

Scilab Textbook Companion for  
A Textbook of Electronic Circuits  
by R. S. Sedha<sup>1</sup>

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# Book Description

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

**Exa** Example (Solved example)

**Eqn** Equation (Particular equation of the above book)

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

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

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# Chapter 3

## SEMICONDUCTORS

Scilab code Exa 3.1 length of wire and current density

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

---

Scilab code Exa 3.2 charge density of free electrons current density current flowing in the wire and electron drift velocity

```
1 clc;
2 //ex3.2
3 d=2*10**-3;
```



```

4 sigma=5.8*10**7;
5 mu=0.0032;
6 E=20*10**-3;
7 q=1.6*10**-19;
8 n=sigma/(q*mu); //sigma=q*n*mu
9 disp(' /m^3 ',n*1,"n=");
10 J=sigma*E; //current density
11 disp(' A/m^2 ',J*1,"J=");
12 A=%pi*d*d/4; //area of cross-section of wire
13 disp(' m^2 ',A*1,"A=");
14 I=J*A; //current flowing in the wire
15 disp(' A ',I*1,"I=");
16 V=mu*E; //electron drift velocity
17 disp(' m/s ',V*1,"V="); //answer printed in the book is
    wrong

```

---

Scilab code Exa 3.3 mobility and relaxation time of electrons

```

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

```

---

Scilab code Exa 3.4 intrinsic conductivity

```

1  clc;
2  //ex 3.4
3  mun=0.38;
4  mup=0.18;
5  n=2.5*10**19;
6  a=0.13;
7  b=0.05;
8  n2=1.5*10**16;
9  q=1.6*10**-19;
10 sigma=q*n*(mun+mup); // intrinsic conductivity for
    germanium
11 disp('ohm-mu^-1',sigma*1,"sigma=");
12 sigma1=q*n2*(a+b); //intrinsic conductivity for
    silicon
13 disp('ohm-m^-1',sigma1*1,"sigma1");

```

---

### Scilab code Exa 3.5 intrinsic conductivity

```

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

```

---

### Scilab code Exa 3.6 concentration of free electrons and drift velocity

```

1  clc;

```

```

2 //ex3.6
3 q=1.60*10**-19;
4 l=0.2*10**-3;
5 a=0.04*10**-6;
6 v=1;
7 i=8*10**-3;
8 mun=0.13;
9 //concentration of free electrons
10 R=v/i;//resistance
11 disp('ohm',R*1,"R=");
12 rho=(R*a)/l;
13 disp('ohm-m',rho*1,"rho=");
14 sigma=1/rho;//conductivity
15 n=sigma/(q*mun);//concentration of free electrons
16 disp('/m^3',n*1,"n=")
17 //Drift velocity
18 j=i/a;
19 disp('amp/m^2',j*1,"j=");
20 v=j/(n*q);
21 disp('m/sec',v*1,"v=");

```

---

### Scilab code Exa 3.7 intrinsic carrier concentration

```

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

```

---

**Scilab code Exa 3.8** conductivity

```
1 clc;  
2 //e.g 3.8  
3 ND=10**21;  
4 NA=5*10**20;  
5 q=1.6*10**-19;  
6 mun=0.18;  
7 ND1=ND-NA;//number of free electrons  
8 disp(' /m3 ',ND1*1,"ND1=");  
9 SIGMA=ND1*q*mun;//conductivity of silicon  
10 disp(' ohm-m-1 ',SIGMA*1,"SIGMA=");
```

---

**Scilab code Exa 3.9** donor concentration

```
1 clc;  
2 //ex3.9  
3 rho=100;  
4 q=1.6*10**-19;  
5 mun=0.36;  
6 sigma=1/rho;  
7 disp(' (ohm-m)-1 ',sigma*1,"sigma=");  
8 ND= sigma/(q*mun);//donar concentration  
9 disp(' atoms/m3 ',ND*1,"ND=");
```

---

**Scilab code Exa 3.10** concentration of electrons and holes

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

```

3 ND=2*10**14;
4 NA=3*10**14;
5 ni=2.3*10**19;
6 n=(ni^2)/NA;
7 disp('electrons/cm^3',n*1,"n=");
8 p=(ni^2)/ND;
9 disp('holes/cm^3',p*1,"p=");

```

---

### Scilab code Exa 3.11 minority electron and hole density

```

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

```

---

### Scilab code Exa 3.12 length

```

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

```

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

---

**Scilab code Exa 3.13** concentration of holes and electrons

```
1 clc;
2 //ex3.13
3 sigma=100;
4 rho=0.1;
5 ni=1.5*10**10;
6 mun=1300;
7 mup=500;
8 ni1=2.5*10**13;
9 mun1=3800;
10 mup1=1800;
11 q=1.602*10**-19;
12 //concentration of p type germanium
13 p=sigma/(q*mup1);
14 disp('/cm^3',p*1,"p=");
15 n=(ni1^2)/p;
16 disp('/cm^3',n*1,"n=");
17 //concentration of n type silicon
18 n=rho/(mun*q);
19 disp('/cm^3',n*1,"n=");
20 p=(ni^2)/n;
21 disp('/cm^3',p*1,"p=");
```

---

**Scilab code Exa 3.14** resistivity of germanium sample

```
1 clc;
2 mun=3800;
3 mup=1800;
4 ni=2.5*10**13;
```

```

5 Nge=4.41*10**22;
6 q=1.602*10**-19;
7 ND=Nge/10**8;
8 disp( '/cm^3 ',ND*1,"ND=");
9 p=(ni^2)/ND;
10 disp( '/cm^3 ',p*1,"p=");
11 n=ND;
12 sigma=q*n*mun;
13 disp( '(ohm-cm)^-1 ',sigma*1,"sigma=");
14 rho=1/sigma;
15 disp( 'ohm-cm ',rho*1,"rho=");

```

---

### Scilab code Exa 3.15 resistivity of intrinsic silicon

```

1 clc;
2 //ex3.15
3 Nsi=4.96*10**22;
4 ni=1.52*10**10;
5 q=1.6*10**-19;
6 mun=1350;
7 mup=480;
8 //resistivity of intrinsic silicon
9 sigma=q*ni*(mun+mup)
10 disp( '(ohm-cm)^-1 ',sigma*1,"sigma=");
11 rho=1/sigma;
12 disp( 'ohm-cm ',rho*1,"rho=");
13 //resistivity of doped silicon
14 ND=Nsi/(50*10^6);
15 disp( '/cm^3 ',ND*1,"ND=");
16 n=ND;
17 p=(ni**2)/n;
18 disp( '/cm**3 ',p*1,"p=");
19 sigma=q*n*mun;
20 disp( '(ohm-cm)^-1 ',sigma*1,"sigma=");
21 rho=1/sigma;

```

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

---

### Scilab code Exa 3.16 conductivity of silicon

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

---

### Scilab code Exa 3.17 diffusion coefficients of holes and electrons

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



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

---

#### Scilab code Exa 3.18 electron mobility

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

---

#### Scilab code Exa 3.19 conduction electrons

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

---

#### Scilab code Exa 3.20 number of electrons

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

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

---

**Scilab code Exa 3.21** mobility and density of charge carrier

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

---

**Scilab code Exa 3.22** resistivity

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

---

# Chapter 5

## PN JUNCTION DIODE

Scilab code Exa 5.1 Current

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

---

Scilab code Exa 5.2 find current

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

---

**Scilab code Exa 5.3** value of n

```
1 clc ;
2 I1=0.5*10**-3;
3 V1=340*10**-3;
4 I2=15*10**-3;
5 V2=440*10**-3;
6 kTbyq=25*10**-3;
7 a=V1/kTbyq;
8 b=V2/kTbyq;
9 //log(I1/I2)==log(exp((b-a)/n));
10 n=(a-b)/(log(I1/I2));
11 disp(n);
```

---

**Scilab code Exa 5.4** saturation current

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

---

**Scilab code Exa 5.5** value of VF for the device

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

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

---

#### Scilab code Exa 5.8 dc current and PDmax

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

---

#### Scilab code Exa 5.9 voltage drop and current

```
1 clc;  
2 R=330;  
3 VS=5;  
4 VD=VS;  
5 disp('V',VD*1,"VD=VS=");  
6 VR=0;  
7 disp(VR,"VR=");  
8 I=0;  
9 disp(I,"I=");
```

---

#### Scilab code Exa 5.10 VD VR I

```
1 clc;  
2 VS=12;  
3 R=470;
```

```
4 VD=0;
5 disp(VD);
6 VR=VS;
7 disp('V',VR*1,"VR=");
8 I=(VS/R);
9 disp('mA',I*10**3,"I=");
```

---

#### Scilab code Exa 5.11 current

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

---

#### Scilab code Exa 5.12 voltage across resistor and current

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

---

#### Scilab code Exa 5.13 total current

```
1 clc;
2 VS=6;
3 VD1=0.7;
4 VD2=0.7;
5 VR=1.5*10**3;
6 I=(VS-VD1-VD2)/VR;
7 disp('mA', I*10**3, ' I=');
```

---

#### Scilab code Exa 5.14 total current

```
1 clc;
2 VS=12;
3 R1=1.5*10**3;
4 R2=1.8*10**3;
5 VD1=0.7;
6 VD2=0.7;
7 I=(VS-VD1-VD2)/(R1+R2);
8 disp('mA', I*10**3, ' I=');
```

---

#### Scilab code Exa 5.15 output voltage

```
1 clc;
2 V1=0;
3 V2=0;
4 V0=0;
5 disp('V', V0*1, 'VO=');
6 V1=0;
7 V2=5;
8 V0=V2-0.7;
9 disp('V', V0*1, 'VO=');
10 V1=5;
11 V2=0;
12 V0=V1-0.7;
```

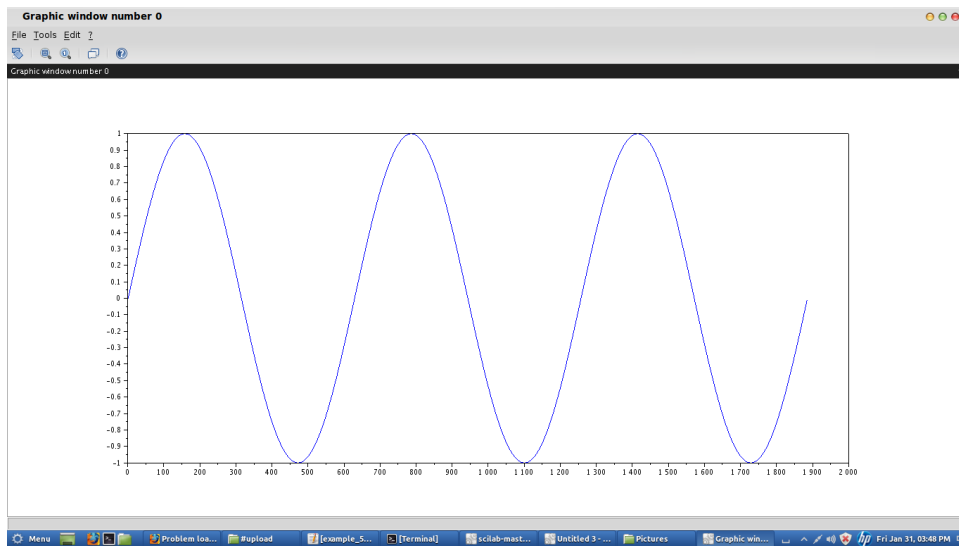


Figure 5.1: waveform of voltage

```

13 disp( 'V' ,V0*1 , "VO=" );
14 V1=5;
15 V2=5;
16 V0=V2-0.7;
17 disp( 'V' ,V0*1 , "VO=" );

```

---

**Scilab code Exa 5.16** waveform of voltage

```

1 clc;
2 R=20*10**3;
3 I=(R-0.7)/R;
4 disp( 'mA' , I*1 , "I=" );
5 rj=50;
6 rB=1;
7 re=rB+rj;
8 R1=(R*re)/(re+R);

```



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

---

## Chapter 7

# SPECIAL PURPOSE DIODES AND OPTO ELECTRONIC DEVICES

Scilab code Exa 7.1 value of  $I_{zm}$

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

---

Scilab code Exa 7.2 maximum power dissipation

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

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

---

**Scilab code Exa 7.3** resistance of device

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

---

**Scilab code Exa 7.4** terminal voltage

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

---

**Scilab code Exa 7.5** tuning range

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

```

5 L=10*10**-3;
6 CT=(C1*C2)/(C1+C2); //CTmax
7 disp('F',CT*1,"CT=");
8 fo=1/(2*%pi*sqrt(L*CT));
9 disp('MHZ',fo*10**-6,"fo=");
10 C1=50*10**-12; //max
11 C2=50*10**-12; //max
12 CT=(C1*C2)/(C1+C2); //CTmin
13 disp('F',CT*1,"CT=");
14 fo=1/(2*%pi*sqrt(L*CT));
15 disp('kHz',fo*10**-3,"fo=");

```

---

**Scilab code Exa 7.6** frequency of 5th harmonic

```

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

```

---

**Scilab code Exa 7.7** resistor

```

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

```

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

---

**Scilab code Exa 7.8** minimum and maximum value of current

```
1 clc;
2 //e.g 7.8
3 VDmin=1.5;
4 VDmax=2.3;
5 Vs=10;
6 R1=470;
7 Imax=(Vs-VDmin)/R1;
8 disp('mA',Imax*10**3,"Imax=");
9 Imin=(Vs-VDmax)/R1;
10 disp('mA',Imin*10**3,"Imin=")
```

---

**Scilab code Exa 7.9** Imin and Imax

```
1 clc;
2
3 //e.g 7.9
4 VDmin=1.8;
5 VDmax=3;
6 Vs1=24;
7 Rs1=820;
8 Vs2=5;
9 Rs2=120;
10 Imin=(Vs2-VDmax)/Rs2;
11 disp('mA',Imin*10**3,"Imin=");
12 Imax=(Vs1-VDmin)/Rs1;
13 disp('mA',Imax*10**3,"Imax=");
14 Imin=(Vs2-VDmax)/Rs2;
15 disp('mA',Imin*10**3,"Imin=");
16 Imax=(Vs2-VDmin)/Rs2;
```

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

---

Scilab code Exa 7.10 resistance and current

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

---

# Chapter 8

## BIPOLAR JUNCTION TRANSISTORS

Scilab code Exa 8.1 base current

```
1 clc;  
2 //e.g 8.1  
3 Ie=10*10**-3;  
4 Ic=9.8*10**-3;  
5 //Ie=Ib+Ic  
6 Ib=Ie-Ic;  
7 disp('mA', Ib*10**3, 'Ib=');
```

---

Scilab code Exa 8.2 current gain

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

---

### Scilab code Exa 8.3 base current

```
1 clc;
2 //e.g8.3
3 a=0.967;
4 Ie=10*10**-3;
5 Ic=Ie*a; //a=Ic/Ie
6 disp('mA',Ic*10**3,"Ic=");
7 Ib=Ie-Ic;
8 disp('mA',Ib*10**3,"Ib=");
```

---

### Scilab code Exa 8.4 IC and IB

```
1 clc;
2 //e.g 8.4
3 Ie=10*10**-3;
4 alpha=0.987;
5 Ic=Ie*alpha; //alpha=Ic/Ie
6 disp('mA',Ic*10**3,"Ic=");
7 Ib=Ie-Ic;
8 disp('mA',Ib*10**3,"Ib=");
```

---

### Scilab code Exa 8.5 alpha and beta

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



```
6 disp(beta);
7 alpha=(beta/(1+beta));
8 disp(alpha);
```

---

#### Scilab code Exa 8.6 emitter current

```
1 clc;
2 //e.g 8.6
3 BETA=100;
4 IC=40*10**-3;
5 IB=IC/BETA;
6 IE=IC+IB;
7 disp('mA', IE*10**3, 'IE=');
```

---

#### Scilab code Exa 8.7 current

```
1 clc;
2 //e.g 8.7
3 beta=150;
4 Ie=10*10**-3;
5 alpha=beta/(1+beta)
6 Ic=alpha*Ie; //as alpha=(Ic/Ie)
7 disp('mA', Ic*10**3, 'Ic=');
8 Ib=Ie-Ic; //as Ie=Ib+Ic
9 disp('mA', Ib*10**3, 'Ib=');
```

---

#### Scilab code Exa 8.8 IB and IE

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

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

---

#### Scilab code Exa 8.9 IC and IE

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

---

#### Scilab code Exa 8.10 IC and IB

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

---

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

```

1  clc;
2  IB=105*10**-6;
3  IC=2.05*10**-3;
4  BETA=IC/IB;
5  disp(BETA);
6  ALPHA=BETA/(1+BETA);
7  disp(ALPHA);
8  IE=IC+IB;
9  disp('mA', IE*10**3, "IE=");
10 DELTA_IB=27*10**-6;
11 DELTA_IC=0.65*10**-3;
12 IBn=IB+DELTA_IB;
13 ICn=IC+DELTA_IC;
14 BETAn=ICn/IBn;
15 disp(BETAn);

```

---

**Scilab code Exa 8.12** collector and emitter current

```

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

```

---

**Scilab code Exa 8.13** collector current

```

1  clc;
2  //e.g 8.13
3  Icbo=10*10**-6;

```

```
4 beta=50;
5 //Value of collector current when Ib=0.25*10**-3;
6 Ib=0.25*10**-3;
7 Ic=(beta*Ib)+(1+beta)*Icbo;
8 disp('mA',Ic*10**3,"Ic=");
9 //Value of new collector current if temperature
   rises to 50 degree
10 t1=27;
11 t2=50;
12 Icbo50=Icbo*2^((t2-t1)/10);
13 disp('microA',Icbo50*10**6,"Icbo50=");
14 //collector current at 50 degree
15 Ic=beta*Ib+(1+beta)*Icbo50;
16 disp('mA',Ic*10**3,"Ic=");
```

---

# Chapter 9

## BJT CHARACTERISTICS

Scilab code Exa 9.1 PDmax

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

---

# Chapter 10

## BJT LOW AND HIGH FREQUENCY MODELS

Scilab code Exa 10.1 hybrid pi parameters

```
1  clc;
2  //e.g 10.1
3  Ic=10;
4  Vce=10;
5  hie=500;
6  hoe=10**-5;
7  hfe=100;
8  hre=10**-4;
9  gm=Ic/25;
10 disp('ohm',gm*1,"gm=");
11 rbe=hfe/gm;
12 disp('ohm',rbe*1,"rbe=");
13 rbb=hie-rbe;
14 disp(rbb);
15 gbc=hre/rbe;
16 disp('*10^-7',gbc*10**7,"gbc=");
17 rce=-1/((hoe-(1+hfe)*gbc));
18 disp('kohm',rce*10**-3,"rce=");
```

---

# Chapter 11

## BJT LOW AND HIGH FREQUENCY MODELS

Scilab code Exa 11.1 drain current

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

---

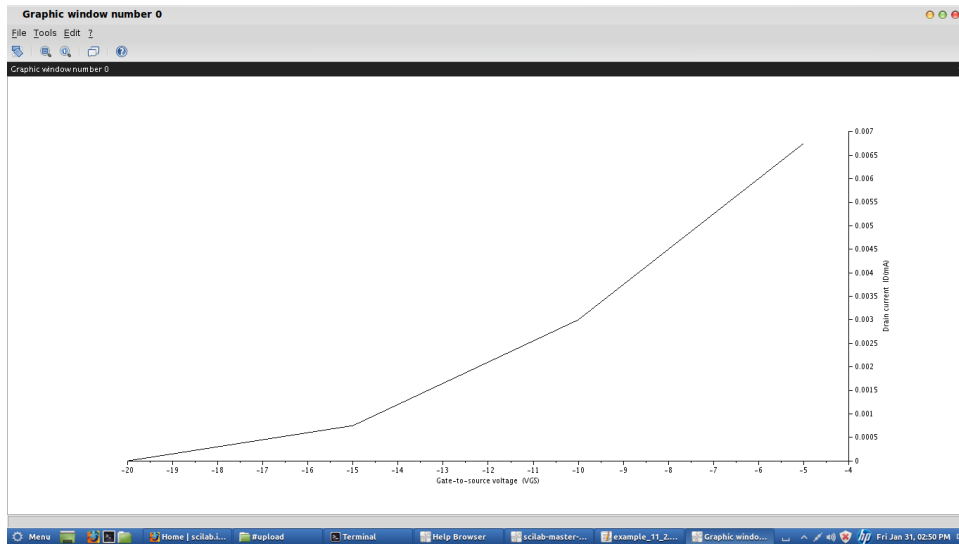


Figure 11.1: transconductance curve

### Scilab code Exa 11.2 transconductance curve

```

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

```

---

### Scilab code Exa 11.4 DRAIN CURRENT AND TRANSCONDUCTANCE



```

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

```

---

#### Scilab code Exa 11.5 value og ID

```

1  clc;
2  //e.g 11.5
3  Idon=10*10**-3;
4  vgs=-12;
5  vgsth=-3;
6  //Id=K*(vgs-vgsth)^2
7  //Idon=K*(vgs-vgsth)^2
8  k=Idon/((vgs-vgsth)^2);
9  disp('mA', k*10**3, "k=");
10 vgs1=-6;
11 Idon=k*(vgs1-vgsth)^2;
12 disp('mA', Idon*10**3, "Idon=");

```

---

# Chapter 12

## THYRISTORS

Scilab code Exa 12.1 destroy the device or not

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

---

Scilab code Exa 12.2 max allowable duration

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

---

### Scilab code Exa 12.3 voltage

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

---

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

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

---

### Scilab code Exa 12.5 rB1 and rB2

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

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

---

# Chapter 13

## PASSIVE CIRCUITS DEVICES

Scilab code Exa 13.4 tolerance

```
1  clc;
2  R1min=2.7;
3  R2min=5.1;
4  Rmin=R1min+R2min;
5  R1max=3.3;
6  R2max=6.9;
7  Rmax=R1max+R2max;
8  a=9-Rmin;
9  b=Rmax-9;
10 tolerance=b/9;
11 Reqmin=(R1min*R2min)/(R1min+R2min);
12 disp('ohm',Reqmin*1,"Reqmin=");
13 Reqmax=(R1max*R2max)/(R1max+R2max);
14 disp('ohm',Reqmax*1,"Reqmax=");
15 R1N=3;
16 R2N=6;
17 Req=(R1N*R2N)/(R1N+R2N);
18 disp('ohm',Req*1,"Req=");
19 minval=Reqmin;
```

```
20 maxval=Reqmax;
21 maxchng=0.235;
22 t=(maxchng/2)*100;
23 disp('%',t*1,'t=');
```

---

### Scilab code Exa 13.5 coil inductance

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

---

### Scilab code Exa 13.6 coefficient of Coupling

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

---

### Scilab code Exa 13.7 Q factor of coil

```
1 clc;
```

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

---

#### Scilab code Exa 13.8 capacitance

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

---

#### Scilab code Exa 13.9 thickness of dielectric

```
1 clc;
2 //e.g 13.9
3 A=0.2;
4 C=0.428*10**-6;
5 e0=8.85*10**-12;
6 er=1200;
7 d=(e0*er*A)/C; //ans printed in the book is wrong
8 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

```
1  clc;
2  //e.g 16.1
3  V1=230;
4  //a=(N2/N1)
5  b=(1/10);
6  V2=V1*b;
7  disp('V',V2*1,"V2=");
8  Vm=sqrt(2)*V2;
9  disp('V',Vm*1,"Vm=");
10 Vdc=0.318*Vm;
11 disp('V',Vdc*1,"Vdc=");
12 PIV=Vm;
13 disp('V',PIV*1,"PIV=");
```

---



### Scilab code Exa 16.2 dc load current

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

---

### Scilab code Exa 16.3 maximum and average power

```
1 clc;
2 //e.g 16.3
3 V1=230;
4 //a=(N2/N1)
5 b=(1/2);
6 RL=200;
7 V2=V1*b;
8 disp('V',V2*1,"V2=");
9 Vm=sqrt(2)*V2;
10 disp('V',Vm*1,"Vm=");
11 Im=Vm/RL;
12 disp('A',Im*1,"Im=");
13 Pm=(Im**2)*RL;
14 disp('W',Pm*1,"Pm=");
15 Vdc=0.318*Vm;
16 disp('V',Vdc*1,"Vdc=");
17 Idc=(Vdc/RL);
18 disp('A',Idc*1,"Idc=");
19 Pdc=(Idc**2)*RL;
20 disp('W',Pdc*1,"Pdc=");
```

---

**Scilab code Exa 16.4** maximum ac voltage

```
1  clc;
2  //e.g 16.4
3  Vdc=30;
4  RL=600;
5  Rf=25;
6  Idc=(Vdc/RL);
7  disp('A', Idc*1, " Idc=");
8  Im=%pi*Idc;
9  disp('A', Im*1, " Im=");
10 Vin=Im*(Rf+RL);
11 disp('V', Vin*1, " Vin=");
```

---

**Scilab code Exa 16.5** dc output voltage

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

---

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

```

1  clc;
2  V1=230;
3  fin=50;
4  //let a=N1/N2
5  a=1/4;
6  V2=V1*a;
7  Vm=sqrt(2)*V2;
8  Vdc=0.636*Vm;
9  disp('V',Vdc*1,"Vdc=");
10 PIV=Vm;
11 disp('V',PIV*1,"PIV=");
12 fout=2*fin;
13 disp('HZ',fout*1,"fout=");

```

---

**Scilab code Exa 16.7** dc output voltage PIV and rectification efficiency

```

1  clc;
2  V1=230;
3  //LET a=N2/N1
4  a=1/5;
5  RL=100;
6  V2=V1*a;
7  Vs=V2/2;
8  Vm=sqrt(2)*Vs;
9  Vdc=2*Vm/%pi;
10 disp('V',Vdc*1,"Vdc=");
11 PIV=2*Vm;
12 disp('V',PIV*1,"PIV=");
13 n=0.812//rectifier efficiency of full wave rectifier

```

---

**Scilab code Exa 16.8** load resistor dc load voltage and PIV

```

1  clc;

```

```

2 Vs=200;
3 Imax=700*10**-3;
4 Iavg=250*10**-3;
5 Imax=0.8*Imax;
6 disp('mA', Imax*10**3, "Imax=");
7 Vm=sqrt(2)*Vs;
8 RL=Vm/Imax;
9 disp('ohm', RL*1, "RL=");
10 Vdc=2*Vm/%pi;
11 disp('V', Vdc*1, "Vdc=");
12 Idc=Vdc/RL;
13 disp('A', Idc*1, "Idc=");
14 PIV=2*Vm;
15 disp(PIV);

```

---

#### Scilab code Exa 16.9 inductance

```

1 clc;
2 f=50;
3 y=0.05;
4 RL=100;
5 L=RL/(y*3*sqrt(2)*2*%pi*f);
6 disp('H', L*1, "L=");
7 f=400;
8 y=0.05;
9 L=RL/(y*3*sqrt(2)*2*%pi*f);
10 disp('H', L*1, "L=");

```

---

#### Scilab code Exa 16.10 capacitance

```

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

```

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

---

**Scilab code Exa 16.11** size of capacitor

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

---

**Scilab code Exa 16.12** ripple factor

```
1 clc;
2 Idc=0.2;
3 Vdc=30;
4 C1=100;
5 C2=100;
6 L=5;
7 f=50;
8 RL=Vdc/Idc;
9 y=5700/(L*C1*C2*RL);
10 disp('%',y*100,"y=");
```

---

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

```
1 clc;  
2 Vs=150;  
3 Idc=2;  
4 Vdc=2.34*Vs;  
5 disp('V',Vdc*1,"Vdc=");  
6 I=Idc/0.955;  
7 disp('A',I*1,"I=");  
8 Iavg=2/3;  
9 disp('A',Iavg*1,"Iavg=");  
10 Pdc=Vdc*Idc;  
11 disp('W',Pdc*1,"Pdc=");
```

---

# Chapter 17

## CONTROLLED RECTIFIERS

Scilab code Exa 17.1 angular firing required

```
1  clc;
2  //e.g 17.1
3  RL=100;
4  Vm=300;
5  //load power P= Vdc*Idc
6  a=(Vm/(2*pi))^2*(1/RL);
7  disp(a);
8  p=25;
9  //1+cosb=sqrt(25/a)
10 b=a*1+sqrt(p/a);
11 cosalpha=(sqrt(p/a))-1;
12 disp(cosalpha);
13 p=80;
14 cosalpha=(sqrt(p/a))-1;
15 disp(cosalpha," cosalpha=");
16 //or;
17 alpha=acosd(cosalpha);
18 disp(' degree ',alpha," alpha=");
```

---

### Scilab code Exa 17.2 power

```
1  clc;
2  //e.g 17.2
3  vm=200;
4  Rl=1*10**3;
5  //ALPHA=0degree
6  Vdc=vm*0.318;
7  Idc=Vdc/Rl;
8  P=Vdc*Idc;
9  disp('mW',P*10**3,'P=');"OR";disp('W',P*1,'P=');
10 //alpha=45 degree
11 Vdc=vm*0.27;
12 Idc=Vdc/Rl;
13 P=Vdc*Idc;
14 disp('mW',P*10**3,'P=');"OR";disp('W',P*1,'P=');
15 //alpha=90 degree
16 Vdc=vm*0.159;
17 Idc=Vdc/Rl;
18 P=Vdc*Idc;
19 disp('mW',P*10**3,'P=');"OR";disp('W',P*1,'P=');
20 //alpha=135 degree
21 Vdc=vm*0.04660;
22 Idc=Vdc/Rl;
23 P=Vdc*Idc;
24 disp('mW',P*10**3,'P=');"OR";
```

---

### Scilab code Exa 17.3 voltage

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



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

---

#### Scilab code Exa 17.4 resistance

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

---

#### Scilab code Exa 17.5 chopper duty cycle and chopping frequency

```
1 clc;
2 //e.g 17.5
3 Ton=30*10**-6;
4 Toff=10*10**-6;
5 //consider duty cycle=a
6 a=Ton/(Ton+Toff);
7 disp(a);
8 f=(1/(Ton+Toff))
9 disp('kHz',f*10**-3,"f=");
```

---

#### Scilab code Exa 17.6 dc output voltage

```
1 clc;  
2 //e.g 17.6  
3 Ton=30*10**-3;  
4 Toff=10*10**-3;  
5 Vdc=200;  
6 a=Ton/(Ton+Toff);  
7 disp(a);  
8 V1=Vdc*a;  
9 disp('V',V1*1,"V1=");
```

---

# Chapter 18

## BJT BIASING AND STABILISATION

Scilab code Exa 18.1 sturation current and cutoff voltage

```
1
2 clc;
3 //e.g 18.1
4 Vbb=10;
5 Rb=47*10**3;
6 Vcc=20;
7 Rc=10*10**3;
8 B=100;
9 Ic=Vcc/Rc;//saturation current
10 disp('mA',Ic*10**3,"Ic=");
11 Vce=Vcc;//cut-off voltage
12 disp('V',Vce*1,"Vce=");
13 i=2:-0.1:0;
14 plot2d(i);
15 a=gca() //get the current axes
16 a.box="off";
17 xlabel("VCE");
```

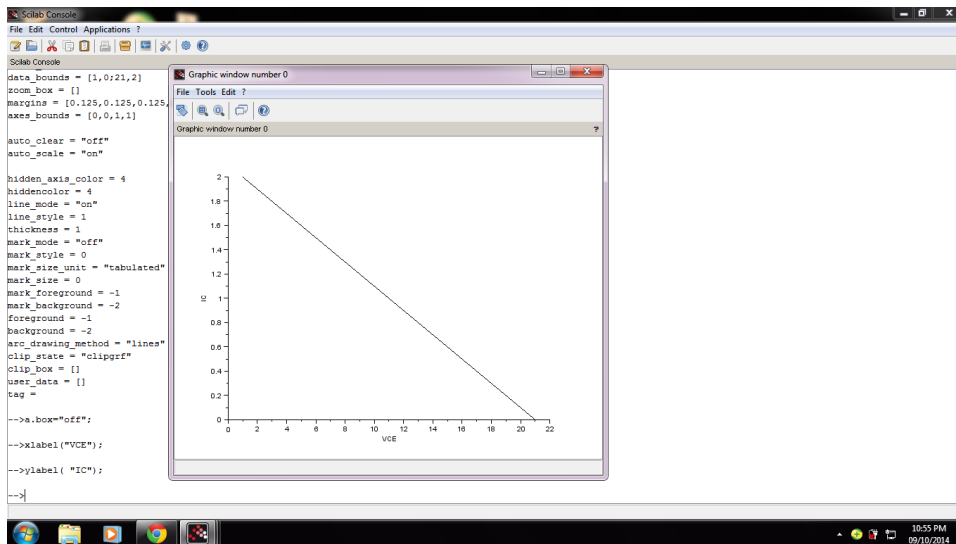


Figure 18.1: sturation current and cutoff voltage

18 ylabel( "IC");

---

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

```

1
2 clc;
3 //e.g 18.2
4 Vbb=10;
5 Rb=50*10**3;
6 Vcc=20;
7 Rc=300;
8 beta=200;
9 Ic=Vcc/Rc; //saturation current

```

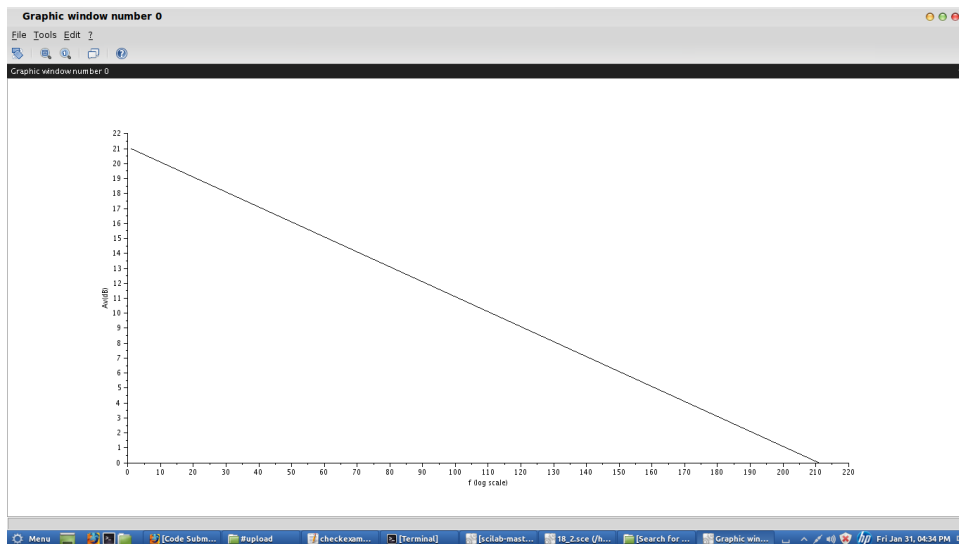


Figure 18.2: upper and lower ends of load line

```

10 disp('mA', Ic*10**3, " Ic=");
11 Vce=Vcc; //cut-off voltage
12 disp('V', Vce*1, " Vce=");
13 Ib=(Vbb-0.7)/Rb;
14 disp('10-3A', Ib*10**3, " Ib=");
15 Ic=beta*Ib;
16 disp('10-3A', Ic*10**3, " Ic=");
17 Vce=Vcc-Ic*Rc;
18 disp('V', Vce*1, " Vce=");
19 i=21:-0.1:0;
20 plot2d(i);
21 a=gca() //get the current axes
22 a.box="off";
23 xlabel("VCE");
24 ylabel("IC");

```

---

Scilab code Exa 18.3 base and collector current and VCE

```

1
2 clc;
3 //e.g 18.3
4 Rb=180*10**3;
5 Vcc=25;
6 Rc=820;
7 beta=80;
8 Ib=Vcc/Rb;//saturation current
9 disp( 'mA',Ib*10**3," Ib=");
10 Ic=beta*Ib;
11 disp( 'mA',Ic*10**3," Ic=");
12 Vce=Vcc-(Ic*Rc);//cut-off voltage
13 disp( 'V',Vce*1," Vce=");

```

---

#### Scilab code Exa 18.4 RB and VCE

```

1
2 clc;
3 //e.g 18.4;
4 Vcc=12;
5 Rc=330;
6 Ib=0.3*10**-3;
7 beta=100;
8 //Ib=Vcc/Rb;//saturation current
9 Rb=Vcc/Ib;
10 disp( 'Kohm',Rb*10**-3," Rb=");
11 S=1+beta;
12 disp(S);
13 Ic=beta*Ib;
14 disp( '10^-3A',Ic*10**3," Ic=");
15 Vce=Vcc-(Ic*Rc);//cut-off voltage
16 disp( 'V',Vce*1," Vce=");

```

---

### Scilab code Exa 18.5 voltage and current

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

---

### Scilab code Exa 18.6 find Ic and Vce

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

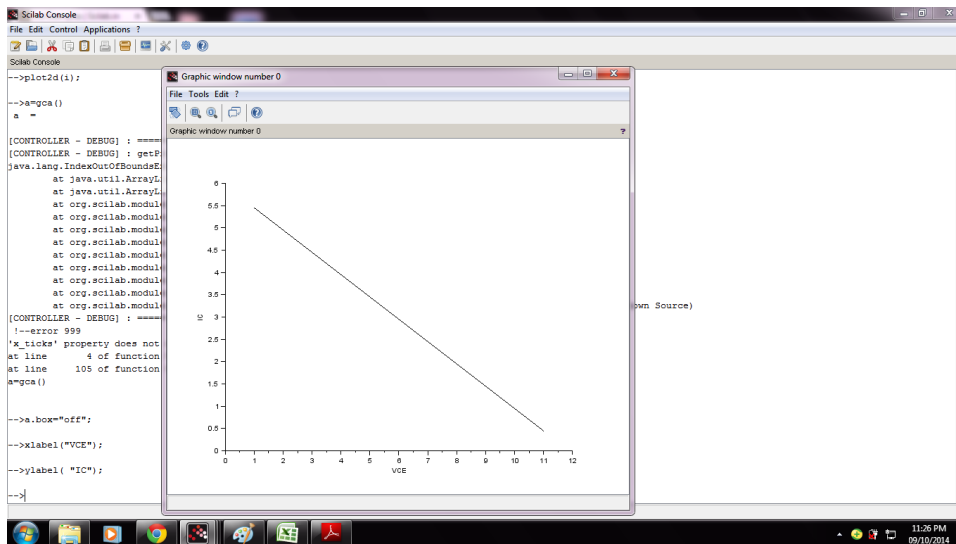


Figure 18.3: find  $I_c$  and  $V_{ce}$

```

15 Vce=Vcc; //cutoff voltage
16 i=5.45:-0.5:0;
17 plot(i);
18 a=gca() //get the current axes
19 a.box=" off ";
20 xlabel("VCE");
21 ylabel(" IC");

```

---

Scilab code Exa 18.7 load line

```

1 clc;
2 //e.g 18.7
3 Vcc=30;

```



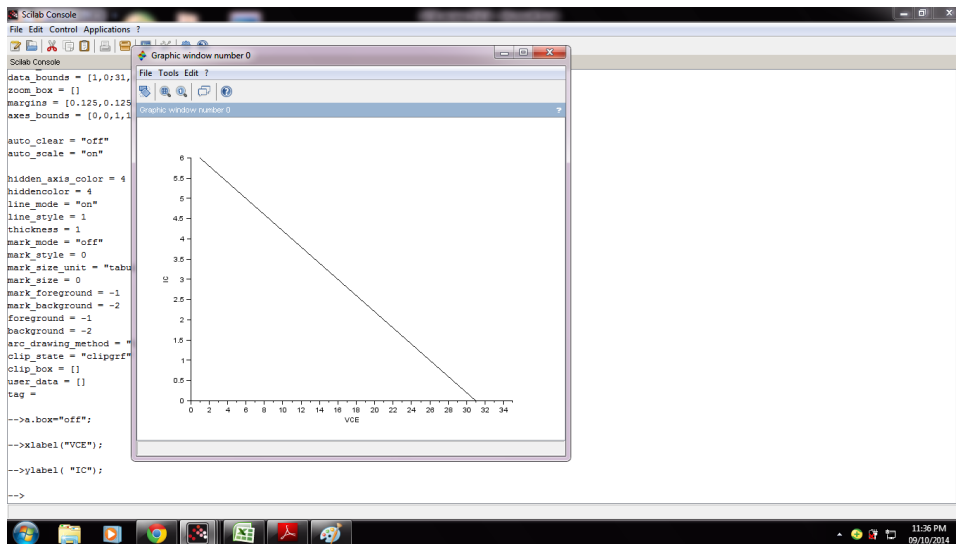


Figure 18.4: load line

```

4 Rb=1.5*10**6;
5 Rc=5*10**3;
6 beta=100;
7 Ic=Vcc/Rc; //saturation current
8 disp('mA',Ic*10**3,"Ic=");
9 Vce=Vcc; //cut-off voltage
10 disp('V',Vce*1,"Vce=");
11 Ib=Vcc/Rb; //base current
12 disp('microA',Ib*10**6,"Ib=");
13 Ic=beta*Ib;
14     disp('mA',Ic*10**3,"Ic=");
15     Vce=Vcc-Ic*Rc;
16     disp('V',Vce*1,"Vce=");
17 i=6:-0.2:0;
18 plot2d(i);
19 a=gca() //get the current axes
20 a.box="off";

```

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

---

### Scilab code Exa 18.9 current voltage and stability factor

```
1
2
3 clc;
4 //e.g 18.9
5 Rb=180*10**3;
6 Vcc=25;
7 Rc=820;
8 Re=200;
9 beta=80;
10 Vbe=0.7;
11 Ic=(Vcc-Vbe)/(Re+(Rb/beta)); //collector current
12 disp('mA',Ic*10**3,"Ic=");
13 Vce=Vcc-(Ic*Rc); //collector to emitter voltage
14 disp('V',Vce*1,"Vce=");
15 S=(1+beta)/(1+beta*(Re/(Re+Rb)));
16 disp(S,"S="); //stability factor
```

---

### Scilab code Exa 18.10 Q point

```
1
2 clc;
3 //e.g 18.10
4 Vbe=0.7;
5 Rb=100*10**3;
6 Vcc=10;
7 Rc=10*10**3;
8 beta=100;
9 Ic=(Vcc-Vbe)/(Rc+(Rb/beta)); //collector current
```

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

---

### Scilab code Exa 18.11 IB IC AND IE

```
1
2
3 clc;
4 //e.g 18.11
5 Rb=100*10**3;
6 Vcc=10;
7 Rc=2*10**3;
8 beta1=50;
9 Vbe=0.7;
10 Ib=(Vcc-Vbe)/(Rb+(beta1*Rc));
11 disp('mA', Ib*10**3, " Ib=");
12 Ic=beta1*Ib;
13 disp('mA', Ic*10**3, " Ic=");
14 Ie=Ic;
15 disp('mA', Ie*10**3, " Ie=");
```

---

### Scilab code Exa 18.12 possible causes

```
1
2 clc;
3 //e.g 18.12
4 VCC=9;
5 RB=220*10**3;
```

```

6 RC=3.3*10**3;
7 VBE=0.3;
8 B=100;
9 // if vc=0
10 IB=(VCC-VBE)/(RB+(B*RC));
11 disp('microA',IB*10**6,"IB=");
12 IC=B*IB;
13 disp('microA',IC*10**6,"IC="); //CORRECTION IN BOOK
14 // if VC=9
15 VC=9;
16 IC=B*IB;
17 disp('mA',IC*10**3,"IC=");
18 //IC*RC=0,which means collector resistance is short
   circuited

```

---

#### Scilab code Exa 18.13 find R1

```

1
2 clc;
3 //e.g 18.13
4 Vcc=12;
5 Rc=3.3*10**3;
6 Re=100;
7 Ie=2*10**-3;
8 Vbe=0.7;
9 alpha=0.98;
10 Ic=alpha*Ie;
11 disp('mA',Ic*10**3,"Ic=");
12 Vb=Vbe+(Ie*Re);
13 disp('V',Vb*1,"Vb=");
14 Vc=Vcc-(Ic*Rc); //collector to emitter voltage
15 disp('V',Vc*1,"Vc=");
16 R2=20*10**3;
17 IR2=Vc/R2;
18 disp('mA',IR2*10**3,"IR2=");

```

```

19 Ib=Ie-Ic;
20 disp('mA', Ib*10**3, "Ib=");
21 IR1=IR2+Ib;
22 disp('mA', IR1*10**3, "IR1=");
23 R1=(Vc-Vb)/IR1;
24 disp('kohm', R1*10**-3, "R1=");

```

---

#### Scilab code Exa 18.14 base resistance

```

1 clc;
2 VCC=24;
3 RC=10*10**3;
4 RE=270;
5 VBE=0.7;
6 B=45;
7 VCE=5;
8 IC=(VCC-VCE)/RC;
9 disp('mA', IC*10**3, "IC=");
10 RB=(2.6*10^3)*B;
11 disp('kohm', RB*10**-3, "RB=")

```

---

#### Scilab code Exa 18.15 dc bias current and voltage

```

1
2 clc;
3 //e.g 18.15
4 Rb=33*10**3;
5 Vcc=3;
6 Rc=1.8*10**3;
7 beta=90;
8 Vbe=0.7;
9 Ib=(Vcc-Vbe)/(Rb+(Rc*beta)); //collector current
10 disp('mA', Ib*10**3, "Ib=");

```

```

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

```

---

#### Scilab code Exa 18.16 current and voltage

```

1
2 clc;
3 //e.g 18.16
4 Vbe=0.7;
5 Vcc=10;
6 Rc=1*10**3;
7 beta=100;
8 R1=10*10**3;
9 R2=5*10**3;
10 Re=500;
11 Vb=Vcc*(R2/(R1+R2));
12 disp('V',Vb*1,"Vb=");
13 Ve=Vb-Vbe;
14 disp('V',Ve*1,"Ve=");
15 Ie=Ve/Re;
16 disp('mA',Ie*10**3,"Ie=");
17 Ic=Ie;
18 disp('mA',Ic*10**3,"Ic=");
19 Vce=Vcc-(Rc+Re);
20 disp('V',Ve*1,"Ve=");

```

---

#### Scilab code Exa 18.17 OPERATING POINT

```

1
2 clc;

```

```

3 //e.g 18.17
4 Vcc=9;
5 Rc=1*10**3;
6 Re=680;
7 beta=100;
8 R1=33*10**3;
9 R2=15*10**3;
10 Vb=Vcc*(R2/(R1+R2));
11 disp('V',Vb*1,"Vb=");
12 Vbe=0.7;
13 Ve=Vb-Vbe;
14 disp('V',Ve*1,"Ve=");
15 Ie=Ve/Re;
16 disp('mA',Ie*10**3,"Ie=");
17 Ic=Ie;
18 disp('mA',Ic*10**3,"Ic=");
19 VRc=Ic*Rc;
20 disp('V',VRc*1,"VRc=");
21 Vc=Vcc-VRc;
22 disp('V',Vc*1,"Vc=");
23 Vce=Vc-Ve;
24 disp('V',Vce*1,"Vce=");

```

---

### Scilab code Exa 18.18 R1 and RC

```

1
2 clc;
3 VCC=5;
4 RE=0.3*10**3;
5 IC=1*10**-3;
6 VCE=2.5;
7 B=100;
8 VBE=0.7;
9 ICO=0;
10 R2=10*10**3;

```

```

11 IE=IC;
12 RC=((VCC-VCE)/IC)-RE;
13 disp('ohm',RC*1,"RC=");
14 VE=IE*RE;
15 VB=VE+VBE;
16 R1=VCC*R2-R2;
17 disp('Kohm',R1*10**-3,"R1=");

```

---

### Scilab code Exa 18.19 IE and VCE

```

1
2 clc;
3 Vcc=20;
4 RC=1*10**3;
5 RE=5*10**3;
6 R1=10*10**3;
7 R2=10*10**3;
8 B=462;
9 VBE=0.7;
10 VB=Vcc*R2/(R1+R2);
11 disp('V',VB*1,"VB=");
12 VE=VB-VBE;
13 IE=VE/RE;
14 disp('mA',IE*10**3,"IE=");
15 IC=IE;
16 VCE=Vcc-IC*RC;
17 disp('V',VCE*1,"VCE=");

```

---

### Scilab code Exa 18.20 base current

```

1
2 clc;
3 VCC=8;

```



```

4 VRC=0.5;
5 RC=800;
6 a=0.96;
7 VCE=VCC-VRC; //VRC=IC*RC
8 IC=VRC/RC;
9 disp('mA', IC*10**3, "IC=");
10 IE=IC/a;
11 disp('mA', IE*10**3, "IE=");
12 IB=IE-IC;
13 disp('microA', IB*10**6, "IB=");

```

---

**Scilab code Exa 18.21** change in collector current

```

1
2 clc;
3 VCC=12;
4 RC=1*10**3;
5 RE=100;
6 R1=25*10**3;
7 R2=5*10**3;
8 B=50;
9 VBE=0.6;
10 VTH=VCC*R2/(R1+R2);
11 RTH=R1*R2/(R1+R2);
12 IE50=(VTH-VBE)/(RE+RTH/B);
13 B=150;
14 IE150=(VTH-VBE)/(RE+RTH/B);
15 ICdiff=(IE150-IE50)/IE50;
16 disp('%', ICdiff*100, "ICdiff=")

```

---

**Scilab code Exa 18.24** value of resistors

```

1 clc;

```

```

2 B=50;
3 VBE=0.7;
4 VCC=22.5;
5 RC=5.6*10**3;
6 VCE=12;
7 IC=1.5*10**-3;
8 S=3;
9 RE=(VCC-IC*RC-VCE)/IC;
10 disp('kohm',RE*10^-3,"RE=");
11 RTH=(4375)-RE;
12 disp('kohm',RTH*10^-3,"RTH=");
13 R2=0.1*B*RE;
14 disp('kohm',R2*10^-3,"R2=");
15 R1=(-RTH*R2)/(RTH-R2);
16 disp('kohm',R1*10^-3,"R1=");

```

---

### Scilab code Exa 18.25 CURRENT AND VOLTAGE

```

1
2 clc;
3 VCC=10;
4 VEE=10;
5 RC=1*10**3;
6 RE=5*10**3;
7 RB=50*10**3;
8 VBE=0.7;
9 VE=-VBE;
10 IE=(VEE-VBE)/RE;
11 disp('mA',IE*10**3,"IE=");
12 IC=IE;
13 disp('mA',IC*10**3,"IC=");
14 VC=VCC-IC*RC;
15 VCE=VC-VE;
16 disp('volts',VCE*1,"VCE=");

```

---

Scilab code Exa 18.26 change in Q point

```
1  clc;
2  VCC=20;
3  VEE=20;
4  RC=5*10**3;
5  RE=10*10**3;
6  RB=10*10**3;
7  B1=50;
8  B2=100;
9  VBE1=0.7;
10 VBE2=0.6;
11 IE1=(VEE-VBE1)/(RE+RB/B1);
12 disp('mA', IE1*10**3, "IE1=");
13 IC1=IE1;
14 VC1=VCC-IC1*RC;
15 disp('V', VC1, "VC1=");
16 VE=-VBE1;
17 VCE1=VC1-VE;
18 disp('V', VCE1, "VCE1=");
19 IE2=(VEE-VBE2)/(RE+RB/B2);
20 disp('mA', IE2*10**3, "IE2=");
21 IC2=IE2;
22 VC2=VCC-IC2*RC;
23 disp('V', VC2, "VC2=");
24 VE=-VBE2;
25 VCE2=VC2-VE;
26 disp('V', VCE2, "VCE2=");
27 delIc=(IC2-IC1)/IC1;
28 disp('%', delIc*100, "delIc=");
29 delVCE=(VCE1-VCE2)/VCE2;
30 disp('%', delVCE*100, "delVCE=");
```

---

### Scilab code Exa 18.27 VOLTAGE AND CURRENT

```
1
2 clc;
3 VCC=12;
4 RC=2*10**3;
5 RE=1*10**3;
6 R1=100*10**3;
7 R2=20*10**3;
8 B=100;
9 VBE=-0.2;
10 VB=-VCC*R2/(R1+R2);
11 disp('V',VB*1,"VB=");
12 VE=VB-VBE;
13 disp('V',VE*1,"VE=");
14 IE=-VE/RE;
15 IC=IE;
16 disp('mA',IC*10**3,"IC=");
17 VC=-(VCC-IC*RC);
18 disp('V',VC*1,"VC=");
19 VCE=VC-(VE);
20 disp('V',VCE*1,"VCE=");
```

---

### Scilab code Exa 18.28 Quiescent points

```
1 clc;
2 VCC=4.5;
3 RC=1.5*10**3;
4 RE=0.27*10**3;
5 R2=2.7*10**3;
6 R1=27*10**3;
7 B=44;
```

```
8 VBE=-0.3;
9 VB=-VCC*R2/(R1+R2);
10 disp('V',VB*1,"VB=");
11 VE=VB-VBE;
12 disp('V',VE*1,"VE=");
13 IE=-VE/RE;
14 IC=IE;
15 disp('mA',IC*10**3,"IC=");
16 VRC=IC*RC;
17 disp('V',VRC*1,"VRC=");
18 VC=-[VCC-VRC]
19 disp('V',VC*1,"VC=");
20 VCE=VC-(VE);
21 disp('V',VCE*1,"VCE=");
```

---

# Chapter 19

## SINGLE STAGE BJT AMPLIFIERS

Scilab code Exa 19.1 resistance and voltage gain

```
1  clc;
2  //e.g 19.1
3  Vcc=10;
4  Rc=10*10**3;
5  Rb=1*10**6;
6  beta=100;
7  Vbe=0.7;
8  Ib=(Vcc-Vbe)/Rb;
9  disp('microA',Ib*10**6,"Ib=");
10 Ic=beta*Ib;
11 disp('mA',Ic*10**3,"Ic=");
12 Ie=Ic;
13 re=25/(Ie*10**3);
14 disp('ohm',re*1,"re=");
15 Ri=beta*re;
16 disp('kohm',Ri*10**-3,"Ri=");
17 Ris=(Rb*beta*re)/(Rb+beta*re);
18 disp('kohm',Ris*10**-3,"Ris=");
19 R0=Rc;
```

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

---

### Scilab code Exa 19.2 current and gain

```
1 clc;
2 //e.g 19.2
3 Ri=2.5*10**3;
4 Av=200;
5 Vs=5*10**-3;
6 beta=50;
7 ib=(Vs/Ri)
8 disp('microA',ib*10**6,'ib=');
9 ic=beta*ib;
10 disp('microA',ic*10**6,'ic=');
11 Ai=beta;
12 Ap=Ai*Av;
13 disp(Ap);
14 Gp=10*log10(Ap);
15 disp('dB',Gp*1,'Gp=');
```

---

### Scilab code Exa 19.3 resistance and gain

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

```

10 disp('mA', Ic*10**3, "Ic=");
11 Ie=Ic;
12 re=25/(Ie*10**3);
13 disp('ohm', re*1, "re=");
14 Ri=beta*(re+Re);
15 disp('kohm', Ri*10**-3, "Ri=");
16 Ris=(Rb*Ri)/(Rb+Ri);
17 disp('kohm', Ris*10**-3, "Ris=");
18 Av=Rc/Re;
19 disp(Av);
20 Gp=10*log10(Av);
21 disp('dB', Gp*1, "Gp=");

```

---

#### Scilab code Exa 19.4 voltage gain and resistance

```

1 clc;
2 //e.g 19.4
3 Vcc=12;
4 Rc=10*10**3;
5 Re=1*10**3;
6 Rb=500*10**3;
7 beta=50;
8 Ic=Vcc/(Re+(Rb/beta));
9 disp('mA', Ic*10**3, "Ic=");
10 Ie=Ic;
11 re=25/(Ie*10**3);
12 disp('ohm', re*1, "re=");
13 Ri=beta*re;
14 disp('ohm', Ri*1, "Ri=");
15 Ris=(Rb*Ri)/(Rb+Ri);
16 disp('ohm', Ris*1, "Ris=");
17 R0=Rc;
18 Av=R0/re;
19 disp(Av);
20 Av=Rc/Re;

```



```
21 disp(Av);
```

---

### Scilab code Exa 19.5 voltage and impedance

```
1 clc;
2 //e.g 19.5
3 Vcc=30;
4 Rc=10*10**3;
5 RL=3.3*10**3;
6 R1=47*10**3;
7 R2=15*10**3;
8 Re=8.2*10**3;
9 beta=200;
10 Vs=5*10**-3;
11 Vbe=0.7;
12 Vth=(Vcc*R2)/(R1+R2);
13 disp('V',Vth*1,"Vth=");
14 Rth=(R1*R2)/(R1+R2);
15 disp('10^3ohm',Rth*10**-3,"Rth=");
16 Ie=(Vth-Vbe)/(Re+(Rth/beta));
17 disp('mA',Ie*10**3,"Ie=");
18 re=25/(Ie*10**3);
19 disp('ohm',re*1,"re=");
20 rl=(Rc*RL)/(Rc+RL);
21 disp('Kohm',rl*10**-3,"rl=");
22 Av=rl/re;
23 disp(Av);
24 Vin=5;
25 V0=Av*Vin
26 disp('mV',V0*1,"V0=");
27 Ri=beta*re;
28 disp('Kohm',Ri*10**-3,"Ri=");
29 Ris=(Rth*Ri)/(Rth+Ri);
30 disp('Kohm',Ris*10**-3,"Ris=");
```

---

Scilab code Exa 19.6 output voltage and output gain

```
1  clc;
2  //e.g 19.6
3  Vcc=10;
4  Rc=5*10**3;
5  Re=1*10**3;0
6  RL=50*10**3;
7  R1=50*10**3;
8  R2=10*10**3;
9  Rs=600;
10 beta=50;
11 Vs=10*10**-3;
12 Vbe=0.7;
13 Vth=(Vcc*R2)/(R1+R2);
14 disp('V',Vth*1,"Vth=");
15 Rth=(R1*R2)/(R1+R2);
16 disp('10^3ohm',Rth*10**-3,"Rth=");
17 Ie=(Vth-Vbe)/(Re+(Rth/beta));
18 disp('mA',Ie*10**3,"Ie=");
19 re=25/(Ie*10**3);
20 disp('ohm',re*1,"re=");
21 Ri=beta*re;
22 Ris=(Rth*Ri)/(Rth+Ri);
23 disp('ohm',Ris*1,"Ris=");
24 rl=(Rc*RL)/(Rc+RL);
25 disp('Kohm',rl*10**-3,"rl=");
26 Av=rl/re;
27 disp(Av);
28 Vin=(Vs*Ris)/(Ris+Rs);
29 disp('mV',Vin*10**3,"Vin=");
30 V0=Av*Vin;
31 disp('mV',V0*1,"V0=");
32 Avs=(Av*Vin)/Vs;
```

```
33 disp(Avs);
```

---

### Scilab code Exa 19.7 voltage and impedance

```
1 clc;
2 //e.g 19.7
3 Vcc=-18;
4 Rc=4.3*10**3;
5 Re=1*10**3;0
6 RL=3*10**3;
7 R1=39*10**3;
8 R2=8.2*10**3;
9 beta1=200;
10 Vbe=-0.7;
11 Vth=(Vcc*R2)/(R1+R2);
12 disp('V',Vth*1,"Vth=");
13 Rth=(R1*R2)/(R1+R2);
14 disp('kohm',Rth*10**-3,"Rth=");
15 Ie=(Vth-Vbe)/(Re+(Rth/beta1));
16 disp('mA',Ie*10**3,"Ie=");
17 re1=(30*10**-3)/(-Ie);
18 disp('ohm',re1*1,"re1=");
19 Ri=beta1*re;
20 Ris=(Rth*Ri)/(Rth+Ri);
21 disp('kohm',Ris*10**-3,"Ris=");
22 re=(Rc*RL)/(Rc+RL);
23 disp('Kohm',re*10**-3,"re=");
24 Av=re/re1;
25 disp(Av);
```

---

### Scilab code Exa 19.8 Av Ri Ro and Avs

```
1 clc;
```

```

2 //e.g 19.8
3 Vcc=20;
4 Rc=5.7*10**3;
5 Re=1*10**3;
6 R1=100*10**3;
7 R2=10*10**3;
8 Rs=100;
9 beta1=100;
10 Vbe=0.7;
11 Vth=(Vcc*R2)/(R1+R2);
12 disp('V',Vth*1,"Vth=");
13 Rth=(R1*R2)/(R1+R2);
14 disp('Kohm',Rth*10**-3,"Rth=");
15 Ie=(Vth-Vbe)/(Re+(Rth/beta1));
16 disp('mA',Ie*10**3,"Ie=");
17 re=25/(Ie*10**3);
18 disp('ohm',re*1,"re=");
19 Ri=beta1*re;
20 Ris=(Rth*Ri)/(Rth+Ri);
21 disp('ohm',Ris*1,"Ris=");
22 rl=Rc;
23 Av=rl/re;
24 disp(Av);
25 Vin=(Vs*Ris)/(Ris+Rs);
26 disp('mV',Vin*1,"Vin=");
27 V0=Av*Vin;
28 disp('V',V0*10**-3,"V0=");
29 Avs=(Av*Vin)/Vs;
30 disp(Avs);

```

---

### Scilab code Exa 19.9 GAIN VOLTAGE AND RESISTANCE

```

1 clc;
2 //e.g 19.9
3 Vcc=10;

```

```

4 Rc=5*10**3;
5 RE1=500;
6 R1=50*10**3;
7 R2=10*10**3;
8 Rs=600;
9 rE=500;
10 beta1=50;
11 Vbe=0.7;
12 vs=100*10**-3;
13 Rl=50*10**3;
14 Vth=(Vcc*R2)/(R1+R2);
15 disp('V',Vth*1,"Vth=");
16 Rth=(R1*R2)/(R1+R2);
17 disp('10^3ohm',Rth*10**-3,"Rth=");
18 RE=RE1+rE;
19 disp('ohm',RE*1,"RE=");
20 Ie=(Vth-Vbe)/(RE+(Rth/beta1));
21 disp('mA',Ie*10**3,"Ie=");
22 re=25/(Ie*10**3);
23 disp('ohm',re*1,"re=");
24 Ri=beta1*(re+rE);
25 disp('Kohm',Ri*10**-3,"Ri=");
26 Ris=(Rth*Ri)/(Rth+Ri);
27 disp('ohm',Ris*1,"Ris=");
28 rl=(Rc*Rl)/(Rc+Rl);
29 disp('kohm',rl*10**-3,"rl=");
30 Av=rl/(re+rE);
31 disp(Av);
32 VinBYVs=(Ris)/(Ris+Rs);
33 disp('V',VinBYVs*1,"VinBYVs=");
34 Avs=Av*VinBYVs;
35 disp(Avs);
36 V0=Avs*vs;
37 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

```
1  clc;
2  VS=10*10**-3;
3  a=0.98;
4  VBE=0.7;
5  VCC=10;
6  RC=10*10**3;
7  RL=5.1*10**3;
8  RE=20*10**3;
9  VEE=10;
10 IE=(VEE-VBE)/RE;
11 re=25/IE*10**-3;
12 Ri=re;
13 Ris=(RE*re)/(RE+re);
14 disp('ohm',Ris,"Ris=");
15 Ai=a;
16 disp(Ai);
17 rL=(RC*RL)/(RC+RL);
18 Av=rL/re;
19 disp(Av);
20 Ap=Av*Ai;
21 disp(Ap);
22 Gp=10*log10(Ap);
23 disp('dB',Gp,"Gp=");
24 Vin=VS;
25 Vo=Av*Vin;
26 disp('mV',Vo*10**3,"Vo=");
```

---

**Scilab code Exa 19.11** VOLTAGE GAIN

```
1  clc;
```

```

2 Rs=50;
3 IE=0.465*10**-3;
4 re1=53.8;
5 Ri=53.8;
6 Ris=52.4;
7 rL=3.38*10**3;
8 Avs=rL/(Rs+re1);
9 disp(Avs);
10 Av=rL/re1;
11 disp(Av);
12 Vs=10;
13 vo=Avs*Vs;
14 vin=vo/Av;
15 disp('mV',vin,"vin=");

```

---

**Scilab code Exa 19.12** resistance and voltage gain

```

1 clc;
2 VEE=10;
3 RE=10*10**3;
4 RB=100*10**3;
5 B=50;
6 VBE=0.7;
7 IE=(VEE-VBE)/(RE+(RB/B));
8 re=25/IE*10**-3;
9 Ri=B*(RE+re);
10 disp('Kohm',Ri*10**-3,"Ri=");
11 Ris=(RB*Ri)/(RB+Ri);
12 Rs=0;
13 Ro=re+((RB*Rs)/(RB+Rs))/B;
14 disp('ohm',Ro,"Ro=");
15 Av=RE/(re+RE);
16 disp(Av);

```

---

Scilab code Exa 19.13 resistance and voltage

```
1  clc;
2  B=80;
3  VBE=0.7;
4  VCC=15;
5  R1=20*10**3;
6  R2=20*10**3;
7  RS=2*10**3;
8  VS=5*10**-3;
9  RE=8.2*10**3;
10 RL=1.5*10**3;
11 VTH=VCC*R2/(R1+R2);
12 RTH=(R1*R2)/(R1+R2);
13 IE=(VTH-VBE)/(RE+(RTH/B));
14 disp('mA', IE*10**3, "IE=");
15 re=25/IE*10**-3;
16 rL=(RE*RL)/(RE+RL);
17 Ri=B*(rL+re);
18 Ris=(RTH*Ri)/(RTH+Ri);
19 disp('kohm', Ris*10**-3, "Ris=");
20 Ro=re+((RS*RTH)/(RS+RTH))/B;
21 disp('ohm', Ro, "Ro=");
22 Vin=VS*Ris/(RS+Ris);
23 disp('mV', Vin*10**3, "Vin=");
```

---



# Chapter 20

## HYBRID PARAMETERS

Scilab code Exa 20.2 Impedance voltage and current gain

```
1  clc;
2  hie=1.0*10**3;
3  hre=1*10**-4;
4  hoe=100*10**-6;
5  RC=1000;
6  RS=1000;
7  rL=RC;
8  hfe=50;
9  Ai=-hfe/(1+hoe*rL);
10 Ri=hie+hre*Ai*rL;
11 Ris=Ri;
12 disp('Ohm',Ris*1,"Ris=");
13 delh=hie*hoe-hre*hfe;
14 his=1000;
15 Ro=(RS+his)/(RS*hoe+delh);
16 disp('kOhm',Ro*10**-3,"Ro=");
17 Ros=(Ro*rL)/(Ro+rL);
18 disp('Ohm',Ros*1,"Ros=");
19 Ais=(Ai*RS)/(RS+Ris);
20 disp(Ais);
21 Av=(Ai*rL)/Ri;
```

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

---

**Scilab code Exa 20.3** impedance current and voltage gain

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

---

**Scilab code Exa 20.4** voltage gain and resistance

```
1 clc;
2 RC=4*10**3;
3 RB=40*10**3;
4 RS=10*10**3;
5 hie=1100;
6 hfe=50;
7 hre=0;
8 hoe=0;
9 RB2=40*10**3;
10 rL=(RC*RB2)/(RC+RB2);
11 Ai=-hfe/(1+hoe*rL);
12 Ri=hie+hre*Ai*rL;
```

```

13 Av=(Ai*rL)/Ri;
14 RB1=40*10**3/(1-Av);
15 Ris=(Ri*RB1)/(Ri+RB1);
16 disp('ohm',Ris*1,"Ris=");
17 Ros=rL;//Ro=infinity
18 disp('Ohm',Ros*1,"Ros=");
19 Avs=(Av*Ris)/(RS+Ris);
20 disp(Avs);

```

---

### Scilab code Exa 20.5 resistance voltage and current gain

```

1 clc;
2 hib=28;
3 hfb=-0.98;
4 hrb=5*10**-4;
5 hob=0.34*10**-6;
6 rL=1.2*10**3;
7 Rs=0;
8 Ai=-hfb/(1+hob*rL);
9 disp(Ai);
10 Ri=hib+hrb*Ai*rL;
11 disp('Ohm',Ri*1,"Ri=");
12 delh=hib*hob-hrb*hfb;
13 Ro=(Rs+hib)/(Rs*hib+delh);
14 disp('kOhm',Ro*10**-3,"Ro=");
15 Av=(Ai*rL)/Ri;
16 disp(Av);

```

---

### Scilab code Exa 20.6 resistance voltage and current gain

```

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

```

```

4 hrc=1;
5 hoc=25*10**-6;
6 rL=5*10**3;
7 RE=5*10**3;
8 Rs=1000;
9 R1=10*10**3;
10 R2=10*10**3;
11 Ai=-hfc/(1+hoc*rL);
12 disp(Ai);
13 Ri=hic+hrc*Ai*rL;
14 disp('kOhm',Ri*10**-3,"Ri=");
15 a=(R1*R2)/(R1+R2);
16 Ris=(Ri*a)/(Ri+a);
17 disp('Ohm',Ris*1,"Ris=");
18 Ro=-(Rs+hic)/hfc;
19 Ros=(Ro*RE)/(Ro+RE);
20 disp('Ohm',Ros*1,"Ros=");
21 Ais=(Ai*Rs)/(Rs+Ris);
22 disp(Ais);
23 Av=(Ai*rL)/Ri;
24 disp(Av);
25 Avs=(Av*Ris)/(Rs+Ris);
26 disp(Avs);

```

---

Scilab code Exa 20.7 resistance voltage and current gain

```

1 clc;
2 hie=1500;
3 hfe=50;
4 hre=50*10**-4;
5 hoe=20*10**-6;
6 RC=5*10**3;
7 RL=10*10**3;
8 R1=20*10**3;
9 R2=10*10**3;

```

```

10 rL=(RC*RL)/(RC+RL);
11 Ai=-hfe;
12 Ri=hie;
13 a=(R1*R2)/(R1+R2);
14 Ris=(Ri*a)/(Ri+a);
15 disp('kOhm',Ris*10**-3,"Ris=");
16 Ro=1/hoe;
17 Ros=(Ro*rL)/(Ro+rL); // correction
18 disp('kOhm',Ros*10**-3,"Ros=");
19 Avs=(Ai*rL)/Ri;
20 disp(Avs);
21 Ais=Ai; // correction
22 disp(Ais);

```

---

#### Scilab code Exa 20.8 voltage and impedance

```

1
2 clc;
3 RC=12*10**3;
4 RL=4.7*10**3;
5 R1=33*10**3;
6 R2=4.7*10**3;
7 IC=1*10**-3;
8 hiemin=1*10**3;
9 hiemax=5*10**3;
10 hfemin=70;
11 hfemax=350;
12 hie=sqrt(hiemin*hiemax);
13 disp('kOhm',hie*10**-3,"hie=");
14 hfe=sqrt(hfemin*hfemax);
15 disp('Ohm',hfe*1,"hfe="); // answer printed in the
    book is wrong
16 Ri=hie;
17 a=(R1*R2)/(R1+R2);
18 Ris=(Ri*a)/(Ri+a);

```

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

---

**Scilab code Exa 20.9** resistance voltage and current gain

```
1 clc;
2 RB=330*10**3;
3 RC=2.7*10**3;
4 hfe=120;
5 hie=1.175*10**3;
6 hoe=20*10**-6;
7 Ri=hie;
8 Ris=(hie*RB)/(hie+RB);
9 disp('kohm',Ris*10**-3,"Ris=");
10 Ro=1/hoe;
11 Ros=(Ro*RC)/(Ro+RC);
12 disp('kohm',Ros*10**-3,"Ros=");
13 Ai=hfe;
14 disp(Ai);
15 Av=(hfe*RC)/Ri;
16 disp(Av);
```

---

**Scilab code Exa 20.10** hfb and hfc

```
1 clc;
2 hfe=50;
3 hfb=-hfe/(1+hfe);
4 disp(hfb);
5 hfc=-(1+hfe);
6 disp(hfc);
```

---

Scilab code Exa 20.11 gain and input resistance

```
1  clc;  
2  hie=1100;  
3  hre=2.5*10**-4;  
4  hfe=50;  
5  hoe=24*10**-6;  
6  rL=10*10**3;  
7  RS=1*10**3;  
8  hic=hie;  
9  hrc=1-hre;  
10 hfc=-(1+hfe);  
11 Ai=hfc/(1+hoe*rL);  
12 disp(Ai);  
13 Ri=hie+hrc*-Ai*rL;  
14 disp('kOhm',Ri*10**-3," Ri=");  
15 Av=(-Ai*rL)/Ri;  
16 disp(Av);
```

---

# Chapter 21

## MULTISTAGE BJT AMPLIFIERS

Scilab code Exa 21.1 total voltage gain

```
1  clc;
2  Av1=10;
3  Av2=20;
4  Av3=40;
5  Av=Av1*Av2*Av3;
6  disp(Av);
7  GV1=20*log10(Av1);
8  GV2=20*log10(Av2);
9  GV3=20*log10(Av3);
10 GV=GV1+GV2+GV3; //CORRECTION
11 disp('dB',GV*1,"GV=");
```

---

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

```
1  clc;
2  vin1=0.05;
```



```

3 vout3=150;
4 Av1=20;
5 vin3=15;
6 Av=vout3/vin1;
7 disp(Av);
8 Av3=vout3/vin3;
9 disp(Av3);
10 Av2=Av/(Av3*Av1);
11 disp(Av2);
12 vin2=Av2/vin3;
13 disp('Vpk-pk ',vin2*1," vin2=");

```

---

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

```

1 clc;
2 VCC=10;
3 Rc=5*10**3;
4 RB=1*10**6;
5 RE=1*10**3;
6 RL=10*10**3;
7 B1=100;
8 B2=100;
9 B=B1;
10 IE=VCC/(RE+(RB/B1));
11 re=25/(IE*10**3);
12 Ri1=B*re;
13 disp('ohm ',Ri1*1," Ri1=");
14 Ri2=B*re;
15 disp('ohm ',Ri2*1," Ri2=");
16 Ro1=(Rc*Ri2)/(Rc+Ri2);
17 disp('ohm ',Ro1*1," Ro1=");
18 Ro2=(Rc*RL)/(Rc+RL);
19 disp('ohm ',Ro2*1," Ro2=");
20 Av1=Ro1/re;

```

```

21 disp(Av1);
22 Av2=Ro2/re;
23 disp(Av2);
24 Av=Av1*Av2;
25 disp(Av);
26 Gv=20*log10(Av);
27 disp('dB',Gv*1,"Gv=");

```

---

#### Scilab code Exa 21.4 voltage gain

```

1  clc;
2  VCC=15;
3  Rc=3.3*10**3;
4  RE=1000;
5  R1=33*10**3;
6  R2=8.2*10**3;
7  RL=10*10**3;
8  B=100;
9  VBE=0.7;
10 VTH=VCC*(R2/(R1+R2));
11 RTH=(R1*R2)/(R1+R2);
12 IE=(VTH-VBE)/(RE+(RTH/B));
13 re=25/(IE*10**3);
14 Ri2=B*re;
15 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.
16 Ro1=(Rc*Ri2)/(Rc+Ri2);
17 disp('ohm',Ro1*1,"Ro1=");
18 Ro2=(Rc*RL)/(Rc+RL);
19 disp('ohm',Ro2*1,"Ro2=");
20 Av1=Ro1/re;
21 disp(Av1);
22 Av2=Ro2/re;

```

```
23 disp(Av2);
24 Av=Av1*Av2;
25 disp(Av);
26 Gv=20*log10(Av);
27 disp('dB',Gv*1,"Gv=");
```

---

### Scilab code Exa 21.5 cutoff frequency and voltage gain

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

---

### Scilab code Exa 21.6 individual stage gains and voltage gain

```
1 clc;
2 VCC=10;
3 RB=470*10**3;
4 RE=1*10**3;
5 RL=1*10**3;
6 a=4;
7 B=50;
8 IE=VCC/(RE+(RB/B));
9 re=25/(IE*10**3);
10 Ri1=(RB*(B*re))/(RB+(B*re));
11 disp('ohm',Ri1*1,"Ri1=");
12 Ri2=(RB*(B*re))/(RB+(B*re));
13 disp('ohm',Ri2*1,"Ri2=");
14 RI2=(a^2)*Ri2;
```

```

15 R01=RI2;
16 RI2=(a^2)*RL;
17 Av1=R01/re;
18 disp(Av1);
19 R02=RI2;
20 Av2=R02/re;
21 disp(Av1);
22 Av=Av1*Av2;
23 disp(Av);
24 Gv=20*log10(Av);
25 disp('dB',Gv*1,"Gv=");

```

---

#### Scilab code Exa 21.7 voltage gain

```

1  clc;
2  VCC=12;
3  R1=100*10**3;
4  R2=20*10**3;
5  R3=10*10**3;
6  R4=2*10**3;
7  R5=10*10**3;
8  R6=2*10**3;
9  B=100;
10 B2=100;
11 VTH=VCC*(R2/(R1+R2));
12 IE1=VTH/R4;
13 re1=25/IE1*10**-3;
14 VR6=VCC-IE1*R3;
15 IE2=VR6/R6;
16 re2=25/IE2*10**-3;
17 Ri2=B2*(re2+R6);
18 R01=(R3*Ri2)/(R3+Ri2);
19 R02=R5;
20 Av1=R01/(re1+R4);
21 disp(Av1);

```

```

22 Av2=R02/(re2+R6);
23 disp(Av2);
24 Av=Av1*Av2;
25 disp(Av);

```

---

Scilab code Exa 21.8 collector current VCE and ac voltage gain

```

1  clc;
2  VCC=10;
3  R1=800;
4  R2=200;
5  R3=600;
6  R4=200;
7  R5=100;
8  R6=1*10**3;
9  B=100;
10 B2=B;
11 VBE=0.7;
12 RE=200;
13 VR2=VCC*(R2/(R1+R2));
14 IE1=(VR2-VBE)/RE;
15 IC1=IE1;
16 disp('mA',IC1*10**3,"IC1=");
17 VC1=VCC-IC1*R3;
18 VE1=IE1*R4;
19 VCE1=VC1-VE1;
20 disp('V',VCE1*1,"VCE1=");
21 VE2=VC1-(-VBE);
22 IE2=(VCC-VE2)/R6;
23 IC2=IE2;
24 VC2=IC2*R5;
25 VCE2=VC2-VE2;
26 disp('V',VCE2*1,"VCE2=");
27 re1=25/IE1*10**-3;
28 re2=25/IE2*10**-3;

```

```

29 Ri2=B2*(re2+R6);
30 R01=(R3*Ri2)/(R3+Ri2);
31 Av1=R01/(re1+R4);
32 disp(Av1*1,"Av1=");
33 Av2=1;
34 disp(Av2*1,"Av2=");
35 Av=Av1*Av2;
36 disp(Av*1,"Av=");

```

---

### Scilab code Exa 21.9 gain emitter diode resistance

```

1  clc;
2  VCC=10;
3  R1=30*10**3;
4  R2=20*10**3;
5  RE=1.5*10**3;
6  B1=150;
7  B2=100;
8  VBE=0.7;
9  Ai=B1*B2;
10 disp(Ai);
11 VR2=VCC*(R2/(R1+R2));
12 VB2=VR2-VBE;
13 VE2=VB2-VBE;
14 IE2=VE2/RE;
15 re2=25/(IE2*10**3);
16 disp('ohm',re2*1,"re2=");
17 Ib2=IE2/B2;
18 IE1=Ib2;
19 re1=25/(IE1*10**3);
20 disp('ohm',re1*1,"re1=");
21 Ri1=(R1*R2)/(R1+R2);
22 disp('Kohm',Ri1*10**-3,"Ri1=");
23 Av=RE/((re1/B2)+(re2+RE));
24 disp(Av);

```



# Chapter 22

## FET AMPLIFIERS

Scilab code Exa 22.1 vdc vgs

```
1  clc;
2  //e.g 22.1
3  ID=5*10**-3;
4  VDD=10;
5  RD=1*10**3;
6  RS=500;
7  VS=ID*RS;
8  disp('V',VS*1,"VS=");
9  VD=VDD-ID*RD;
10 disp('V',VD*1,"VD=");
11 VDS=VD-VS;
12 disp('V',VDS*1,"VDS=");
13 VGS=-VS;
14 disp('V',VGS*1,"VGS=");
```

---

Scilab code Exa 22.2 R1

```
1  clc;
```



```

2 //e.g 22.2
3 RD=56*10**3;
4 RG=1*10**6;
5 IDSS=1.5*10**-3;
6 VP=-1.5;
7 VD=10;
8 VDD=20;
9 ID=VD/RD;
10 disp('mA', ID*10**3, "ID=");
11 //ID=IDSS*(1-(VGS/VP))**2
12 VGS=VP*(1-sqrt(ID/IDSS));
13 disp('V', VGS*1, "VGS=");
14 VS=VGS;
15 R1=(-VS/ID)-4*10**3;
16 disp('kohm', R1*10**-3, "R1=");

```

---

### Scilab code Exa 22.3 RS and RD

```

1 clc;
2 //e.g 22.3
3 ID=1.5*10**-3;
4 VDS=10;
5 IDSS=5*10**-3;
6 VP=-2;
7 VDD=20;
8 //ID=IDSS*(1-(VGS/VP))**2
9 VGS=VP*(1-(ID/IDSS));
10 VS=-VGS;
11 RS=(VS/ID);
12 disp('ohm', RS*1, "RS=");
13 RD=((VDD-VDS)/ID)-RS;
14 disp('Kohm', RD*10**-3, "RD=");

```

---

### Scilab code Exa 22.5 RD and RS

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

---

### Scilab code Exa 22.6 self bias operation point

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

---

### Scilab code Exa 22.7 VGS and VDS

```

1  clc;
2  //e.g 22.7
3  VDD=20;
4  RD=2.5*10**3;
5  RS=1.5*10**3;
6  R1=2*10**6;
7  R2=250*10**3;
8  ID=4*10**-3;
9  VG=(R2*VDD)/(R1+R2);
10 VS=ID*RS;
11 VGS=VG-VS;
12 disp('V',VGS*1,"VGS=");
13 VD=VDD-ID*RD;
14 VDS=VD-VS;
15 disp('V',VDS*1,"VDS=");

```

---

#### Scilab code Exa 22.8 voltage gain

```

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

```

---

#### Scilab code Exa 22.9 voltage gain

```

1  clc;
2  //e.g 22.9
3  gm=2.5*10**-3;
4  rd=500*10**3;
5  RD=10*10**3;
6  rL=(RD*rd)/(rd+RD);

```

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

---

#### Scilab code Exa 22.10 voltage gain

```
1 clc;
2 //e.g 22.10
3 gm=2*10**-3;
4 rd=40*10**3;
5 RD=20*10**3;
6 RG=100*10**6;
7 rL=(RD*rd)/(RD+rd);
8 Av=-gm*rL;
9 disp(Av);
10 Ri=RG;
11 disp('Mohm',Ri*10**-6,"Ri=");
12 Ro=rL;
13 disp('Kohm',Ro*10**-3,"Ro=");
```

---

#### Scilab code Exa 22.11 voltage gain

```
1 clc;
2 //e.g 22.11
3 gm=2*10**-3;
4 rd=10*10**3;
5 RD=50*10**3;
6 r1=(rd*RD)/(rd+RD);
7 Av=-gm*r1;
8 disp(Av);
```

---

Scilab code Exa 22.12 voltage gain

```
1 clc;
2 //e.g 22.12
3 RD=100*10**3;
4 gm=1.6*10**-3;
5 rd=44*10**3;
6 Cgs=3*10**-12;
7 Cds=1*10**-12;
8 Cgd=2.8*10**-12;
9 rl=(RD*rd)/(RD+rd);
10 Av=-gm*rl;
11 disp(Av);
```

---

Scilab code Exa 22.13 rms output voltage

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

---

Scilab code Exa 22.14 voltage gain

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

```

5  RG=10*10**6;
6  rs=500;
7  rl=RD;
8  AV=-(gm*rl)/(1+gm*rs);
9  disp(AV);
10 RL=100*10^3;
11 rL=(RD*RL)/(RD+RL);
12 AV=-(gm*rL)/(1+gm*rs);
13 disp(AV);

```

---

Scilab code Exa 22.15 voltage gain

```

1  clc;
2  // e.g 22.15
3  RD=1.5*10**3;
4  RS=750;
5  RG=1*10**6;
6  IDSS=10*10**-3;
7  VP=-3.5;
8  IDQ=2.3*10**-3;
9  VGSQ=-1.8;
10 gmo=-2*IDSS/VP;
11 gm=gmo*(1-(VGSQ/VP));
12 rL=RD;
13 AV=-(gm*rL)/(1+gm*RS);
14 disp(AV);
15 AV=-gm*rL;
16 disp(AV);

```

---

Scilab code Exa 22.16 voltage gain and input output resistance

```

1  clc;
2  //e.g 22.16

```

```

3 gm=8000*10**-6;
4 RS=10*10**3;
5 RG=100*10**6;
6 (1/gm);
7 AV=RS/(RS+(1/gm));
8 disp(AV);
9 Ri=RG;
10 Ro=1/gm;
11 disp('ohm',Ro*1,"Ro=");

```

---

Scilab code Exa 22.17 voltage gain and resistance

```

1 clc;
2 //e.g 22.17
3 vin=2*10**-3;
4 gm=5500*10**-6;
5 R1=1*10**6;
6 R2=1*10**6;
7 RS=5000;
8 RL=2000;
9 (1/gm);
10 AV=RS/(RS+(1/gm));
11 disp(AV);
12 Ri=(R1*R2)/(R1+R2);
13 disp('Mohm',Ri*10**-6,"Ri=");
14 Ro=(RS/gm)/(RS+1/gm);
15 disp('ohm',Ro*1,"Ro=");
16 Vo=(RL/(RL+Ro))*(AV*vin);
17 disp('mV',Vo*10**3,"Vo=");

```

---

Scilab code Exa 22.18 voltage gain and input resistance

```

1 clc;

```

```

2 //e.g 22.18
3 gm=2500*10**-6;
4 Ri=2000;
5 RD=10000;
6 AV=gm*RD;
7 disp(AV);
8 Ri1=(Ri/gm)/(Ri+1/gm);
9 disp('ohm',Ri1*1,"Ri1=");

```

---

Scilab code Exa 22.19 output resistance

```

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

```

---

Scilab code Exa 22.20 input resistance and ac voltage gain

```

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

```



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

---

## Chapter 23

# AMPLIFIERS WITH COMPOUND CONFIGURATION

Scilab code Exa 23.1 voltage gain and impedance

```
1  clc;
2  ID=4*10**-3;
3  IDSS=2*ID;
4  RS=390;
5  VGSQ=-ID*RS;
6  VP=-4.5;
7  RD=2.2*10**3;
8  gm0=(2*IDSS)/(-VP);
9  gm=gm0*(1-(VGSQ/VP));
10 Av1=-gm*RD;
11 Av2=-gm*RD;
12 Av=Av1*Av2;
13 disp(Av);
14 vi=20*10**-3;
15 vo=Av*vi;
16 disp('mV',vo*10**3,"vo=");
17 Zi=10*10**6;
```

```

18 RG=10*10**6;
19 disp('Mohm', Zi*10**-6, "Zi=RG=");
20 Z0=2.2*10**3;
21 RD=2.2*10**3;
22 disp('Kohm', Z0*10**-3, "Z0=RD=");
23 RL=10*10**3;
24 VL=(RL/(Z0+RL))*vo;
25 disp('V', VL*10**3, "VL=");

```

---

### Scilab code Exa 23.3 voltage gain

```

1  clc;
2  VCC=18;
3  R1=7.5*10**3;
4  R2=6.2*10**3;
5  R3=3.9*10**3;
6  RC=1.5*10**3;
7  B1=200;
8  B2=200;
9  RE=1*10**3;
10 CE=100*10**-6;
11 VB1=VCC*(R2+R3)/(R1+R2+R3);
12 disp('V', VB1*1, "VB1=");
13 VB2=VCC*(R3)/(R1+R2+R3);
14 disp('V', VB2*1, "VB2=");
15 IE2=(VB2-0.7)/RE;
16 IC2=IE2;
17 IE1=IC2;
18 IE=IE1;
19 re1=26*10**-3/IE;
20 AV1=-re1/re1;
21 AV2=-RC/re1;
22 AV=AV1*AV2;
23 disp(AV); //ans given in book has -ve sign which is
      wrong

```

---

**Scilab code Exa 23.4** current gain

```
1 clc ;
2 B1=160;
3 B2=160;
4 BD=B1*B2;
5 disp(BD);
```

---

**Scilab code Exa 23.5** CURRENT GAIN

```
1 clc ;
2 BD=6000;
3 B1=BD;
4 B2=B1;
5 B=sqrt(BD);
6 disp(B);
```

---

**Scilab code Exa 23.6** VE2 IE2 voltage gain

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

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

---

### Scilab code Exa 23.7 zmatrix

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

---

### Scilab code Exa 23.8 dc bias currents and voltages

```
1 clc;
2 VCC=16;
3 B1=160;
4 B2=200;
5 RB=1.5*10**6;
6 Vi=120*10**-3;
7 VEB1=0.7;
8 RC=100;
9 IB1=(VCC-VEB1)/(RB+B1*B2*RC);
10 IB2=B1*IB1;
11 IC2=B2*IB2;
12 IE1=IB2;
```

```

13 IC=IE1+IC2;
14 Vodc=VCC-IC*RC;
15 VBE=0.7;
16 Vidc=Vodc-VBE;
17 disp('V',Vidc*1,"Vidc=");

```

---

**Scilab code Exa 23.9** load current and output voltage

```

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

```

---

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

```

1 clc;
2 VEE=-18;
3 R1=4.3*10**3;
4 R2=4.3*10**3;
5 RE=1.8*10**3;
6 B=100;
7 VB=-(-VEE*R2)/(R1+R2);
8 VE=VB-0.7;
9 IE=(VE-(VEE))/RE;
10 disp('mA',IE*10**3,"IE=");

```

---

### Scilab code Exa 23.11 current

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

---

### Scilab code Exa 23.12 current

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

---

### Scilab code Exa 23.13 value of current

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

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

---

### Scilab code Exa 23.14 dc voltage and current

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

---

### Scilab code Exa 23.15 IC AV VO1

```
1 clc;
2 VCC=12;
3 VEE=12;
4 RE=33*10**3;
5 RC1=36*10**3;
6 RC2=36*10**3;
7 B1=150;
8 B2=150;
9 vi1=2*10**-3;
10 IE=(VEE-0.7)/RE;
11 disp('mA',IE*10**3,"IE=");
```



```
12 IC=IE/2;
13 disp('mA',IC*10**3,"IC=");
14 RC=36*10**3;
15 VC=VCC-IC*RC;
16 disp('V',VC*1,"VC=");
17 re1=25*10**-3/IE;
18 Av=RC/(2*re1);
19 disp(Av);
20 vo1=Av*vi1;
21 disp('V',vo1*1,"vo1=");
```

---

**Scilab code Exa 23.16** common mode voltage gain

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

---

## Chapter 24

# FREQUENCY RESPONSE OF BJT AND JFET AMPLIFIERS

Scilab code Exa 24.1 power gain

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

---

Scilab code Exa 24.2 power gain

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

---

### Scilab code Exa 24.3 power gain

```
1
2 clc;
3  $P_i=20*10**{-6}$ ;
4  $P_o=100*10**{-6}$ ;
5  $G=10*\log_{10}(P_o/P_i)$ ;
6 disp('dB',G*1,"G=");
```

---

### Scilab code Exa 24.4 power gain

```
1
2 clc;
3  $P_o=25$ ;
4  $G=10*\log_{10}(P_o/(1*10**{-3}))$ ;
5 disp('dB',G*1,"G=");
```

---

### Scilab code Exa 24.5 gain

```
1
2 clc;
3  $V_2=100$ ;
4  $V_1=25$ ;
5  $G=10*\log_{10}(V_2/V_1)$ ;
6 disp('dB',G*1,"G=");
```

---

### Scilab code Exa 24.8 frequency response

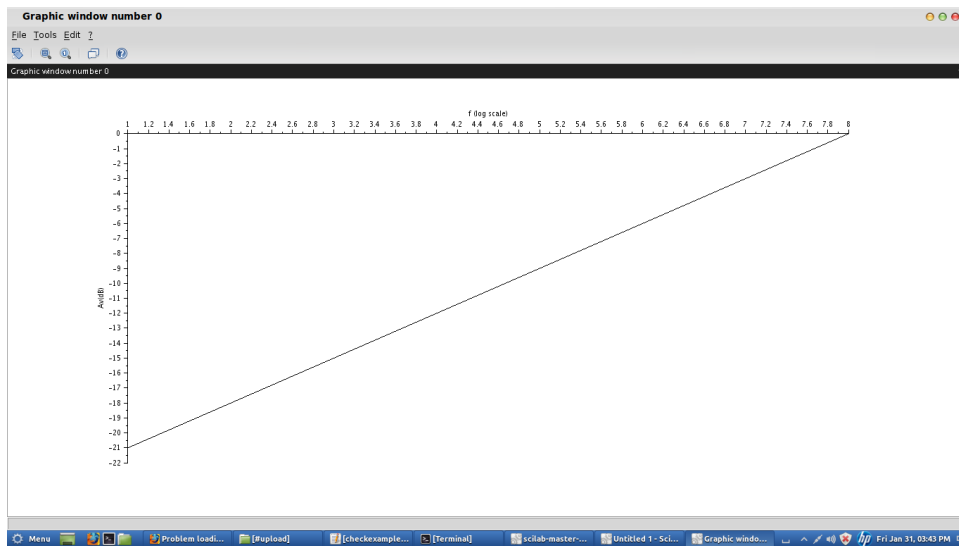


Figure 24.1: frequency response

```

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

```

---

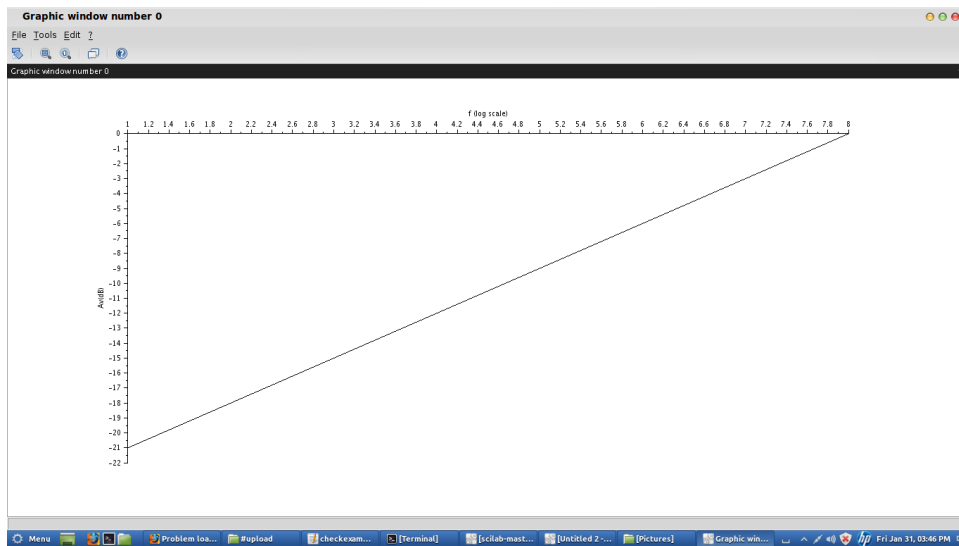


Figure 24.2: FREQUENCY AND PLOT

### Scilab code Exa 24.9 FREQUENCY AND PLOT

```

1
2 clc;
3 RC=4*10**3;
4 R1=40*10**3;
5 R2=10*10**3;
6 RE=2*10**3;
7 RS=1*10**3;
8 RL=2.2*10**3;
9 CS=10*10**-6;
10 CE=20*10**-6;
11 CC=1*10**-6;
12 B=100;
13 VCC=20;
14 VB=(R2*VCC)/(R2+R1);
15 IE=(VB-0.7)/RE;
16 re=(26*10**-3)/IE;
17 B*re;
18 vo=-(RC*RL)/(RC+RL);

```

```

19 Av=vo/re;
20 a=(R1*R2)/(R1+R2);
21 Ri=(a*(B*re))/(a+(B*re));
22 Rs=1*10**3;
23 vibyvs=Ri/(Ri+Rs);
24 Avs=Av*vibyvs;
25 a=(R1*R2)/(R1+R2);
26 Ri=(a*(B*re))/(a+(B*re));
27 fLS=1/(2*pi*(Rs+Ri)*CS);
28 disp('HZ',fLS*1,"fLS=");
29 fLC=1/(2*pi*(RC+RL)*CC);
30 disp('HZ',fLC*1,"fLC=");
31 a=(R1*R2)/(R1+R2);
32 RS=(a*RS)/(a+RS);
33 b=(RS/B+re);
34 Re=(RE*b)/(RE+b);
35 fLE=1/(2*pi*Re*CE);
36 disp('HZ',fLE*1,"fLE=");
37 i=-21:3:0;
38 plot2d(i);
39 a=gca() //get the current axes
40 a.box="off";
41 a.x_location="top";
42 xlabel("f (log scale)");
43 ylabel("Av(dB)");

```

---

## Chapter 25

# LARGE SIGNAL OR POWER AMPLIFIERS

Scilab code Exa 25.1 collector current and Vce

```
1  clc;
2  VCC=10;
3  R1=10*10**3;
4  R2=5*10**3;
5  RC=1*10**3;
6  RE=500;
7  RL=1.5*10**3;
8  B=100;
9  VBE=0.7;
10 VR2=VCC*(R2/(R1+R2));
11 IEQ=(VR2-VBE)/RE;
12 ICQ=IEQ;
13 VCEQ=VCC-ICQ*(RC+RE);
14 rL=(RC*RL)/(RC+RL);
15 ICsat=ICQ+(VCEQ/rL);
16 disp('mA', ICsat*10**3, " ICsat=");
17 VCEsat=0;
18 disp(VCEsat);
19 ICcutoff=0;
```

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

---

### Scilab code Exa 25.2 COMPLIANCE

```
1 clc;
2 VCC=20;
3 R1=10*10**3;
4 R2=1.8*10**3;
5 RC=620;
6 RE=200;
7 RL=1.2*10**3;
8 hfe=180;
9 VB=VCC*(R2/(R1+R2));
10 VBE=0.7;
11 VE=VB-VBE;
12 IE=VE/RE;
13 IC=IE;
14 VCE=VCC-IE*(RC+RE);
15 ICQ=IC;
16 VCEQ=VCE;
17 rL=(RC*RL)/(RC+RL);
18 PP=2*ICQ*rL;
19 disp('V',PP,"PP=");
20 PP=2*VCEQ;
21 disp('V',PP,"PP=");
```

---

### Scilab code Exa 25.3 voltage gain and power gain

```
1 clc;
2 re=8;
3 RC=220;
```



```
4 RE=47;
5 R1=4.7*10**3;
6 R2=470;
7 B=50;
8 rL=RC;
9 AV=rL/re;
10 Ai=B;
11 Ap=AV*Ai;
12 disp(Ap);
```

---

**Scilab code Exa 25.4** collector efficiency and power rating of transistor

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

---

**Scilab code Exa 25.5** ac power

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

---

**Scilab code Exa 25.6** power dissipated

```

1  clc;
2  nc=0.5;
3  VCC=24;
4  Poac=3.5;
5  Ptrdc=Poac/nc;
6  disp('W',Ptrdc,"Ptrdc=");
7  Pcdc=Ptrdc-Poac;
8  disp('W',Pcdc,"Pcdc=");

```

---

### Scilab code Exa 25.7 power and efficiency

```

1  clc;
2  VCC=20;
3  VCEQ=10;
4  ICQ=600*10**-3;
5  RL=16;
6  IP=300*10**-3;
7  Pindc=VCC*ICQ;
8  disp('W',Pindc,"Pindc=");
9  PRLdc=ICQ**2*RL;
10 disp('W',PRLdc,"PRLdc=");
11 I=IP/sqrt(2);
12 Poac=I**2*RL;
13 disp('W',Poac,"Poac=");
14 Ptrdc=Pindc-PRLdc;
15 disp('W',Ptrdc,"Ptrdc=");
16 Pcdc=Ptrdc-Poac;
17 disp('W',Pcdc,"Pcdc=");
18 no=Poac/Pindc;
19 disp('%',no*100,"no=");
20 no=Poac/Ptrdc;
21 disp('%',no*100,"no=");

```

---

**Scilab code Exa 25.8** resistance

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

---

**Scilab code Exa 25.9** turns ratio

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

---

**Scilab code Exa 25.10** max power

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

---

**Scilab code Exa 25.11** ac output power ICQ turns ratio

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

```

3 VCC=10;
4 RL=16;
5 no=0.5;
6 Poac=no*Ptrdc;
7 disp('mW',Poac*10**3,"Poac=");
8 ICQ=2*Poac/VCC;
9 disp('A',ICQ,"ICQ=");
10 RL1=VCC/ICQ;
11 a=sqrt(RL1/RL);
12 disp(a);

```

---

#### Scilab code Exa 25.12 power

```

1 clc;
2 VCC=10;
3 IP=50*10**-3;
4 RL=4;
5 I=IP/sqrt(2);
6 Poac=I^2*RL;
7 disp('mW',Poac*10**3,"Poac=");
8 ICQ=IP;
9 RL1=VCC/ICQ;
10 a=sqrt(RL1/RL);
11 disp(a);
12 V1=VCC;
13 V2=V1/a;
14 I2p=V2/RL;
15 I2=I2p/sqrt(2);
16 P=(I2^2)*RL;
17 disp('mW',P*10**3,"P=");

```

---

#### Scilab code Exa 25.13 power

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

---

### Scilab code Exa 25.14 PinDC PoAC

```
1 clc;  
2 no=0.6;  
3 Pcdc=2.5;  
4 //Poac=Pinde*no;  
5 //Pinde=2*Pcdc+Poac;  
6 Pinde=(2*Pcdc)/(1-no);  
7 disp('W',Pinde,"Pinde=");  
8 Poac=0.6*Pinde;  
9 disp('W',Poac,"Poac=");
```

---

# Chapter 26

## TUNED AMPLIFIERS

Scilab code Exa 26.1 frequency

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

---

Scilab code Exa 26.2 frequency and impedance

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

---

### Scilab code Exa 26.3 bandwidth

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

---

### Scilab code Exa 26.4 Q factor

```
1 clc;  
2 //e.g 26.4  
3 fo=1600*10**3;  
4 BW=10*10**3;  
5 Qo=fo/BW;  
6 disp(Qo);
```

---

### Scilab code Exa 26.5 Q factor

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

---

### Scilab code Exa 26.6 impedance

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

---



# Chapter 27

## FEEDBACK AMPLIFIERS

Scilab code Exa 27.1 voltage gain

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

---

Scilab code Exa 27.2 fraction of output

```
1 clc;  
2 //e.g 27.2  
3 AV=1000;  
4 AV1=10;  
5 beta=((AV/AV1)-1)/AV;  
6 disp(beta);
```

---

### Scilab code Exa 27.3 feedback

```
1 clc ;  
2 //e.g 27.3  
3 AV=100;  
4 AV1=20;  
5 beta=((AV/AV1)-1)/AV;  
6 disp(beta);
```

---

### Scilab code Exa 27.4 voltage gain and beta

```
1 clc ;  
2 //e.g 27.4  
3 Vo=12.5;  
4 Vin1=1.5;  
5 Vin=0.25;  
6 AV=Vo/Vin;  
7 disp(AV);  
8 AV1=Vo/Vin1;  
9 beta=((AV/AV1)-1)/AV;  
10 disp(beta);
```

---

### Scilab code Exa 27.5 beta

```
1 clc ;  
2 //e.g 27.5  
3 AV=60;  
4 AV1=80;  
5 //80=AV/(1-BETA*AV)  
6 beta=((AV1/AV)-1)/AV1;  
7 disp(beta,"beta=");  
8 beta=1/AV;  
9 disp(beta,"beta=");
```

---

**Scilab code Exa 27.6** beta

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

---

**Scilab code Exa 27.7** change in closed loop gain

```
1
2  clc;
3  Av=800;
4  B=0.05;
5  dAvbyAv=20;
6  a=dAvbyAv*(1/(1+B*Av));
7  disp('%',a*1," a=");
```

---

**Scilab code Exa 27.8** values of AV and beta

```
1  clc;
2  AV1=100;
3  A=0.01;
4  B=0.2;
```

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

---

#### Scilab code Exa 27.9 gain and beta

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

---

#### Scilab code Exa 27.10 bw

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

---

### Scilab code Exa 27.11 frequency

```
1  clc;
2  //e.g 27.11
3  Rin=4.2*10**3;
4  AV=220;
5  beta=0.01;
6  Ri=(1+beta*AV)*Rin;
7  disp('Kohm',Ri*10**-3,'Ri=');
8  F1=1.5*10**3;
9  FC1=F1/(1+beta*AV);
10 disp('HZ',FC1,'FC1=');
11 F2=501.5*10**3;
12 FC2=(1+beta*AV)*F2;
13 disp('KHZ',FC2*10**-3,'FC2=');
```

---

### Scilab code Exa 27.12 gain and distortion gain

```
1  clc;
2  //e.g 27.12
3  AV=1000;
4  f1=50;
5  f2=200*10**3;
6  D=0.05;
7  beta=0.01;
8  AV1=AV/(1+beta*AV);
9  disp(AV1);
10 fl1=f1/(1+beta*AV);
11 disp('HZ',fl1,'fl1=');
12 fu2=(1+beta*AV)*f2;
13 disp('MHZ',fu2*10**-6,'fu2=');
14 D1=D/(1+beta*AV);
```

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

---

**Scilab code Exa 27.13** beta and gain

```
1 clc;
2 //e.g 27.13
3 AV=100;
4 RDN=0.8;
5 //0.8=1-(1/(1+beta*AV));
6 beta=((1/0.2)-1)/100;
7 disp(beta);
8 AV1=AV/(1+beta*AV);
9 disp(AV1);
```

---

**Scilab code Exa 27.14** voltage gain and resistance

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

---

**Scilab code Exa 27.15** voltage gain and resistance

```

1  clc;
2  //e.g 27.15
3  hfe=100;
4  hie=2*10**3;
5  Rc=470;
6  Re1=100;
7  Re2=100;
8  R1=15000;
9  R2=5600;
10 AV=(hfe*Rc)/hie;
11 disp(AV);
12 a=((R1*R2)/(R1+R2));
13 Ri=(a*hie)/(a+hie);
14 disp('ohm',Ri*1," Ri=");
15 b=Re1/Rc;
16 AV1=AV/(1+b*AV);
17 disp(AV1);
18 Ri1=Ri*(1+b*AV);
19 disp('OHM',Ri1*1," Ri1=");

```

---

#### Scilab code Exa 27.16 gain and resistance

```

1  clc;
2  //e.g 27.16
3  hfe=99;
4  hie=2*10**3;
5  hie1=2000;
6  hie2=2000;
7  Rc=22*10**3;
8  R4=100;
9  R1=220*10**3;
10 R2=22*10**3;
11 RC1=4.7*10**3;
12 R3=7.8*10**3;
13 Ri=hie;

```

```
14 a=(R1*R2)/(R1+R2);
15 b=(a*Rc)/(a+Rc);
16 R01=(b*hie1)/(b+hie1)
17 disp('Kohm',R01*10**-3,'R01=');
18 Ri2=hie;
19 C=(R3+R4);
20 R02=(RC1*C)/(RC1+C)
21 disp('Kohm',R02*10**-3,'R02=');
22 AV1=hfe*R01/hie;
23 AV2=hfe*R02/hie;
24 AV=AV1*AV2;
25 bta=R4/(R3+R4);
26 Ri1=Ri*(1+bta*AV);
27 disp('Kohm',Ri1*10**-3,'Ri1=');
28 R02=R02/(1+bta*AV);
29 disp('ohm',R02*1,'R02=');
30 AV1=AV/(1+bta*AV);
31 disp(AV1);
```

---



# Chapter 28

## SINUSOIDAL OSCILLATORS

Scilab code Exa 28.1 inductance

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

---

Scilab code Exa 28.2 frequency

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

---

### Scilab code Exa 28.3 frequency

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

---

### Scilab code Exa 28.4 frequency

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

---

### Scilab code Exa 28.5 frequency

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

---

### Scilab code Exa 28.6 capacitance

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

---

### Scilab code Exa 28.7 capacitance

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

---

### Scilab code Exa 28.8 c1 and c2

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

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

---

#### Scilab code Exa 28.9 gain and frequency

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

---

#### Scilab code Exa 28.10 frequency

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

---

#### Scilab code Exa 28.11 inductance and frequency

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

```

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

```

---

#### Scilab code Exa 28.13 frequency

```

1 clc;
2 //e.g 28.13
3 C1=0.1*10**-6;
4 C2=1*10**-6;
5 C3=100*10**-12;
6 L=470*10**-6;
7 C=1/((1/C1)+(1/C2)+(1/C3));
8 fo=1/(2*%pi*sqrt(L*C));
9 disp('kHz',fo*10**-3,'fo=');

```

---

#### Scilab code Exa 28.14 frequency

```

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

```

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

---

**Scilab code Exa 28.15** frequency fs and fp

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

---

# Chapter 29

## NON SINUSOIDAL OSCILLATORS

Scilab code Exa 29.1 FREQUENCY

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

---

Scilab code Exa 29.2 value of capacitors

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

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

---

### Scilab code Exa 29.3 value of capacitors

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

---

### Scilab code Exa 29.4 value of circuit components

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



```

13 IBsat=IC/hFE;
14 IB=2*IBsat;
15 R=VCC/IB;
16 R1=R;
17 R2=R;
18 C1=T2A/(0.69*R1);
19 disp('pF',C1*10**12,"C1=");
20 C2=T2B/(0.69*R2);
21 disp('pF',C2*10**12,"C2=");
22 tao1=R1*C1;
23 disp('microsec',tao1*10**6,"tao1=");
24 tao2=R2*C2;
25 disp('microsec',tao2*10**6,"tao2=");
26 tao11=RC1*C1/2;
27 disp('microsec',tao11*10**6,"tao11=");
28 tao12=RC2*C2/2;
29 disp('microsec',tao12*10**6,"tao12=");

```

---

#### Scilab code Exa 29.5 duty cycle

```

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

```

---

#### Scilab code Exa 29.6 R3 and C1

```

1
2 clc;
3 close;

```

```

4 f=100*10(-3);
5 T=(1/f);
6 disp('us',T*1,'T=');
7 tp=(1/T);
8 disp('us',tp*1,'tp=');
9 C1=0.001*10(-6);
10 R3=((5*10(-6))/(0.69*C1));
11 disp('kohm',R3*10(-3),'R3=');

```

---

Scilab code Exa 29.7 width

```

1
2 clc;
3 RC=2*10**3;
4 R3=20*10**3;
5 rbb=200;
6 C1=1000*10**-12;
7 T=0.69*C1*R3;
8 disp('microsec',T*10**6,"T=");

```

---

Scilab code Exa 29.8 value of pulse width

```

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

```

---

Scilab code Exa 29.9 CIRCUIT

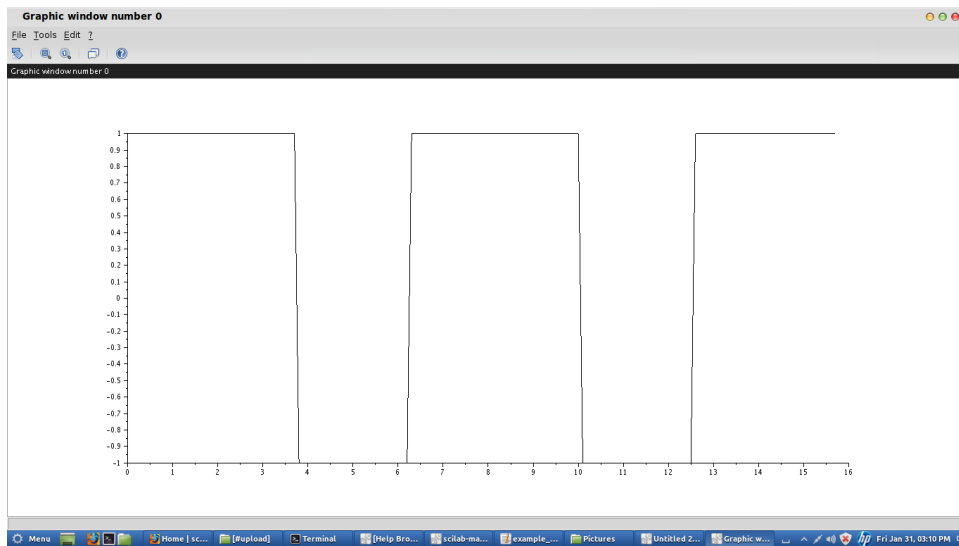


Figure 29.1: CIRCUIT

```

1
2 clc;
3 tp=10*10**-6;
4 c=1000*10**-12;
5 R1=tp/(1.1*c);
6 disp( 'Kohm ', R1*10**-3, "R1=" );
7 t=(0:0.1:5*%pi)';
8 plot2d1( 'onn', t, [squarewave(t,60)]);

```

---

Scilab code Exa 29.10 duty cycle

```

1 clc;
2 //e.g 29.10
3 R1=6.8*10**3;
4 R2=4.7*10**3;
5 C1=1000*10**-12;

```



Figure 29.2: frequency and graph

```

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

```

---

### Scilab code Exa 29.11 frequency and graph

```

1
2 clc;
3 R1=27*10**3;
4 R2=56*10**3;
5 C1=0.01*10**-6;
6 t2=0.7*R2*C1;
7 t1=0.7*(R1+R2)*C1;

```

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

---

### Scilab code Exa 29.12 design

```
1
2 clc;
3 f=50*10**3;
4 dutyc=0.60;
5 C=0.0022*10**-6;
6 T=1/f;
7 t1=dutyC*T;
8 t2=T-t1;
9 R2=(t2)/(0.7*C);
10 disp('Kohm',R2*10**-3," R2=");
11 R1=(t1)/(0.7*C)-R2;
12 disp('Kohm',R1*10**-3," R1=");
```

---

# Chapter 30

## LINEAR WAVE SHAPING CIRCUIT

Scilab code Exa 30.2 VOLTAGE

```
1
2 clc;
3 C=1*10**-6;
4 Vi=6;
5 R=10*10**3;
6 Vo=-3;
7 t=8*10**-3;
8 tao=R*C;
9 disp('msec',tao*10**3,"tao=");
10 vf=6*(1-exp(-8/10));
11 disp('V',vf*1,"vf=");
12 output=vf-3.0;
13 disp('V',output*1,"output=");
```

---

Scilab code Exa 30.3 VOLTAGE

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

---

**Scilab code Exa 30.4** peak value of input voltage

```
1
2 clc;
3 tao=250*10**-12;
4 v=50;
5 a=v/tao;
6 t=0.05*10**-6;
7 vp=a*t;
8 disp('kV',vp*10**-3,"vp=");
```

---

# Chapter 31

## TIME BASE CIRCUIT

Scilab code Exa 31.1 frequency

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

---

Scilab code Exa 31.2 period and frequency of oscillation and R

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



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

---

# Chapter 32

## OPERATIONAL AMPLIFIERS

Scilab code Exa 32.1 CMRR

```
1 clc ;  
2 Adm=200000 ;  
3 Acn=6.33 ;  
4 CMRR=20*log10(Adm/Acn) ;  
5 disp('dB', CMRR*1, "CMRR=") ;
```

---

Scilab code Exa 32.2 common mode gain

```
1 clc ;  
2 Adm=30000 ;  
3 //CMRR=20*log10(Adm/Acn) ;  
4 a=90/20 ;  
5 Acn=(Adm/10^a) ;  
6 disp(Acn) ;
```

---

### Scilab code Exa 32.3 maximum frequency

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

---

### Scilab code Exa 32.4 suitable opamps

```
1 clc;
2 Vpk=10;
3 slewrate=0.5*10**6;
4 fmax=slewrate/(2*%pi*Vpk);
5 disp('HZ',fmax*1,"fmax="); //value of microamp 741
6 slewrate=13*10**6;
7 fmax=slewrate/(2*%pi*Vpk);
8 disp('kHz',fmax*10**-3,"fmax="); //TLO 81
9 //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

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

---

**Scilab code Exa 32.7** voltage

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

---

**Scilab code Exa 32.8** output voltage

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

---

**Scilab code Exa 32.9** gain input impedance cmrr and fmax

```
1 clc;  
2 AcM=0.001;  
3 Aol=180000;  
4 Zin=1*10**6;  
5 Zout=80;  
6 SR=0.5;  
7 R2=100*10**3;  
8 R1=10*10**3;
```

```

9  Acl=R2/R1;
10 disp(Acl);
11 Zin=R1;
12 disp('kOhm',Zin*10**-3,"Zin=");
13 disp('Ohm',Zout*1,"Zout=");
14 CMRR=Acl/Acm;
15 disp(CMRR);
16 Vpk=5;
17 fmax=SR/(2*%pi*Vpk);
18 disp('kHz',fmax*10**3,"fmax=");

```

---

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

```

1  clc;
2  R2=100*10**3;
3  R1=10*10**3;
4  Acl=1+(R2/R1);
5  Acm=0.001;
6  disp(Acl);
7  CMRR=Acl/Acm;
8  disp(CMRR);
9  SR=0.5;
10 Vpk=5.5;
11 fmax=SR/(2*%pi*Vpk);
12 disp('kHz',fmax*10**3,"fmax=");

```

---

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

```

1  clc;
2  Acm=0.001;
3  AOL=180000;
4  Zin=1*10**6;
5  Zout=80;

```

```

6 SR=0.5;
7 Ac1=1;
8 CMRR=Ac1/Acm;
9 disp(CMRR);
10 Vpk=3;
11 fmax=SR/(2*pi*Vpk)
12 disp('kHz',fmax*10**3,"fmax=");

```

---

Scilab code Exa 32.12 output voltage

```

1 clc;
2 //e.g 32.12
3 V1= 0.1;
4 V2=1;
5 V3=0.5;
6 R1=10*10**3;
7 R2=10*10**3;
8 R3=10*10**3;
9 R4=22*10**3;
10 Vout=((-R4*V1)/R1)+((-R4*V2)/R2)+((-R4*V3)/R3);
11 disp('V',Vout*-1,"Vout=");

```

---

Scilab code Exa 32.14 output voltage

```

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

```

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

---

# Chapter 33

## OP AMP APPLICATION

Scilab code Exa 33.1 value of capacitance

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

---

Scilab code Exa 33.2 frequency

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

---



**Scilab code Exa 33.3** cutoff frequency and max operating frequency

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

---

**Scilab code Exa 33.4** frequency

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

---

## Chapter 34

# REGULATED POWER SUPPLIES

Scilab code Exa 34.1 value of line regulation

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

---

Scilab code Exa 34.2 Change in output voltage

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

---

**Scilab code Exa 34.3** value of load regulation

```
1 clc ;
2 //e.g 34.3
3 IL=40*10**-3;
4 VNL=8;
5 VFL=7.995;
6 LR=(VNL-VFL)/IL;
7 disp('microV/mA',LR*10**3,'LR=');
```

---

**Scilab code Exa 34.4** voltage under full load

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

---

**Scilab code Exa 34.5** magnitude of variation in output voltage

```
1 clc ;
2 //e.g 34.5
3 V0=10;
4 R=0.00002
5 VAR=V0*R;
6 disp('mV',VAR*10**3,'VAR=');
```

---

**Scilab code Exa 34.6** load voltage voltage drop and current

```
1 clc;  
2 //e.g 34.6  
3 vs=30;  
4 rs=240;  
5 vz=12;  
6 rl=500;  
7 vl=vz;  
8 disp('V',vl," vl=");  
9 Is=(vs-vz)/rs  
10 Vd=Is*rs;  
11 disp('V',Vd*1," Vd=");  
12 Iz=Is-(vl/rl)  
13 disp('A',Iz*1," Iz=");
```

---

**Scilab code Exa 34.7** min and max value of input voltage

```
1 clc;  
2 //e.g 34.7  
3 Vz=5.1;  
4 rz=10;  
5 Izmin=1*10**-3;  
6 Izmax=15*10**-3;  
7 Rs=600;  
8 Vomn=Vz+Izmin*rz;  
9 disp('V',Vomn*1," Vomn=");  
10 Vsmin=Izmin*Rs+Vomn;  
11 disp('V',Vsmin*1," Vsmin=");  
12 Vomax=Vz+Izmax*rz;  
13 disp('V',Vomax*1," Vomax=");
```

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

---

**Scilab code Exa 34.8** min and max value of load current

```
1 clc;  
2 //e.g 34.8  
3 Vs=24;  
4 Rs=500;  
5 Vz=12;  
6 Izmin=3*10**-3;  
7 Izmax=90*10**-3;  
8 rz=0;  
9 Is=(Vs-Vz)/Rs;  
10 disp('mA',Is*10**3,"Is=");  
11 ILmax=Is-Izmin;  
12 disp('mA',ILmax*10**3,"ILmax=");  
13 RLmin=Vz/ILmax;  
14 disp('ohm',RLmin*1,"RLmin=");
```

---

**Scilab code Exa 34.9** min and max value of zener current

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

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

---

**Scilab code Exa 34.10** max value of Rs and power

```
1 clc;
2 Vz=10;
3 Vsmin=13;
4 Vsmax=16;
5 ILmin=10*10**-3;
6 ILmax=85*10**-3;
7 Izmin=15*10**-3;
8 Rsmax=(Vsmin-Vz)/(Izmin+ILmax);
9 disp('ohm',Rsmax*1,"Rsmax=");
10 Izmax=((Vsmax-Vz)/Rsmax)-ILmin;
11 Pzmax=Izmax*Vz;
12 disp('W',Pzmax*1,"Pzmax=");
```

---

**Scilab code Exa 34.11** regulated resistance

```
1 clc;
2 Vsmin=19.5;
3 Vsmax=22.5;
4 RL=6*10**3;
5 Vz=18;
6 Izmin=2*10**-6;
7 Pzmax=60*10**-3;
8 rz=20;
9 Izmax=sqrt(Pzmax/rz);
10 IL=Vz/RL;
11 ILmax=IL;
12 ILmin=IL;
13 Rsmax=(Vsmin-Vz)/(Izmin+ILmax);
```

```
14 disp('ohm',Rsmx*1,"Rsmx=");
15 Rsmn=(Vsmx-Vz)/(Izmx+ILmn);
16 disp('ohm',Rsmn*1,"Rsmn=");
```

---

**Scilab code Exa 34.12** min and max value of zener current

```
1 clc;
2 Vsmin=8;
3 Vsmax=12;
4 Rs=2.2*10**3;
5 Vz=5;
6 RL=10*10**3;
7 Ismin=(Vsmin-Vz)/Rs;
8 Ismax=(Vsmax-Vz)/Rs;
9 IL=Vz/RL;
10 Izmin=Ismin-IL;
11 disp('mA',Izmin*10**3,"Izmin=");
12 Izmax=Ismax-IL;
13 disp('mA',Izmax*10**3,"Izmax=");
```

---

**Scilab code Exa 34.13** zener regulator

```
1 clc;
2 VL=5;
3 Vz=5;
4 IL=20*10**-3;
5 Pzmax=500*10**-3;
6 Vsmax=15;
7 Vsmin=9;
8 Izmax=Pzmax/Vz;
9 Ismax=IL+Izmax;
10 Vz=VL;
11 Rsmn=(Vsmax-Vz)/(Izmax+IL);
```

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

---

**Scilab code Exa 34.14** regulated voltage and circuit current

```
1 clc;
2 Vz=10;
3 Vbe=0.7;
4 RL=100;
5 Vs=15;
6 B=100;
7 Rs=33;
8 VL=Vz+Vbe;
9 IL=VL/RL;
10 Is=(Vs-VL)/Rs;
11 Ic=Is-IL;
12 Ib=Ic/B;
13 disp('microA',Ib*10**6,"Ib=");
```

---

**Scilab code Exa 34.15** voltage current

```
1 clc;
2 Vs=15;
3 Vz=8.3;
4 B=100;
5 R=1.8*10**3;
6 RL=2*10**3;
7 Vbe=0.7;
8 VL=Vz-Vbe;
9 Vce=Vs-VL;
10 IR=(Vs-Vz)/R;
```



```

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

```

---

**Scilab code Exa 34.16** max value of Resistance and power

```

1  clc;
2  ILmin=0;
3  ILmax=2;
4  VL=12;
5  Vsmin=15;
6  Vsmax=20;
7  B=100;
8  VBE=0.5;
9  Vz=12.5;
10 Izmin=1*10**-3;
11 IBmax=ILmax/B;
12 IR=IBmax+Izmin
13 Rmax=(Vsmin-Vz)/IR;
14 disp('ohm',Rmax*1,"Rmax=");
15 Izmax=(Vsmax-Vz)/Rmax;
16 disp('mA',Izmax*10**3,"Izmax=");
17 Pzmax=Vz*Izmax;
18 disp('W',Pzmax*1,"Pzmax=");
19 PRmax=(Vsmax-Vz)*Izmax;
20 disp('W',PRmax*1,"PRmax=");
21 VCEmax=Vsmax-VL;
22 disp('V',VCEmax*1,"VCEmax=");
23 PDmax=VCEmax*ILmax;
24 disp('W',PDmax*1,"PDmax=");

```

---

Scilab code Exa 34.17 circuit and value of current

```
1  clc;
2  VL=12;
3  IL=200*10**-3;
4  Vs=30;
5  Rs=10;
6  B1=150;
7  Ic1=10*10**-3;
8  VBE1=0.7;
9  B2=100;
10 VBE2=0.7;
11 Vz=6;
12 Rz=10;
13 Iz=20*10**-3;
14 ID=10*10**-3;
15 I1=10*10**-3;
16 RD=(VL-Vz)/ID;
17 disp('ohm',RD*1,"RD=");
18 //a=R1/R2;
19 a=(VL/(Vz+VBE2))-1;
20 Ic2=Ic1;
21 IB2=Ic2/B2;
22 V2=Vz+VBE2;
23 Vz=12;
24 R1=(Vz-V2)/I1;
25 disp('ohm',R1*1,"R1=");
26 R2=R1/a;
27 disp('ohm',R2*1,"R2=");
28 hfe1=B1;
29 IB1=(IL+I1+ID)/hfe1;
30 I=IB1+Ic2;
31 R3=(Vs-(VBE1+VL))/I;
32 disp('Kohm',R3*10**-3,"R3=");
```

---

**Scilab code Exa 34.18** vout IL IE PI

```
1  clc;
2  Vs=25;
3  Vz=15;
4  RL=1*10**3;
5  VBE2=0.7;
6  Vout=(Vz/2)+VBE2;
7  disp('V',Vout*1,"Vout=");
8  IL=Vout/RL;
9  IE1=IL;
10 disp('mA',IE1*10**3,"IE1=");
11 Vce1=Vs-Vout;
12 P1=Vce1*IE1;
13 disp('mW',P1*10**3,"P1=");
```

---

**Scilab code Exa 34.19** min and max value of voltage

```
1  clc;
2  IADJ=100*10**-6;
3  Vin=35;
4  VREF=1.25;
5  R2=0;
6  R1=220;
7  Voutmin=VREF*(1+(R2/R1))+IADJ*R2;
8  disp('V',Voutmin*1,"Voutmin=");
9  R2=5000;
10 Voutmax=VREF*(1+(R2/R1))+IADJ*R2;
11 disp('V',Voutmax*1,"Voutmax=");
```

---

Scilab code Exa 34.20 regulated voltage

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

---

Scilab code Exa 34.21 regulated dc output voltage

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

---