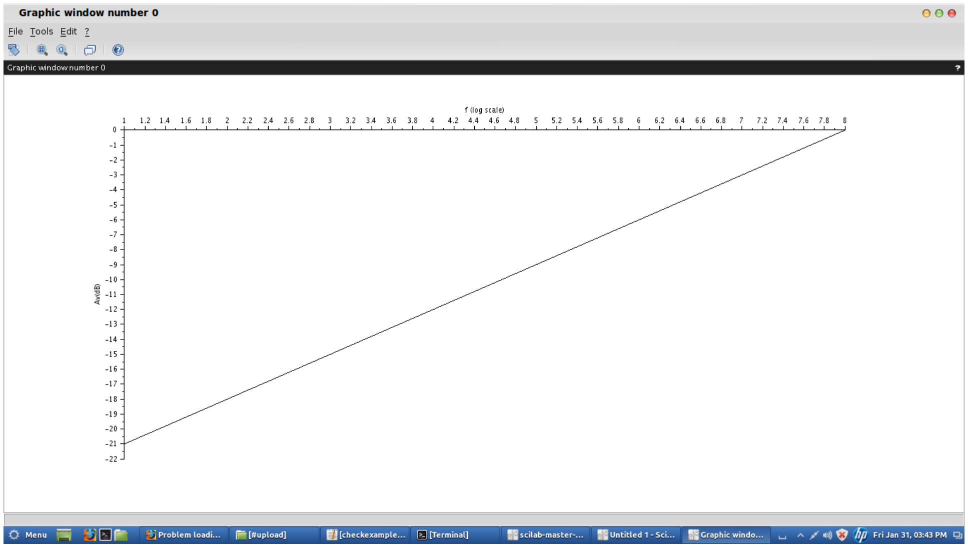

Figure 24.1: frequency response

```

clc;
R=5*10**3;
C=0.1*10**-6;
f1=1/(2*%pi*R*C);
disp('HZ',f1*1,"f1=");
i=-21:3:0;
plot2d(i);
a=gca() //get the current axes
a.box="off";
a.x_location="top";
xlabel("f (log scale)");
ylabel( "Av(dB)");
```

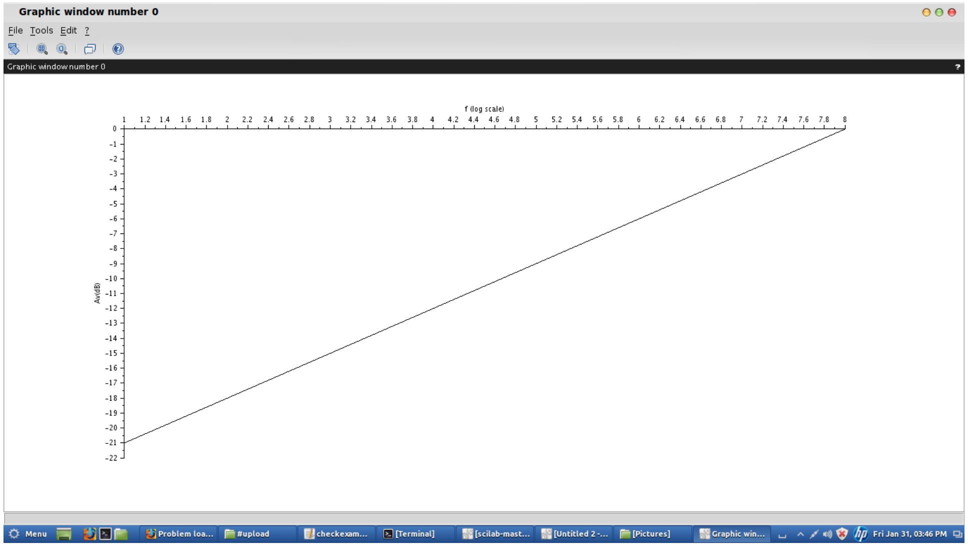

Figure 24.2: FREQUENCY AND PLOT

Scilab code Exa 24.9 `FREQUENCY AND PLOT`

```

clc;
RC=4*10**3;
R1=40*10**3;
R2=10*10**3;
RE=2*10**3;
RS=1*10**3;
RL=2.2*10**3;
CS=10*10**-6;
CE=20*10**-6;
CC=1*10**-6;
B=100;
VCC=20;
VB=(R2*VCC)/(R2+R1);
IE=(VB-0.7)/RE;
re=(26*10**-3)/IE;
B*re;
vo=-(RC*RL)/(RC+RL);
```

```
Av=vo/re;
a=(R1*R2)/(R1+R2);
Ri=(a*(B*re))/(a+(B*re));
Rs=1*10**3;
vibyvs=Ri/(Ri+Rs);
Avs=Av*vibyvs;
a=(R1*R2)/(R1+R2);
Ri=(a*(B*re))/(a+(B*re));
fLS=1/(2*%pi*(Rs+Ri)*CS);
disp('HZ',fLS*1,"fLS=");
fLC=1/(2*%pi*(RC+RL)*CC);
disp('HZ',fLC*1,"fLC=");
a=(R1*R2)/(R1+R2);
RS=(a*RS)/(a+RS);
b=(RS/B+re);
Re=(RE*b)/(RE+b);
fLE=1/(2*%pi*Re*CE);
disp('HZ',fLE*1,"fLE=");
i=-21:3:0;
plot2d(i);
a=gca() //get the current axes
a.box="off";
a.x_location="top";
xlabel("f (log scale)");
ylabel( "Av(dB)");
```

Chapter 25

LARGE SIGNAL OR POWER AMPLIFIERS

Scilab code Exa 25.1 `collector current and Vce`

```
clc;
VCC=10;
R1=10*10**3;
R2=5*10**3;
RC=1*10**3;
RE=500;
RL=1.5*10**3;
B=100;
VBE=0.7;
VR2=VCC*(R2/(R1+R2));
IEQ=(VR2-VBE)/RE;
ICQ=IEQ;
VCEQ=VCC-ICQ*(RC+RE);
rL=(RC*RL)/(RC+RL);
ICsat=ICQ+(VCEQ/rL);
disp('mA',ICsat*10**3,"ICsat=");
VCEsat=0;
disp(VCEsat);
ICcutoff=0;
```

```
disp(ICcutoff);
VCEcutoff=VCEQ+ICQ*rL;
disp('V',VCEcutoff,"VCEcutoff=");
```

Scilab code Exa 25.2 COMPLIANCE

```
clc;
VCC=20;
R1=10*10**3;
R2=1.8*10**3;
RC=620;
RE=200;
RL=1.2*10**3;
hfe=180;
VB=VCC*(R2/(R1+R2));
VBE=0.7;
VE=VB-VBE;
IE=VE/RE;
IC=IE;
VCE=VCC-IE*(RC+RE);
ICQ=IC;
VCEQ=VCE;
rL=(RC*RL)/(RC+RL);
PP=2*ICQ*rL;
disp('V',PP,"PP=");
PP=2*VCEQ;
disp('V',PP,"PP=");
```

Scilab code Exa 25.3 voltage gain and power gain

```
clc;
re=8;
RC=220;
```

```
RE=47;
R1=4.7*10**3;
R2=470;
B=50;
rL=RC;
AV=rL/re;
Ai=B;
Ap=AV*Ai;
disp(Ap);
```

Scilab code Exa 25.4 collector efficiency and power rating of transistor

```
clc;
Ptrdc=20;
Poac=5;
ne=(Poac/Ptrdc);
disp('%',ne*100,"ne=");
"power rating of transistor=20W";
```

Scilab code Exa 25.5 ac power

```

clc;
pcdc=10;
nc=0.32;
poac=pcdc*nc/(1-nc);
disp('W',poac,"poac=");
```

Scilab code Exa 25.6 power dissipated

```
clc;
nc=0.5;
VCC=24;
Poac=3.5;
Ptrdc=Poac/nc;
disp('W',Ptrdc,"Ptrdc=");
Pcdc=Ptrdc-Poac;
disp('W',Pcdc,"Pcdc=");
```

Scilab code Exa 25.7 power and efficiency

```
clc;
VCC=20;
VCEQ=10;
ICQ=600*10**-3;
RL=16;
IP=300*10**-3;
Pindc=VCC*ICQ;
disp('W',Pindc,"Pindc=");
PRLdc=ICQ**2*RL;
disp('W',PRLdc,"PRLdc=");
I=IP/sqrt(2);
Poac=I**2*RL;
disp('W',Poac,"Poac=");
Ptrdc=Pindc-PRLdc;
disp('W',Ptrdc,"Ptrdc=");
Pcdc=Ptrdc-Poac;
disp('W',Pcdc,"Pcdc=");
no=Poac/Pindc;
disp('%',no*100,"no=");
no=Poac/Ptrdc;
disp('%',no*100,"no=");
```

Scilab code Exa 25.8 resistance

```
clc;
a=15;
RL=8;
RL1=a**2*RL;
disp('Kohm',RL1*10**-3,"RL1=");
```

Scilab code Exa 25.9 turns ratio

```
clc;
RL=16;
RL1=10*10**3;
a=sqrt(RL1/RL);
disp(a);
```

Scilab code Exa 25.10 max power

```
clc;
RL=8;
a=10;
ICQ=500*10**-3;
RL=a**2*RL;
Poac=(1/2)*ICQ**2*RL;
disp('W',Poac,"Poac=");
```

Scilab code Exa 25.11 ac output power ICQ turns ratio

```
clc;
Ptrdc=100*10**-3;
```

```
VCC=10;
RL=16;
no=0.5;
Poac=no*Ptrdc;
disp('mW',Poac*10**3,"Poac=");
ICQ=2*Poac/VCC;
disp('A',ICQ,"ICQ=");
RL1=VCC/ICQ;
a=sqrt(RL1/RL);
disp(a);
```

Scilab code Exa 25.12 power

```
clc;
VCC=10;
IP=50*10**-3;
RL=4;
I=IP/sqrt(2);
Poac=I^2*RL;
disp('mW',Poac*10**3,"Poac=");
ICQ=IP;
RL1=VCC/ICQ;
a=sqrt(RL1/RL);
disp(a);
V1=VCC;
V2=V1/a;
I2p=V2/RL;
I2=I2p/sqrt(2);
P=(I2^2)*RL;
disp('mW',P*10**3,"P=");
```

Scilab code Exa 25.13 power

```
clc;
RL=8;
VP=16;
P=(VP^2)/(2*RL);
disp('W',P,"P=");
```

Scilab code Exa 25.14 PinDC PoAC

```
clc;
no=0.6;
Pcdc=2.5;
//Poac=Pindc*no;
//Pindc=2*Pcdc+Poac;
Pindc=(2*Pcdc)/(1-no);
disp('W',Pindc,"Pindc=");
Poac=0.6*Pindc;
disp('W',Poac,"Poac=");
```

Chapter 26

TUNED AMPLIFIERS

Scilab code Exa 26.1 frequency

```
clc;
//e.g 26.1
L=150*10**-6;
C=100*10**-12;
fo=0.159/sqrt (L*C);
disp('MHZ',fo*10**-6,"fo");
```

Scilab code Exa 26.2 frequency and impedance

```
clc;
//e.g 26.2
L=100*10**-6;
C=100*10**-12;
R=5;
fo=0.159/sqrt (L*C);
disp('MHZ',fo*10**-6,"fo=");
Zp=L/(C*R);
disp('Kohm',Zp*10**-3,"Zp=");
```

Scilab code Exa 26.3 bandwidth

```
clc;
//e.g 26.3
fo=1*10**6;
Qo=100;
BW=fo/Qo;
disp('kHZ',BW*10**-3,"BW=");
```

Scilab code Exa 26.4 Q factor

```
clc;
//e.g 26.4
fo=1600*10**3;
BW=10*10**3;
Qo=fo/BW;
disp(Qo);
```

Scilab code Exa 26.5 Q factor

```
clc;
//e.g 26.5
fo=2*10**6;
BW=50*10**3;
Qo=fo/BW;
disp(Qo);
```

Scilab code Exa 26.6 `impedance`

```
clc;
//e.g 26.6
fo=455*10**3;
BW=10*10**3;
XL=1255;
Qo=fo/BW;
R=XL/Qo;
L=XL/(2*%pi*fo);
C=1/(XL*2*%pi*fo);
Zp=L/(C*R);
disp('Kohm',Zp*10**-3,"Zp=");
```

Chapter 27

FEEDBACK AMPLIFIERS

Scilab code Exa 27.1 voltage gain

```
clc;
//e.g 27.1
AV=400;
beta=0.1;
AV1=AV/(1+beta*AV);
disp(AV1);
```

Scilab code Exa 27.2 fraction of output

```
clc;
//e.g 27.2
AV=1000;
AV1=10;
beta=((AV/AV1)-1)/AV;
disp(beta);
```

Scilab code Exa 27.3 feedback

```
clc;
//e.g 27.3
AV=100;
AV1=20;
beta=((AV/AV1)-1)/AV;
disp(beta);
```

Scilab code Exa 27.4 voltage gain and beta

```
clc;
//e.g 27.4
Vo=12.5;
Vin1=1.5;
Vin=0.25;
AV=Vo/Vin;
disp(AV);
AV1=Vo/Vin1;
beta=((AV/AV1)-1)/AV;
disp(beta);
```

Scilab code Exa 27.5 beta

```
clc;
//e.g 27.5
AV=60;
AV1=80;
//80=AV/(1-BETA*AV)
beta=((AV1/AV)-1)/AV1;
disp(beta,"beta=");
beta=1/AV;
disp(beta,"beta=");
```

Scilab code Exa 27.6 beta

```
clc;
//e.g 27.6
AV1=100;
Vin=50*10**-3;
Vin1=0.6;
Vo=AV1*Vin1;
Av=Vo/Vin;
disp(Av);
beta=((Av/AV1)-1)/Av;
disp('*10^-3 ',beta*10**3,"beta=");
```

Scilab code Exa 27.7 change in closed loop gain

```

clc;
Av=800;
B=0.05;
dAvbyAv=20;
a=dAvbyAv*(1/(1+B*Av));
disp('%',a*1,"a=");
```

Scilab code Exa 27.8 values of AV and beta

```
clc;
AV1=100;
A=0.01;
B=0.2;
```

```
C=B/A;
AV=AV1*C;
beta=C/AV;
disp(beta,"beta=");
```

Scilab code Exa 27.9 gain and beta

```
clc;
//e.g 27.9
AV=100;
BW=200*10**3;
beta=0.05;
BW1=(1+beta*AV)*BW;
disp('KHZ',BW1*10^-3,"BW1=");
AV1=AV/(1+beta*AV);
disp(AV1);
//1*10**6=(1+beta1*AV)*BW;
beta1=(((1*10**6)/(200*10**3))-1)/100;
disp(beta1);
```

Scilab code Exa 27.10 bw

```
clc;
//e.g 27.10
AV=1500;
BW=4*10**6;
AV1=150;
beta=((1500/150)-1)/1500;
disp(beta);
BW1=(1+beta*AV)*BW;
disp('MHZ',BW1*10**-6,"BW1=");
```

Scilab code Exa 27.11 frequency

```
clc;
//e.g 27.11
Rin=4.2*10**3;
AV=220;
beta=0.01;
Ri=(1+beta*AV)*Rin;
disp('Kohm',Ri*10**-3,"Ri=");
F1=1.5*10**3;
FC1=F1/(1+beta*AV);
disp('HZ  ',FC1,"FC1=");
F2=501.5*10**3;
FC2=(1+beta*AV)*F2;
disp('KHZ',FC2*10**-3,"FC2=");
```

Scilab code Exa 27.12 gain and distortion gain

```
clc;
//e.g 27.12
AV=1000;
f1=50;
f2=200*10**3;
D=0.05;
beta=0.01;
AV1=AV/(1+beta*AV);
disp(AV1);
fl1=f1/(1+beta*AV);
disp('HZ',fl1,"fl1=");
fu2=(1+beta*AV)*f2;
disp('MHZ',fu2*10**-6,"fu2=");
D1=D/(1+beta*AV);
```

```
disp('%',D1*100,"D1=");
```

Scilab code Exa 27.13 beta and gain

```
clc;
//e.g 27.13
AV=100;
RDN=0.8;
//0.8=1-(1/(1+beta*AV));
beta=((1/0.2)-1)/100;
disp(beta);
AV1=AV/(1+beta*AV);
disp(AV1);
```

Scilab code Exa 27.14 voltage gain and resistance

```
clc;
//e.g 27.14
AV=300;
Ri=1.5*10**3;
R0=50*10**3;
b=1/15;
AV1=AV/(1+b*AV);
disp(AV1);
Ri1=(1+b*AV)*Ri;//input resistance
disp('Kohm',Ri1*10**-3,"Ri1=");
Ri1=R0/(1+b*AV);//output resistance
disp('kohm',Ri1*10**-3,"Ri1=");
```

Scilab code Exa 27.15 voltage gain and resistance

```
clc;
//e.g 27.15
hfe=100;
hie=2*10**3;
Rc=470;
Re1=100;
Re2=100;
R1=15000;
R2=5600;
AV=(hfe*Rc)/hie;
disp(AV);
a=((R1*R2)/(R1+R2));
Ri=(a*hie)/(a+hie);
disp('ohm',Ri*1,"Ri=");
b=Re1/Rc;
AV1=AV/(1+b*AV);
disp(AV1);
Ri1=Ri*(1+b*AV);
disp('OHM',Ri1*1,"Ri1=");
```

Scilab code Exa 27.16 gain and resistance

```
clc;
//e.g 27.16
hfe=99;
hie=2*10**3;
hie1=2000;
hie2=2000;
Rc=22*10**3;
R4=100;
R1=220*10**3;
R2=22*10**3;
RC1=4.7*10**3;
R3=7.8*10**3;
Ri=hie;
```

```
a=(R1*R2)/(R1+R2);
b=(a*Rc)/(a+Rc);
R01=(b*hie1)/(b+hie1)
disp('Kohm',R01*10**-3,"R01=");
Ri2=hie;
C=(R3+R4);
R02=(RC1*C)/(RC1+C)
disp('Kohm',R02*10**-3,"R02=");
AV1=hfe*R01/hie;
AV2=hfe*R02/hie;
AV=AV1*AV2;
bta=R4/(R3+R4);
Ri1=Ri*(1+bta*AV);
disp('Kohm',Ri1*10**-3,"Ri1=");
RO2=R02/(1+bta*AV);
disp('ohm',RO2*1,"RO2=");
AV1=AV/(1+bta*AV);
disp(AV1);
```

Chapter 28

SINUSOIDAL OSCILLATORS

Scilab code Exa 28.1 inductance

```
clc;
//e.g 28.1
fo=22*10**3;;
C=2*10**-9;
L=((0.159/fo)^2)/C;
disp('H',L*1,"L=");
```

Scilab code Exa 28.2 frequency

```
clc;
//e.g 28.2
fo=2.2*10**6;
//fo1=(sqrt(2))/sqrt(C);
fo1=sqrt(2)*fo;
disp('MHZ',fo1*10**-6,"fo1=");
```

Scilab code Exa 28.3 `frequency`

```
clc;
//e.g 28.3
C=100*10**-12;
L1=30*10**-6;
L2=1*10**-8;
fo=1/(2*%pi*sqrt((L1+L2)*C));
disp('MHZ',fo*10**-6,"fo=");
```

Scilab code Exa 28.4 `frequency`

```
clc;
//e.g 28.4
L1=1000*10**-6;
L2=100*10**-6;
M=20*10**-6;
C=20*10**-12;
fo=1/(2*%pi*sqrt((L1+L2+2*M)*C));
disp('MHZ',fo*10**-6,"fo=");
```

Scilab code Exa 28.5 `frequency`

```
clc;
//e.g 28.5
C=1*10**-9;
L1=4.7*10**-3;
L2=47*10**-6;
fo=1/(2*%pi*sqrt((L1+L2)*C));
disp('KHZ',fo*10**-3,"fo=");
```

Scilab code Exa 28.6 capacitance

```
clc;
//e.g 28.6
L1=2*10**-3;
L2=20*10**-6;
fo=950*10**3;
C=1/(4*%pi^2*(L1+L2)*fo^2);
disp('pF',C*10**12,"C=");
fo=2050*10**3;
C=1/(4*%pi^2*(L1+L2)*fo^2);
disp('pF',C*10**12,"C=");
```

Scilab code Exa 28.7 capacitance

```
clc;
//e.g 28.7
L1=0.1*10**-3;
L2=10*10**-6;
fo=4110*10**3;
M=20*10**-6;
C=1/(4*%pi^2*(L1+L2+M)*fo^2);
disp('pF',C*10**12,"C=");
AV=(L1/L2);
disp(AV);
```

Scilab code Exa 28.8 c1 and c2

```
clc;
//e.g 28.8
fo=100*10**3;
L=0.5*10**-3;
C=2/(4*%pi^2*L*fo^2);
```

```
disp('microF',C*10**6,"C=");
```

Scilab code Exa 28.9 gain and frequency

```
clc;
//e.g 28.9
C1=0.001*10**-6;
C2=0.01*10**-6;
L=5*10**-6;
AV=C2/C1;
disp(AV);
C=(C1*C2)/(C1+C2)
fo=1/(2*%pi*sqrt(L*C));
disp('MHZ',fo*10**-6,"fo=");
```

Scilab code Exa 28.10 frequency

```
clc;
//e.g 28.10
C1=0.1*10**-6;
C2=1*10**-6;
L=470*10**-6;
C=(C1*C2)/(C1+C2)
fo=1/(2*%pi*sqrt(L*C));
disp('kHZ',fo*10**-3,"fo=");
```

Scilab code Exa 28.11 inductance and frequency

```
clc;
//e.g 28.11
```

```
C1=100*10**-12;
C2=7500*10**-12;
f01=950*10**3;
f02=2050*10**3;
C=(C1*C2)/(C1+C2);
//f01=1/(2*%pi*sqrt(L*C))
L1=1/(4*(%pi)^2*C*f01^2);
disp('microH',L1*10**6,"L1=");
L2=1/(4*(%pi)^2*C*f02^2);
disp('microH',L2*10**6,"L2=");
```

Scilab code Exa 28.13 `frequency`

```
clc;
//e.g 28.13
C1=0.1*10**-6;
C2=1*10**-6;
C3=100*10**-12;
L=470*10**-6;
C=1/((1/C1)+(1/C2)+(1/C3));
fo=1/(2*%pi*sqrt(L*C));
disp('kHZ',fo*10**-3,"fo=");
```

Scilab code Exa 28.14 `frequency`

```
clc;
//e.g 28.14
L=0.33;
C1=0.065*10**-12;
C2=1*10**-12;
R=5.5*10**3;
fs=1/(2*%pi*sqrt(L*C1));
disp('MHZ',fs*10**-6,"fs=");
```

```
Q=(2*%pi*fs*L)/R;
disp(Q);
```

Scilab code Exa 28.15 frequency fs and fp

```
clc;//e.g 28.14
L=0.8;
C1=0.08*10**-12;
C2=1*10**-12;
R=5*10**3;
fs=1/(2*%pi*sqrt(L*C1));
disp('MHZ',fs*10**-6,"fs=");
C=(C1*C2)/(C1+C2);
fp=1/(2*%pi*sqrt(L*C));
disp('MHZ',fp*10**-6,"fp=");
```

Chapter 29

NON SINUSOIDAL OSCILLATORS

Scilab code Exa 29.1 FREQUENCY

```
clc;
//e.g 29.1
R=20*10**3;
C=100*10**-12;
f=1/(1.38*R*C);
disp('kHZ',f*10**-3,"f=");
```

Scilab code Exa 29.2 value of capacitors

```
clc;
//e.g 29.2
R1=2*10**3;
R2=20*10**3;
C1=0.01*10**-6;
C2=0.05*10**-6;
T=0.69*(R1*C1+R2*C2)
```

```
disp('ms',T*10**3,"T=");
f=1/T;
disp('kHZ',f*10**-3,"f=");
```

Scilab code Exa 29.3 value of capacitors

```

clc;
T1=1*10**-6;
f=100*10**3;
R1=10*10**3;
R2=10*10**3;
T=1/f;
C1=T1/(0.69*R1);
disp('pF',C1*10**12,"C1=");
T2=T-T1;
C2=T2/(0.69*R1);
disp('pF',C2*10**12,"C2=");
```

Scilab code Exa 29.4 value of circuit components

```

clc;
T2A=310*10**-6;
T2B=250*10**-6;
VCC=15;
IC=5*10**-3;
hFC=20;
RC=VCC/IC;
RC1=RC;
RC2=RC;
disp('ohm',RC*1,"RC1=RC2=RC=");
hFE=hFC;
```

```
IBsat=IC/hFE;
IB=2*IBsat;
R=VCC/IB;
R1=R;
R2=R;
C1=T2A/(0.69*R1);
disp('pF',C1*10**12,"C1=");
C2=T2B/(0.69*R2);
disp('pF',C2*10**12,"C2=");
tao1=R1*C1;
disp('microsec',tao1*10**6,"tao1=");
tao2=R2*C2;
disp('microsec',tao2*10**6,"tao2=");
tao11=RC1*C1/2;
disp('microsec',tao11*10**6,"tao11=");
tao12=RC2*C2/2;
disp('microsec',tao12*10**6,"tao12=");
```

Scilab code Exa 29.5 duty cycle

```

clc;
f=20*10**3;
T=1/f;
disp('microsec',T*10**6,"T=");
t=(0:0.1:5*%pi)';
plot2d1('onn',t,[squarewave(t,75)]);
```

Scilab code Exa 29.6 R3 and C1

```

clc;
close;
```

```
f=100*10^(-3);
T=(1/f);
disp('us',T*1,'T=');
tp=(1/T);
disp('us',tp*1,'tp=');
C1=0.001*10^(-6);
R3=((5*10^(-6))/(0.69*C1));
disp('kohm',R3*10^(-3),'R3=');
```

Scilab code Exa 29.7 `width`

```

clc;
RC=2*10**3;
R3=20*10**3;
rbb=200;
C1=1000*10**-12;
T=0.69*C1*R3;
disp('microsec',T*10**6,"T=");
```

Scilab code Exa 29.8 `value of pulse width`

```
clc;
//e.g 29.8
R1=2.2*10**3;
C1=0.01*10**-6;
tp=1.1*R1*C1;
disp('microS',tp*10**6,"tp=");
```

Scilab code Exa 29.9 `CIRCUIT`

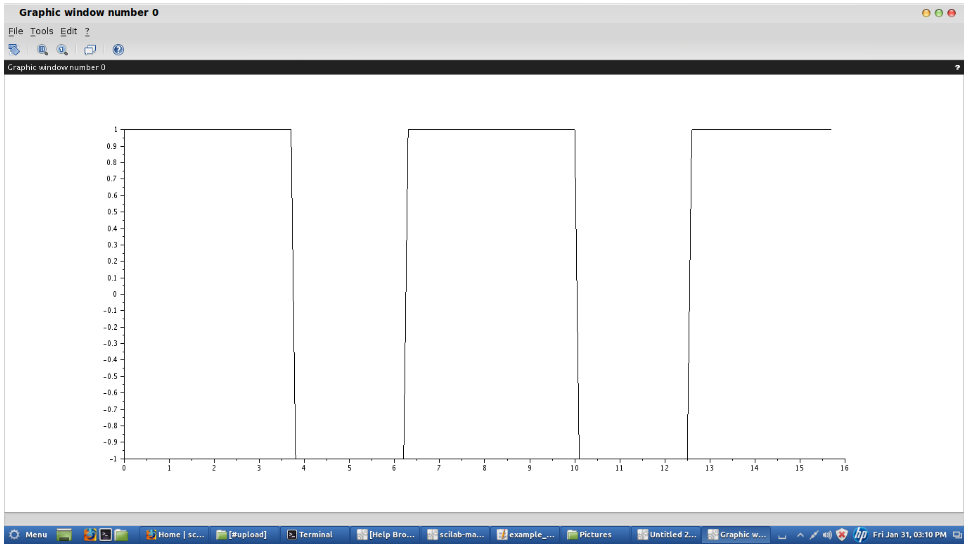

Figure 29.1: CIRCUIT

```
clc;
tp=10*10**-6;
c=1000*10**-12;
R1=tp/(1.1*c);
disp('Kohm',R1*10**-3,"R1=");
t=(0:0.1:5*%pi)';
plot2d1('onn',t,[squarewave(t,60)]);
```

Scilab code Exa 29.10 `duty cycle`

```
clc;
//e.g 29.10
R1=6.8*10**3;
R2=4.7*10**3;
C1=1000*10**-12;
```

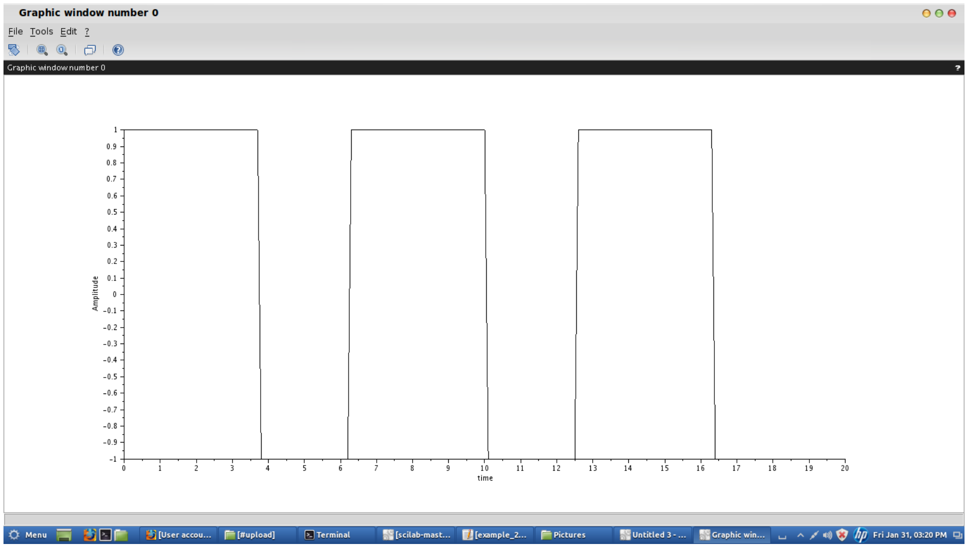

Figure 29.2: frequency and graph

```
t2=0.7*R2*C1;
disp('microS',t2*10**6,"t2=");
t1=0.7*(R1+R2)*C1;
disp('microS',t1*10**6,"t1=");
dc=(t1/(t1+t2))*100;
disp('%',dc*1,"dc=");
```

Scilab code Exa 29.11 `frequency and graph`

```

clc;
R1=27*10**3;
R2=56*10**3;
C1=0.01*10**-6;
t2=0.7*R2*C1;
t1=0.7*(R1+R2)*C1;
```

```
T=t1+t2;
f=1/T;
disp('kHZ',f*10**-3,"f=");
t=(0:0.1:6*%pi)';
plot2d1('onn',t,[squarewave(t,60)]);
```

Scilab code Exa 29.12 `design`

```

clc;
f=50*10**3;
dutyc=0.60;
C=0.0022*10**-6;
T=1/f;
t1=dutyc*T;
t2=T-t1;
R2=(t2)/(0.7*C);
disp('Kohm',R2*10**-3,"R2=");
R1=(t1)/(0.7*C)-R2;
disp('Kohm',R1*10**-3,"R1=");
```

Chapter 30

LINEAR WAVE SHAPING CIRCUIT

Scilab code Exa 30.2 VOLTAGE

```

clc;
C=1*10**-6;
Vi=6;
R=10*10**3;
Vo=-3;
t=8*10**-3;
tao=R*C;
disp('msec',tao*10**3,"tao=");
vf=6*(1-exp(-8/10));
disp('V',vf*1,"vf=");
output=vf-3.0;
disp('V',output*1,"output=");
```

Scilab code Exa 30.3 VOLTAGE

```
clc;
t=0.1;
tao=0.2;
vc=0.5*exp(-t/tao);
disp('V',vc*1,"vc=");
```

Scilab code Exa 30.4 `peak value of input voltage`

```
clc;
tao=250*10**-12;
v=50;
a=v/tao;
t=0.05*10**-6;
vp=a*t;
disp('kV',vp*10**-3,"vp=");
```

Chapter 31

TIME BASE CIRCUIT

Scilab code Exa 31.1 frequency

```
clc;
//e.g 31.1
R=100*10**3;
C=0.4*10**-6;
n=0.57;
f=1/(2.3*R*C*log10(1/(1-n)));
disp('HZ',f*1,"f=");
```

Scilab code Exa 31.2 period and frequency of oscillation and R

```
clc;
//e.g 31.2
n=0.62;
R=5*10**3;
C=0.05*10**-6;
T=2.3*R*C*log10(1/(1-n))
disp('msec',T*10**3,"T=");
f=1/T;
```

```
disp('HZ',f*1,"f=");
f1=50;
T1=1/f1;
R=T1/(2.3*C*log10(1/(1-n)));
disp('kohm',R*10**-3,"R=");
C=0.5*10**-6;
R=T1/(2.3*C*log10(1/(1-n)));
disp('kohm',R*10**-3,"R=");
```

Chapter 32

OPERATIONAL AMPLIFIERS

Scilab code Exa 32.1 CMRR

```
clc;
Adm=200000;
Acm=6.33;
CMRR=20*log10(Adm/Acm);
disp('dB',CMRR*1,"CMRR=");
```

Scilab code Exa 32.2 common mode gain

```
clc;
Adm=30000;
//CMRR=20*log10(Adm/Acm);
a=90/20;
Acm=(Adm/10^a);
disp(Acm);
```

Scilab code Exa 32.3 maximum frequency

```
clc;
//e.g 32.3
SR=0.5*10**6;
Vpk=0.1;
fmax=SR/(2*%pi*Vpk);
disp('kHZ',fmax*10**-3,"fmax=");
```

Scilab code Exa 32.4 suitable opamps

```
clc;
Vpk=10;
slewrate=0.5*10**6;
fmax=slewrate/(2*%pi*Vpk);
disp('HZ',fmax*1,"fmax=");//value of microamp 741
slewrate=13*10**6;
fmax=slewrate/(2*%pi*Vpk);
disp('kHZ',fmax*10**-3,"fmax=");//TLO 81
//value of microamp 741 is much lower than that of
    the input signal.And value of TLO81 is much
    higher than input signal,therefore TLO81 can be
    used
```

Scilab code Exa 32.5 value of vin

```
clc;
//e.g 32.5
ACL=200;
Vout=8;
Vin=Vout/ACL;
disp('mV',Vin*10**3,"Vin=");
```

Scilab code Exa 32.7 voltage

```
clc;
//e.g 32.7
R1=1*10**3;
R2=10*10**3;
ACL=R2/R1
disp("Voltage at node A increases from 1V to 4v");
```

Scilab code Exa 32.8 output voltage

```
clc;
R1=1*10**3;
R2=2*10**3;
Vi=1;
Acl=R2/R1;
V0=Acl*Vi;
disp('V',V0*1,"V0=");
```

Scilab code Exa 32.9 gain input impedance cmrr and fmax

```
clc;
Acm=0.001;
Aol=180000;
Zin=1*10**6;
Zout=80;
SR=0.5;
R2=100*10**3;
R1=10*10**3;
```

```
Acl=R2/R1;
disp(Acl);
Zin=R1;
disp('kOhm',Zin*10**-3,"Zin=");
disp('Ohm',Zout*1,"Zout=");
CMRR=Acl/Acm;
disp(CMRR);
Vpk=5;
fmax=SR/(2*%pi*Vpk);
disp('kHZ',fmax*10**3,"fmax=");
```

Scilab code Exa 32.10 `Acl CMRR and maximum operating frequency`

```
clc;
R2=100*10**3;
R1=10*10**3;
Acl=1+(R2/R1);
Acm=0.001;
disp(Acl);
CMRR=Acl/Acm;
disp(CMRR);
SR=0.5;
Vpk=5.5;
fmax=SR/(2*%pi*Vpk);
disp('kHZ',fmax*10**3,"fmax=");
```

Scilab code Exa 32.11 `Acl CMRR and maximum operating frequency`

```
clc;
Acm=0.001;
AOL=180000;
Zin=1*10**6;
Zout=80;
```

```
SR=0.5;
Acl=1;
CMRR=Acl/Acm;
disp(CMRR);
Vpk=3;
fmax=SR/(2*%pi*Vpk)
disp('kHZ',fmax*10**3,"fmax=");
```

Scilab code Exa 32.12 output voltage

```
clc;
//e.g 32.12
V1= 0.1;
V2=1;
V3=0.5;
R1=10*10**3;
R2=10*10**3;
R3=10*10**3;
R4=22*10**3;
Vout=((-R4*V1)/R1)+((-R4*V2)/R2)+((-R4*V3)/R3);
disp('V',Vout*-1,"Vout=");
```

Scilab code Exa 32.14 output voltage

```
clc;
V1=-2;
V2=2;
V3=-1;
R1=200*10**3;
R2=250*10**3;
R3=500*10**3;
Rf=1*10**6;
Vout=(-Rf/R1)*V1+(-Rf/R2)*V2+(-Rf/R3)*V3;
```

```
disp('V',Vout*1,"Vout=");
```

Chapter 33

OP AMP APPLICATION

Scilab code Exa 33.1 value of capacitance

```
clc;
R1=1*10**3;
R2=100*10**3;
Rf=R2;
f1=159;
C=1/(2*%pi*R2*f1);
disp('microF',C*1,"C=");
```

Scilab code Exa 33.2 frequency

```
clc;
R1=1*10**3;
Rf=51*10**3;
Cf=0.1*10**-6;
f=1/(2*%pi*Rf*Cf);
disp('HZ',f*1,"f=");//ans given in book is wrong
fmin=10*f;
disp('HZ',fmin*1,"fmin=");
```

Scilab code Exa 33.3 cutoff frequency and max operating frequency

```
clc;
R1=10*10**3;
Cf=0.01*10**-6;
f=1/(2*%pi*R1*Cf);
disp('HZ',f*1,"f=");//ans given in book is wrong
fmin=f/10;
disp('HZ',fmin*1,"fmin=");
```

Scilab code Exa 33.4 frequency

```
clc;
R=51*10**3;
C=0.001*10**-6;
f0=1/(2*%pi*R*C);
disp('HZ',f0*1,"f0=");
```

Chapter 34

REUGULATED POWER SUPPLIES

Scilab code Exa 34.1 `value of line regulation`

```
clc;
//e.g 34.1
VL=100*10**-6;
VS=5;
LR=VL/VS;
disp('microV/V',LR*10**6,"LR=");
```

Scilab code Exa 34.2 `Change in output voltage`

```
clc;
//e.g 34.2
LR=1.4*10**-6;
VS=10;
//LR=VL/VS;
VL=LR*VS
disp('microV',VL*10**6,"VL=");
```

Scilab code Exa 34.3 value of load regulation

```
clc;
//e.g 34.3
IL=40*10**-3;
VNL=8;
VFL=7.995;
LR=(VNL-VFL)/IL;
disp('microV/mA',LR*10**3,"LR=");
```

Scilab code Exa 34.4 voltage under full load

```
clc;
//e.g 34.4
VNL=5;
IL=20*10**-3;
LR=10*10**-6;
//LR=(VNL-VFL)/IL;
VFL=VNL-IL*LR;
disp('V',VFL*1,"VFL=");
```

Scilab code Exa 34.5 magnitude of variation in output voltage

```
clc;
//e.g 34.5
V0=10;
R=0.00002
VAR=V0*R;
disp('mV',VAR*10**3,"VAR=");
```

Scilab code Exa 34.6 load voltage voltage drop and current

```
clc;
//e.g 34.6
vs=30;
rs=240;
vz=12;
rl=500;
vl=vz;
disp('V',vl,"vl=");
Is=(vs-vz)/rs
Vd=Is*rs;
disp('V',Vd*1,"Vd=");
Iz=Is-(vl/rl)
disp('A',Iz*1,"Iz=");
```

Scilab code Exa 34.7 min and max value of input voltage

```
clc;
//e.g 34.7
Vz=5.1;
rz=10;
Izmin=1*10**-3;
Izmax=15*10**-3;
Rs=600;
Vomin=Vz+Izmin*rz;
disp('V',Vomin*1,"Vomin=");
Vsmin=Izmin*Rs+Vomin;
disp('V',Vsmin*1,"Vsmin=");
Vomax=Vz+Izmax*rz;
disp('V',Vomax*1,"Vomax=");
```

```
Vsmax=Izmax*Rs+Vomax;
disp('V',Vsmax*1,"Vsmax=");
```

Scilab code Exa 34.8 min and max value of load current

```
clc;
//e.g 34.8
Vs=24;
Rs=500;
Vz=12;
Izmin=3*10**-3;
Izmax=90*10**-3;
rz=0;
Is=(Vs-Vz)/Rs;
disp('mA',Is*10**3,"Is=");
ILmax=Is-Izmin;
disp('mA',ILmax*10**3,"ILmax=");
RLmin=Vz/ILmax;
disp('ohm',RLmin*1,"RLmin=");
```

Scilab code Exa 34.9 min and max value of zener current

```
clc;
//e.g 34.9
Vsmin=22;
Rs=1*10**3;
Vz=10;
RL=2*10**3;
Vsmax=40;
IL=Vz/RL;
disp('mA',IL*10**3,"IL=");
Izmax=((Vsmax-Vz)/Rs)-IL;
disp('mA',Izmax*10**3,"Izmax=");
```

```
Izmin=((Vsmin-Vz)/Rs)-IL;
disp('mA',Izmin*10**3,"Izmin=");
```

Scilab code Exa 34.10 max value of Rs and power

```
clc;
Vz=10;
Vsmin=13;
Vsmax=16;
ILmin=10*10**-3;
ILmax=85*10**-3;
Izmin=15*10**-3;
Rsmax=(Vsmin-Vz)/(Izmin+ILmax);
disp('ohm',Rsmax*1,"Rsmax=");
Izmax=((Vsmax-Vz)/Rsmax)-ILmin;
Pzmax=Izmax*Vz;
disp('W',Pzmax*1,"Pzmax=");
```

Scilab code Exa 34.11 regulated resistance

```
clc;
Vsmin=19.5;
Vsmax=22.5;
RL=6*10**3;
Vz=18;
Izmin=2*10**-6;
Pzmax=60*10**-3;
rz=20;
Izmax=sqrt(Pzmax/rz);
IL=Vz/RL;
ILmax=IL;
ILmin=IL;
Rsmax=(Vsmin-Vz)/(Izmin+ILmax);
```

```
disp('ohm',Rsmax*1,"Rsmax=");
Rsmin=(Vsmax-Vz)/(Izmax+ILmin);
disp('ohm',Rsmin*1,"Rsmin=");
```

Scilab code Exa 34.12 min and max value of zener current

```
clc;
Vsmin=8;
Vsmax=12;
Rs=2.2*10**3;
Vz=5;
RL=10*10**3;
Ismin=(Vsmin-Vz)/Rs;
Ismax=(Vsmax-Vz)/Rs;
IL=Vz/RL;
Izmin=Ismin-IL;
disp('mA',Izmin*10**3,"Izmin=");
Izmax=Ismax-IL;
disp('mA',Izmax*10**3,"Izmax=");
```

Scilab code Exa 34.13 zener regulator

```
clc;
VL=5;
Vz=5;
IL=20*10**-3;
Pzmax=500*10**-3;
Vsmax=15;
Vsmin=9;
Izmax=Pzmax/Vz;
Ismax=IL+Izmax;
Vz=VL;
Rsmin=(Vsmax-Vz)/(Izmax+IL);
```

```
disp('ohm',Rsmin*1,"Rsmin=");
ILmax=IL;
Iz=((Vsmin-Vz)/Rsmin)-ILmax;
disp('mA',Iz*10**3,"Iz=");
```

Scilab code Exa 34.14 regulated voltage and circuit current

```
clc;
Vz=10;
Vbe=0.7;
RL=100;
Vs=15;
B=100;
Rs=33;
VL=Vz+Vbe;
IL=VL/RL;
Is=(Vs-VL)/Rs;
Ic=Is-IL;
Ib=Ic/B;
disp('microA',Ib*10**6,"Ib=");
```

Scilab code Exa 34.15 voltage current

```
clc;
Vs=15;
Vz=8.3;
B=100;
R=1.8*10**3;
RL=2*10**3;
Vbe=0.7;
VL=Vz-Vbe;
Vce=Vs-VL;
IR=(Vs-Vz)/R;
```

```
IL=VL/RL;
IB=IL/B;
disp('microA',IB*10**6,"IB=");//In question beta is
   100 but while solving it is taken as 50 which is
   wrong
Iz=IR-IB;
disp('mA',Iz*10**3,"Iz=");
```

Scilab code Exa 34.16 max value of Resistance and power

```
clc;
ILmin=0;
ILmax=2;
VL=12;
Vsmin=15;
Vsmax=20;
B=100;
VBE=0.5;
Vz=12.5;
Izmin=1*10**-3;
IBmax=ILmax/B;
IR=IBmax+Izmin
Rmax=(Vsmin-Vz)/IR;
disp('ohm',Rmax*1,"Rmax=");
Izmax=(Vsmax-Vz)/Rmax;
disp('mA',Izmax*10**3,"Izmax=");
Pzmax=Vz*Izmax;
disp('W',Pzmax*1,"Pzmax=");
PRmax=(Vsmax-Vz)*Izmax;
disp('W',PRmax*1,"PRmax=");
VCEmax=Vsmax-VL;
disp('V',VCEmax*1,"VCEmax=");
PDmax=VCEmax*ILmax;
disp('W',PDmax*1,"PDmax=");
```

Scilab code Exa 34.17 `circuit and value of current`

```
clc;
VL=12;
IL=200*10**-3;
Vs=30;
Rs=10;
B1=150;
Ic1=10*10**-3;
VBE1=0.7;
B2=100;
VBE2=0.7;
Vz=6;
Rz=10;
Iz=20*10**-3;
ID=10*10**-3;
I1=10*10**-3;
RD=(VL-Vz)/ID;
disp('ohm',RD*1,"RD=");
//a=R1/R2;
a=(VL/(Vz+VBE2))-1;
Ic2=Ic1;
IB2=Ic2/B2;
V2=Vz+VBE2;
Vz=12;
R1=(Vz-V2)/I1;
disp('ohm',R1*1,"R1=");
R2=R1/a;
disp('ohm',R2*1,"R2=");
hfe1=B1;
IB1=(IL+I1+ID)/hfe1;
I=IB1+Ic2;
R3=(Vs-(VBE1+VL))/I;
disp('Kohm',R3*10**-3,"R3=");
```

Scilab code Exa 34.18 vout IL IE PI

```
clc;
Vs=25;
Vz=15;
RL=1*10**3;
VBE2=0.7;
Vout=(Vz/2)+VBE2;
disp('V',Vout*1,"Vout=");
IL=Vout/RL;
IE1=IL;
disp('mA',IE1*10**3,"IE1=");
Vce1=Vs-Vout;
P1=Vce1*IE1;
disp('mW',P1*10**3,"P1=");
```

Scilab code Exa 34.19 min and max value of voltage

```
clc;
IADJ=100*10**-6;
Vin=35;
VREF=1.25;
R2=0;
R1=220;
Voutmin=VREF*(1+(R2/R1))+IADJ*R2;
disp('V',Voutmin*1,"Voutmin=");
R2=5000;
Voutmax=VREF*(1+(R2/R1))+IADJ*R2;
disp('V',Voutmax*1,"Voutmax=");
```

Scilab code Exa 34.20 `regulated voltage`

```
clc;
R1=220;
R2=1500;
Vo=1.25*(1+(R2/R1));
disp('V',Vo*1,"Vo=");//answer given in book is wrong
```

Scilab code Exa 34.21 `regulated dc output voltage`

```
clc;
R1=240;
R2=2.4*10**3;
Vo=1.25*(1+(R2/R1));
disp('V',Vo*1,"Vo=");
```