Scilab Textbook Companion for Electronic Devices and Circuits by J. Paul[1]

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June 18, 2016

[1]Funded by a grant from the National Mission on Education through ICT, http://spoken-tutorial.org/NMEICT-Intro. This Textbook Companion and Scilab codes written in it can be downloaded from the "Textbook Companion Project" section at the website http://scilab.in

Book Description

Title: Electronic Devices and Circuits

Author: J. Paul

Publisher: New Age International

Edition: 1

Year: 2003

ISBN: 812241415X

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

Exa Example (Solved example)

Eqn Equation (Particular equation of the above book)

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

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

Contents

List of Scilab Codes

Chapter 1

Semiconductor Physics

Scilab code Exa 1.1 Minority carrier concentration

```
1 //pagenumber 24 example 1
2 clear
3 incaco=1.5*10^16;//cubic metre
4 resist=2*10^3;//ohm metre
5 dopcon=10^20;//metre
6 q=26*10^-3;//electron volt
7 //(1)
8 w=2.25*10^32/dopcon;
9 //(3)
10 shifer=q*log(dopcon/incaco);//shift in fermi level
11 ni=9*10^32;
12 //(3)
13 w1=ni/dopcon;
14 disp("minority concentration = "+string((w))+"
     per metre square");
15 disp("shift in fermi = "+string((shifer))+"volt"
     );
16 disp("minority concentration when n doubled = "+
     string((w1))+"per cubic metre");
```

Scilab code Exa 1.2 example 2

```
1 //pagenumber 25 example 2
2 clear
3 format(12)
4 numfre=7.87*10^28;//per cubic metre
5 molity=34.8;//square centimetre/velocity second
6 e=30;//volt per centimetre
7 //(1)
8 molity=molity*10^-4;q=1.6*10^-19;
9 conduc=numfre*q*molity;
10 //(2)
11 e=e*10^2;
12 veloci=(molity*e);
13 curden=conduc*e;
14 disp("conductivity = "+string((conduc))+"second
   per metre");
15 disp("drift velocity = "+string((veloci))+"metre
    per second");
16 disp("density = "+string((curden))+"ampere per
   cubic metre");
```

Scilab code Exa 1.3 example 3

```
1 //pagenumber 26 example 3
2 clear
3 ni=2.5*10^13;//per square centimetre
```

```
4 moe=3800//square centimetre/velocity second
5 mo1=1800;//square centimetre/velocity second
6 num=4.51*10^22;//number of atoms
7 q=1.6*10^-19;
8 conduc=ni*q*(moe+mo1);
9 num=num/10^7;
10 impura=(ni^2)/num;
11 ni=5*10^14;
12 condu1=ni*q*moe;
13 disp("conductivity = "+string((conduc))+"second
   per centimetre");
14 disp("conductivity at extent of 1 impurity = "+
   string((condu1))+"second per centimetre");//there
    is mistake in book as 3.04s/cm
15 conduc=num*q*mo1;
16 disp("conductivity acceptor to extent of 1 impurity
     = "+string((conduc))+"second per centimetre"
   );
```

Scilab code Exa 1.4 example 4

```
1 //pagenumber 27 example 4
2 clear
3 ni=1.5*10^10;//per cubic centimetre
4 moe=1300;//square centimetre/velocity second
5 mo1=500;//square centimetre/velocity second
6 w=5*10^22;//atoms per cubic centimetre
7 q=1.6*10^-19;
8 //(a) conductivity intrinisc at 300kelvin
9 conduc=ni*q*(moe+mo1);//conductivity
10 u=((ni)/(5*10^14));
11 ni=5*10^14;
12 //(b)conductivity when donor atom added to extent of
```

```
    1 impurity
13 condu1=ni*q*moe;
14 disp("conductivity intrinisc at 300kelvin  =  "+
   string((conduc))+"second per centimetre");
15 disp("conductivity when donor atom added to extent
   of 1 impurity  =  "+string((condu1))+"second
   per centimetre");
16 //conductivity when acceptor added to extent of 1
   impurity
17 conduc=ni*q*mo1;
18 disp("conductivity when acceptor added to extent of
   1 impurity  =  "+string((conduc))+"second per
   centimetre");
```

Scilab code Exa 1.5 example 5

```
1  //pagenumber 28 example 5
2  clear
3  ni=2.5*10^13;//per cubic centimetre
4  moe=3800;//square centimetre/velocity second
5  mo1=1800;//square centimetre/velocity second
6  w=4.5*10^22;//atoms per cubic centimetre
7  q=1.6*10^-19;
8  //(1) conductivity intrinisc at 300kelvin
9  conduc=ni*q*(moe+mo1);
10 u=10^6;
11 u=((w)/(u));
12 //(2) conductivity with donor impurity 1
13 condu1=u*q*moe;
14 disp("conductivity intrinisc at 300kelvin  =  "+
   string((conduc))+"second per centimetre");
15 disp("conductivity with donor impurity 1  =  "+
   string((condu1))+"second per centimetre");
```

```
16 u=10^7;u=w/u;
17 //(3) conductivity with acceptor impurity 1
18 conduc=u*q*mo1;
19 disp("conductivity with acceptor impurity 1   =   "+
      string((conduc))+"second per centimetre");
20 u=0.9*(w/10^6);
21 //(4) conductivity on both
22 conduc=u*q*moe;
23 disp("conductivity on both   =   "+string((conduc))+
      "second per centimetre");
```

Scilab code Exa 1.6 example 6

```
1 //pagenumber 29 example 6
2 clear
3 ferlev=0.3;//electron volt
4 u=300;//kelvin
5 u1=330;//kelvin
6 ferlev=ferlev*u1/u;
7 disp("fermi   =   "+string((ferlev))+"electron volt"
     );
8 disp("fermi below the conduction band");
```

Scilab code Exa 1.7 example 7

```
1 //pagenumber 29 example 7
2 clear
3 ferlev=0.02;//electron volt
4 q=4;//donor impurity added
```

```
w=0.025;//electron volt
ferlev=-((log(q)-8))/40;
disp("fermi   =   "+string((ferlev))+"electron volt"
   );
```

Scilab code Exa 1.8 example 8

```
//pagenumber 30 example 8
clear
area=1.5*10^-2;//centimetre square
w=1.6;//centimetre
resist=20;//ohm centimetre
durati=60*10^-6;//second in book given as mili
quanti=8*10^15;//photons per second


//(1) resistance at each photon gives a electron
   hole pair
up=1800;//centimetre square per velocity second
un=3800;//centimetre square per velocity second
q=1.6*10^-19;//coulomb
ni=2.5*10^13;//per cubic centimetre
sigma1=1/resist;
z1=3800;
z=-sigma1/q;
u=ni^2/up;
n=poly([(z1) z u],'n');
roots(n);
n=7.847*10^13;//n>ni taken so it is admissible
p1=ni^2/n;
volume=w*area;
nchang=quanti*durati/volume;
pchang=nchang;
```

```
26 sigm11=q*((n+nchang)*un+(pchang+p1)*up);
27 resis1=1/sigm11;
28 r1=resis1*w/area;
29 disp("resistance    =    "+string((r1))+"ohm");//book
      only one resistance has been given
```

Scilab code Exa 1.9 example 9

```
1 //pagenumber 31 example 9
2 clear
3 moe=1350;//square centimetre/velocity second
4 mo1=450;//square centimetre/velocity second
5 ni=1.5*10^10;//per cubic centimetre
6 concn1=ni*((sqrt(mo1/moe)));//concentration
7 concne=((ni^2)/(concn1));
8
9
10 disp("concentration of electron    =    "+string((
      concn1))+"per cubic centimetre");
11 disp("concentration of holes    =    "+string((concne)
      )+"per cubic centimetre");
```

Scilab code Exa 1.10 example 10

```
1 //pagenumber 32 example 10
2 clear
3 resist=0.12;//ohm metre
4 q=1.6*10^-19;
```

```
5 concn1=((1/resist)/(0.048*q));//concentration of
    hole
6 concne=((1.5*10^16)^(2))/concn1;//concentration of
    electron
7 disp("concentration of hole   =   "+string((concn1))
    +"per cubic centimetre");
8 disp("concentration of electron   =   "+string((
    concne))+"per cubic centimetre");
```

Scilab code Exa 1.11 example 11

```
1 //pagenumber 32 example 11
2 clear
3 resist=1*10^3;//ohm
4 w=20*10^-6;//wide metre
5 w1=400*10^-6;//long metre
6 mo1=500;//square centimetre/velocity second
7 q=1.6*10^-19;
8 conduc=(resist*w*4*10^-6)/w1;
9 concentration=((1)/(conduc*mo1*q));
10 disp("concentration of acceptor atoms   =   "+string
    ((concentration))+"per cubic metre");//correction
     in the book
```

Scilab code Exa 1.12 example 12

```
1 //pagenumber 32 example 12
2 clear
3 w=0.026;
```

```
4 moe=3800;//square centimetre/velocitysecond
5 mo1=1300;//square centimetre/velocitysecond
6 u=(moe*w);
7 u1=(mo1*w);
8 disp("dn constants   =   "+string((u))+"square metre
      per second");//correction in the book
9 disp("dp constants   =   "+string((u1))+"square
     metre per second");//correction in the book
```

Scilab code Exa 1.13 example 13

```
1 //pagenumber 33 example 13
2 clear
3 w=0.026*(3/2)*log(3)/2;
4 disp("distance of fermi level from center   =   "+
     string((w))+"   electron volt");
```

Scilab code Exa 1.14 example 14

```
1 //pagenumber 33 example 14
2 clear
3 up=1800;//centimetre square per velocity second
4 un=3800;//centimetre square per velocity second
5
6 //(1) resistivity is 45 ohm
7 q=1.6*10^-19;//coulomb
8 ni=2.5*10^13;
9 sigma1=(un+up)*q*ni;
10 resist=1/sigma1;
```

```
11 disp("resistivity = "+string((resist))+" ohm
   centimetre");
12 disp("resistivity equal to 45");
13 //(2) impurity added to extent of 1 atom per 10^9
14 n=4.4*10^22/10^9;
15
16 p1=ni^2/n;
17 sigma1=(n*un+p1*up)*q;
18 resist=1/sigma1;
19
20 disp("resistivity = "+string((resist))+" ohm
   centimetre");
21 disp("resistivity equal to 32.4");
```

Scilab code Exa 1.15 example 15

```
1 //pagenumber 34 example 15
2 clear
3 nd=4*10^14;//atoms per cubic centimetre
4 na=5*10^14;//atoms per cubic centimetre
5 //(1) concentration
6 ni=2.5*10^13;
7 np=ni^2;
8 //p1=n+10^14
9 z=1;
10 z1=10^14;
11 u=-ni^2;
12 n=poly([z z1 u],'q');
13 roots(n);//n taken as
14 n=1.05*10^4;
15 disp("concentration of the a free electrons = "+
   string((n)));
16 p1=n+10^14;
```

```
17 disp("concentration of the a free holes   =   "+
     string((p1)));
18 //(2)
19 disp("sample p");
20 a=ni^2/(300^3*exp(-(0.785/0.026)));
21 w=400;//kelvin
22 ni=sqrt(a*w^3*exp(-0.786/(8.62*10^-5*w)));
23 ni=((n)*(n+10^14))/10^3;
24 n=ni-0.05*10^15;
25 disp("n   =   "+string((n))+"electrons per cubic
     centimetre");
26 p1=n+10^14;
27 disp("p   =   "+string((p1))+"holes per cubic
     centimetre");
28
29
30 disp("essentially intrinsic");
```

Scilab code Exa 1.16 example 16

```
1 //pagenumber 35 example 16
2 clear
3 w=300;//kelvin
4 conduc=300;//ohm centimetre inverse
5 u=1800;
6 p=conduc/(u*1.6*10^-19);//concentration holes
7 n=(2.5*10^13)^2/(p);
8 disp("concentration of n   =   "+string((n))+"
     electrons per cubic centimetre");
9
10 disp("concentration of holes   =   "+string((p))+"
     holes per cubic centimetre");
```

Scilab code Exa 1.17 example 17

```
1 //pagenumber 35 example 17
2 clear
3 nd=10^14;//atoms per cubic centimetre
4 na=5*10^13;//atoms per cubic centimetre
5 un=3800;
6 up=1800;
7 q=1.6*10^-19;//coulomb
8 resist=80;//ohm metre
9 e1=5;//volt per metre
10 w=nd-na;
11 ni=(un+up)*q*resist;
12 p1=poly([1 w -ni^2],'q');
13 roots(p1);//p1=taken as 3.65*19^12
14 p1=3.65*10^12;
15 n=p1+w;
16 j=(n*un+p1*up)*q*e1;
17 disp("current density = "+string((j))+"ampere
   per square centimetre");
```

Scilab code Exa 1.18 example 18

```
1 //pagenumber 36 example 18
2 clear
3 na=1*10^16;//per cubic centimetre
   correction in the book
4 ni=1.48*10^10;//per cubic centimetre
```

```
un=0.13*10^4;//centimetre square per velocity second
u=0.05*10^4;//centimetre square per velocity second
n=ni^2/na;
q=1/(1.6*10^-19*(un*n+(u*na)));
disp("resistivity   =   "+string((q))+"ohm
   centimetre");
```

Scilab code Exa 1.19 example 19

```
//pagenumber 37 example 19
clear
e1=750;//volt per metre
b=0.05;//metre square per velocity second
un=0.05;//metre square per velocity second
up=0.14;//metre square per velocity second
//(1) voltage
w=1.25*10^-2;//metre
v1=e1*w;
disp("voltage across sample   =   "+string((v1))+"
   volt");
//(2) drift velocity
vd=un*e1;
disp("drift velocity   =   "+string((vd))+"metre per
    second");
//transverse force per  coulomb
f1=vd*b;
disp("transverse force per coulomb   =   "+string((
   f1))+"newton per coulomb");
//(4) transverse electric field
e1=vd*b;
disp("transverse electric field   =   "+string((e1))
   +"volt per metre");
//(5) hall voltage
```

```
21 q=0.9*10^-2;
22 vh=e1*q;
23
24 disp("hall voltage = "+string((vh))+"volt");
```

Scilab code Exa 1.20 example 20

```
1 //pagenumber 37 example 20
2 clear
3 un=1300;//centimetre square per velocity second
4 //at 300kelvin
5 ni=1.5*10^10;
6 u=500;//centimetre square per velocity second
7 conduc=1.6*10^-19*1.5*10^10*(un+u);
8 q=1/conduc;
9 //impurity of 1 atom included per 10^5 atoms
10 disp("resistivity at 300kelvin = "+string((q))+"
   ohm centimetre");
11 n=5*10^22/10^5;
12 p=ni^2/n;
13 q=1/(1.6*10^-19*(un*n+(u*p)));
14
15
16 disp("resistivity at impurity of 1 atom included per
    10^5 atoms = "+string((q))+"ohm centimetre")
   ;
```

Scilab code Exa 1.21 example 21

```
1  //pagenumber 38 example 21
2  clear
3  n=4.4*10^22;
4  nd=n/10^7;
5  w=300;//kelvin
6  nc=4.82*10^15*w^(3/2)/1/sqrt(8);
7  ec_ef1=-0.026*log((nc/(nd)));
8  disp("ec-ef   =   "+string((ec_ef1)));
9  //(2) impurities included inratio 1 to 10^3
10 n=4.4*10^22;
11 nd=n/(10^3);
12 ec_ef1=-0.026*log(nc/nd);
13 disp("ec-ef   =   "+string((ec_ef1))+"electron volt
       ef above ec");
14 q=log10(nd/nc)/log10(10);
15 disp("impurities included per germanium atoms   =
     0.0002");
```

Scilab code Exa 1.22 example 22

```
1  //pagenumber 39 example 22
2  clear
3  n=5*10^22;//atoms per cubic centimetre
4  //(1) 1 atom per 10^6
5  m=0.8;//metre
6  na=n/10^6;
7  w=300;//kelvin
8  nv=4.82*10^15*(m)^(3/2)*w^(3/2);
9  ef_ec=0.026*log(nv/na);
10 disp("ef-ec   =   "+string((ef_ec))+"electron volt")
       ;
11 //(2) impurity included 10*10^3 per atom
12 na=n/(10*10^3);
```

```
13 ef_ec=0.026*log(nv/na);
14 disp("ef-ec    =    "+string((ef_ec))+"electron volt")
     ;
15 //(3) condition to concide ec=ef
16 na=4.81*10^15;
17 w=(nv/na)^(2/3);
18 disp("temperature    =    "+string((w))+"kelvin");//
     correction in the book
```

Scilab code Exa 1.23 example 23

```
1 //pagenumber 40 example 23 //figure is not given in
     the book
2 clear
3 nd=10^7;//per cubic centimetre
4 na=10^17;//per cubic centimetre
5 voltag=0.1*3800*10^-4*1500*3*10^-3;
6 disp("hall voltage    =    "+string((voltag))+"volt");
7 disp("remains the same but there change in polarity"
     );
```

Scilab code Exa 1.24 example 24

```
1 //pagenumber example 24
2 clear
3 vh=60*10^-3;//volt
4 w=6*10^-3;//metre
5 bz=0.1;//weber per metre square
6 i1=10*10^-6;//ampere
```

```
resist=300000*10^-2;//ohm metre
//(1)
//mobility
rh=vh*w/(bz*i1);
u1=rh/resist;
disp("mobilty    =    "+string((u1))+"metre square per
    velocity second");
```

Chapter 2

Semiconductor Diodes

Scilab code Exa 2.1 example 1

```
1  //pagenumber 99 example 1
2  clear
3  q=0.01;//centimetre
4  sigma1=1;//ohm centimetre inverse
5  q1=0.01;//centimetre
6  sigm11=0.01;//ohm centimetre inverse
7  iratio=(0.0224^2*2.11*20)*3.6^2/((3.11*(4.3^2*10^-6)
       ^2*2.6*20*10^3));
8  for q=1:2
9      if q==1 then
10         un=3800;
11         up=1500;
12         q=1.6*10^-19;
13         ni=2.5*10;
14     else
15         q=1.6*10^-19;
16         up=500
17         un=1300;
18         ni=1.5*10
```

```
19 end
20
21     b=un/up;
22     sigmai=(un+up)*q*ni;
23 end
24 disp("ratio of reverse saturation current   =   "+
     string((iratio)));//correction in the book
```

Scilab code Exa 2.2 example 2

```
1 //pagenumber 100 example 2
2 clear
3 sigma1=0.01;//ohm centimetre inverse
4 area11=4*10^-3;//metre square
5 q=0.01*10^-2;//metre
6 un=1300;
7 up=500;
8 ni=1.5*10^15;//per cubic centimetre
9 sigma1=(un+up)*1.6*10^-19*ni;
10 iratio=(4*10^-10*0.026*sigma1^2*2.6*2/10^-4)/3.6^2;
11 disp("reverse current ratio   =   "+string((iratio))
     );//correction in the book
```

Scilab code Exa 2.3 example 3

```
1 //pagenumber 100 example 3
2 clear
3 a=4*10^-4;//metre square
4 sigmap=1;
```

```
5 sigman=0.1;
6 de=0.15;
7 vtem=26*10^-3;
8 i=(a*vtem*((2.11)*(0.224))/((3.22)^(2)))*((1/de*
    sigman)+(1/de*sigmap));
9 disp("reverse saturation current   =   "+string(i)+"
    ampere");//correction in the book
```

Scilab code Exa 2.4 example 4

```
1 //pagenumber 101 example 4
2 clear
3 w=0.9;
4 voltaf=0.05;//volt
5 revcur=10*10^-6;//ampere
6 //(1) voltage
7 volrev=0.026*(log((-w+1)));//voltage at which the
    reverse saturation current at saturate
8 resacu=((exp(voltaf/0.026)-1)/((exp(-voltaf/0.026)
    -1)));//reverse saturation current
9 disp("voltage at which the reverse saturation
    current at saturate   =   "+string((volrev))+"
    volt");
10 disp("reverse saturation current   =   "+string((
    resacu))+"ampere");
11 u=0.1;
12 for q=1:3
13         reverc=revcur*(exp((u/0.026))-1)
14         disp("reverse saturation current "+string((u
             ))+"   =   "+string((reverc))+"ampere");
15         u=u+0.1;
16 end
```

Scilab code Exa 2.6 example 6

```
1 //pagenumber 103 example 6
2 clear
3 a=1*10^-6;//metre square
4 w=2*10^-6;//thick centimetre
5 re=16;
6 eo=8.854*10^-12;
7 c=(eo*re*a)/w;
8 disp("capacitance    =    "+string(c)+"farad");
```

Scilab code Exa 2.7 example 7

```
1 //pagenumber 105 example 7
2 volbar=0.2;//barrier voltage for germanium volt
3 na=3*10^20;//atoms per metre
4 //(1) width of depletion layer at 10 and 0.1 volt
5
6 for q=[-10 -0.1 0.1]
7     w=2.42*10^-6*sqrt((0.2-(q)));
8     disp("width of depletion layer at "+string((q))+
        "    =    "+string((w))+"metre");//for -0.1volt
          correction in the book
9 end
10 //(d) capacitance
11 for q=[-10 -0.1]
12     capaci=0.05*10^-9/sqrt(0.2-q);
```

```
13      disp("capacitance at "+string((q))+"    =    "+
          string((capaci))+"farad");
14  end
```

Scilab code Exa 2.8 example 8

```
1  //pagenumber 104 example 8
2  clear
3  p=2;//watts
4  voltaf=900*10^-3;//volt
5  i1=p/voltaf;
6  r1=voltaf/i1;
7  disp("maximum forward current    =    "+string(i1)+"
       ampere");
8
9
10 disp("forward diode resistance    =    "+string(r1)+"
       ohm");
```

Scilab code Exa 2.11 example 11

```
1  //pagenumber 108 example 11
2  clear
3  r=250;//ohm
4  c=40*10^-6;//farad
5  alpha1=180-atand(377*r*c);
6  disp("alpha    =    "+string(alpha1)+"degre");
```

Scilab code Exa 2.12 example 12

```
1 //pagenumber 109 example 12
2 clear
3 i1=0.1;//current in ampere
4 vms=40;//rms voltage in volts
5 c=40*10^-6;//capacitance in farad
6 r1=50;//resistance in ohms
7 ripple=0.0001;
8 induct=((1.76/c)*sqrt(0.472/ripple));//inductance
9 outv=(2*sqrt(2)*vms)/3.14-i1*r1;//output voltage
10 disp("inductance = "+string(induct)+"henry");//
   correction in the book
11 disp("output voltage = "+string(outv)+"volt");
```

Scilab code Exa 2.14 example 14

```
1 //pagenumber 109 example 14
2 clear
3 voltag=40;//volt
4 i1=0.2;//ampere
5 c1=40*10^-6;//farad
6 c2=c1;
7 induct=2;//henry
8 //(1) ripple
9 vdc=2*sqrt(2)*voltag/3.14;
10 r1=vdc/i1;
11 induc1=r1/1130;
```

```
12 v1=voltag/(3*3.14^3*120^2*4*induct*c1);
13 disp("ripple voltage = "+string((v1))+"volt");
14 //(2) with two filter
15 v1=4*voltag/((3*3.14^5)*(16*120^2*induct^2*c1^2));
16 disp("ripple voltage including filters = "+
     string((v1))+"volt");//correction in the book
17 //(3)ripple voltage
18 v1=4*voltag/(5*3.14*1.414*2*3.14*240*240*3.14*induct
     *c1);
19 v1=v1/20;
20 disp("ripple voltage = "+string((v1))+"volt");
```

Scilab code Exa 2.15 example 15

```
1 //pagenumber 111 example 15
2 clear
3 voltag=375;//volt
4 r1=2000;//ohm
5 induct=20;//henry
6 c1=16*10^-6;//farad
7 r11=100;//ohm
8 r=200;//ohm
9 //(1) voltage and ripple with load
10 disp("voltage and ripple with load");
11 r=r+r11+400;
12 vdc=((2*sqrt(2)*voltag/3.14))/1.35;
13 ripple=r1/(3*sqrt(2)*(377)*induct*2);
14 disp("vdc = "+string((vdc))+"volt");
15 disp("ripple = "+string((ripple)));
16 //(2) capacitance connected across load
17 disp("capacitance connected across load");
18 vdc=sqrt(2)*voltag/(1+1/(4*(60)*r1*2*c1));
19 ripple=1/(4*sqrt(3)*(60)*r1*2*c1);
```

```
disp("vdc    =    "+string((vdc))+" volt");
disp("ripple    =    "+string((ripple)));
//(3) filter containing two inductors and capacitors
    in parallel
disp("filter containing two inductors and capacitors
    in parallel");
vdc=250;//volt
ripple=0.83*10^-6/(2*induct*2*c1);//correction in
   the book
disp("vdc    =    "+string((vdc))+" volt");
disp("ripple    =    "+string((ripple)));
//(4) two filter
disp("two filter");
vdc=250;
ripple=sqrt(2)/(3*16*3.14^2*60^2*induct*c1)^2;//
   correction in the book
disp("vdc    =    "+string((vdc))+" volt");
disp("ripple    =    "+string((ripple)));
vdc=sqrt(2)*voltag/(1+(4170/(r1*16))+(r/r1));
ripple=3300/(16^2*2*20*r1);
disp("vdc    =    "+string((vdc))+" volt");
disp("ripple    =    "+string((ripple)));
```

Scilab code Exa 2.16 example 16

```
//pagenumber 112 example 16
clear
capaci=4;//farad
induct=20;//henry
i1=50*10^-3;//ampere
resist=200;//ohm
maxvol=300*sqrt(2);
vdc=maxvol-((4170/capaci)*(i1))-(i1*resist);
```

```
ripple=(3300*i1)/((capaci^2)*(induct)*353);
disp("output voltage    =    "+string((vdc))+"volt");
disp("ripple voltage    =    "+string((ripple)));
```

Scilab code Exa 2.17 example 17

```
//pagenumber 113 example 17
clear
voltag=25;//volt
c1=10*10^-6;//farad
i1=100*10^-3;//ampere
ripple=0.001;
w=754;//radians
//(1) inductance and resistance


r1=voltag/i1;
induct=40/(sqrt(2)*w^2*(c1));
disp("inductance of filter    =    "+string((induct))+
   "henry");//correction in the book
disp("resistance of filter    =    "+string((r1))+"ohm
   ");
```

Scilab code Exa 2.18 example 18

```
//pagenumber 113 example 18
clear
resacu=0.1*10^-12;//ampere
u=20+273;//kelvin
```

```
5  voltaf=0.55;//volt
6  w=1.38*10^-23;
7  q=1.6*10^-19;
8  for z=1:2
9      if z==2 then
10         u=100+273;
11         disp("current at 100celsius rise");
12     end
13     voltag=w*u/q;
14     i1=(10^-13)*(exp((voltaf/voltag))-1);
15     if z==2 then
16         i1=(256*10^-13)*((exp(voltaf/voltag)-1));
17     end
18     disp("current   =   "+string((i1))+"ampere");
19 end
```

Scilab code Exa 2.19 example 19

```
1  //pagenumber 114 example 19
2  clear
3  na=10*22;//atoms per cubic metre
4  nd=1.2*10^21;//donor per cubic metre
5  voltag=1.38*10^-23*(273+298)/(1.6*10^-19);//
       correction in the book
6  voltag=0.026;
7  ni=1.5*10^16;
8  ni=ni^2;
9  v1=voltag*log((na*nd)/(ni));
10 disp("thermal voltage   =   "+string((voltag))+"volt
       ");
11 disp("barrier voltage   =   "+string(abs(v1))+"volt"
       );//correction in the book
```

Scilab code Exa 2.20 example 20

```
1 //pagenumber 114 example 20
2 clear
3 i1=2*10^-7;//ampere
4 voltag=0.026;//volt
5 i=i1*((exp(0.1/voltag)-1));
6 disp("current    =    "+string((i))+"ampere");
```

Scilab code Exa 2.21 example 21

```
1 //pagenumber 115 example 21
2 clear
3 resacu=1*10^-6;//ampere
4 voltaf=150*10^-3;//volt
5 w=8.62*10^-5;
6 voltag=0.026;//volt
7 u=300;//kelvin
8 uw=u*w;
9 resist=(uw)/((resacu)*exp(voltaf/voltag));
10 disp("resistance at 150mvolt    =    "+string((resist)
   )+"ohm");//correction in the book
```

Scilab code Exa 2.22 example 22

```
1 //pagenumber 115 example 22
2 clear
3 dopfac=1000;
4 w=300;//kelvin
5 q=0.026*log(dopfac);
6 disp("change in barrier   =   "+string((q))+"volt");
```

Scilab code Exa 2.23 example 23

```
1 //pagenumber 116 example 23
2 clear
3 area12=1*10^-8;//metre square
4 volre1=-1;//reverse voltage
5 capac1=5*10^-12;//farad
6 volbu1=0.9;//volt
7 voltag=0.5;//volt
8 i1=10*10^-3;//ampere
9 durmin=1*10^-6;//ssecond
10 //(1) capacitance
11 capac1=capac1*sqrt((volre1-volbu1)/(voltag-volbu1));
12 disp("depletion capacitance   =   "+string((capac1))
   +"farad");
13 //(2) capacitance
14 capac1=i1*durmin/(0.026);
15
16 disp("capacitance   =   "+string((capac1))+"farad");
```

Scilab code Exa 2.24 example 24

```
1  //pagenumber 116 example 24
2  quantg=4*10^22;//atoms per cubic centimetre
3  quants=5*10^22;//atoms per cubic centimetre
4  w=2.5*10^13;//per cubic centimetre
5  w1=1.5*10^10;//per cubic centimetre
6  for q=[quantg quants]
7      na=2*q/(10^8);
8      nd=500*na;
9      if q==quantg then
10         w=w;
11         voltag=0.026*log(na*nd/w^2);
12         disp("potential germanium   =   "+string((
               voltag))+"volt");
13     end
14     if q==quants then
15         w=w1;
16         voltag=0.026*log(na*nd/w^2);
17         disp("potential silicon   =   "+string((
               voltag))+"volt");
18     end
19
20 end
```

Scilab code Exa 2.25 example 25

```
1  //pagenumber 117 example 25
2  clear
3  u=0.05;//metre square per velocity second correction
       in the book
4  un=0.13;//metre square per velocity second
5  condun=20;//second per metre conductivity of n
       region
6  condup=1000;//second per metre conductivity of p
```

```
    region
p=condup/(1.6*10^-19*u);
no=condun/(1.6*10^-19*un);
disp("electrons density   =   "+string((no))+"per
    cubic metre");
disp("holes density   =   "+string((p))+"per cubic
    metre");//others to find is not in the book
```

Chapter 3

special semiconductor diodes

Scilab code Exa 3.1 example 1

```
1 //pagenumber 138 example 1
2 clear
3 //zener diode
4 voltag=5.2;//volts
5 w=260*10^-3;//watts
6 appv=15;//voltsw1=50;//watts
7 imax=w/voltag*0.1;
8 //to maitain a constant voltage
9 imax1=(w/voltag)-imax;
10 resmin=(appv-voltag)/(w/voltag);
11 resmax=(appv-voltag)/imax1;
12 //load 50
13 resmax1=((9.8)/(45*10^-3))-50;
14 resmin1=((9.8)/(50*10^-3))-50;
15 res50=resmax1-resmin1;
16 disp("resistance range from "+string(resmin)+" to "+
   string(resmax)+"ohms");
17 disp("resistance range at 50 from "+string(resmin1)+
   " to "+string(resmax1)+"ohms");
```

Scilab code Exa 3.2 example 2

```
1 //pagenumber 139 example 2
2 clear
3 i1=20*10^-3;//ampere
4 i=30*10^-3;//ampere
5 v1=5.6;//volts
6 v=5.65;//volts
7 //condition
8 u=35*10^-3;//ampere
9 voltag=5*u+5.5;
10 disp("voltage drop    =    "+string(voltag)+"volts");
```

Scilab code Exa 3.3 example 3

```
1 //example 3 pagenumber 139
2 clear
3 v=4.3;//volt
4 q=4;//volt
5 dop=10^17;//per cubic centimetre
6 fi0=0.254*log(dop/(5.1*10^10));
7 fi01=0.407+q+0.55;
8 disp('fi0    =    '+string(fi01));
```

Scilab code Exa 3.4 example 4

```
1  //example 4 pagenumber 140
2  clear
3  v1=20;//volt
4  i1=((v1)/(200+1))*10^-3;
5  disp('current   =   '+string(i1)+'ampere');
6  //greater than 20
7  vone=16;
8  r=vone/i1;
9  r1=r-1*10^3;
10 r11=200*10^3-r1;
11 disp('resistance   =   '+string(r)+'ohm');
12 disp("r1   =   "+string((r1))+"ohm");
13 disp("r2   =   "+string((r11))+"ohm");
```

Scilab code Exa 3.6 example 6

```
1  //example 6 pagenumber 142
2  clear
3  v1=150;//volt
4  vone=300//volt
5  idmax=40*10^-3;//ampere
6  idmin=5*10^-3;//ampere
7  r=(vone-v1)/idmax;
8  imax=idmax-idmin;
9  disp('maximum current   =   '+string(imax)+'ampere')
   ;
10 //minimum
11 zq=1;
12 while (zq<=2)
13     if zq==1 then
14         ione=25*10^-3;
```

```
15          i1=ione+idmin;
16          vmin=(i1*r)+v1;
17          disp('v1 minimum    =    '+string(vmin)+'volt'
               );
18          else
19          ione=25*10^-3;
20          i1=ione+idmax;
21          vmin=(i1*r)+v1;
22          disp('v1 maximum    =    '+string(vmin)+'volt'
               );
23
24      end
25      zq=zq+1;
26
27
28
29
30  end
```

Scilab code Exa 3.7 example 7

```
1  //example 7 pagenumber 142
2  clear
3  q=4.5*10^22;//atoms per cubic metre
4  na=q/(10^4);
5  eo=0.026*24.16;
6  e=1.6*10^-19;
7  W=sqrt((4*16*0.628)/(36*3.14*10^9*na*10^6*e));
8  disp('width    =    '+string(W)+'metre');
```

Chapter 4

Biplolar Junction Transistor

Scilab code Exa 4.1 example 1

```
1  //page number 201 example 1
2  clear
3  alpha=0.98;
4  vbe=0.7;//base emitter voltage volt
5  ie=-4*10^-3;//emitter current
6  vc=12;//colector voltage volt
7  colr=3.3*10^3;//ohms
8  colCurrent=ie*(-alpha);
9  baseCurrent=0.02*ie;
10 vbn=vbe+(-4*10^-3*100);
11 i2=-vbn/(10*10^3);
12 i1=-(baseCurrent+i2);
13 vcn=(vc-((colCurrent+i1)*colr));
14 v1=vcn-0.9;
15 r1=v1/i1;
16 disp("r1    =    "+string(abs(r1))+"ohm");
```

Scilab code Exa 4.2 example 2

```
1 //pagenumber 202 example 2
2 clear
3 colvoltag=12;//volts
4 vbe=5;//volts
5 colcur=10*10^-3;//ampere
6 vce=5;//volts
7 beta1=50;
8 ib=colcur/beta1;
9 rb=(vbe-0.7)/ib;
10 rc=(12-vbe)/colcur;
11 //when 100ohm included
12 disp("rb    =    "+string(rb)+"ohm");
13 disp("rc    =    "+string(rc)+"ohm");
14 rb=(vce-0.7-(colcur+ib)*beta1)/ib;
15
16 disp("rb at emitter resistance 100ohm    =    "+string
   (rb)+"ohm");//correction in the book
```

Scilab code Exa 4.5 example 5

```
1 //pagenumber 205 example 5
2 clear
3 //given
4 reveri=2*10^-6;//ampere at 25
5 icb=2*10^-6*2^5;//ampere at 75
6 basevoltag=5;//volt
```

```
7 //(1)
8 rb=(-0.1+basevoltag)/(icb);
9 disp("max resistance    =    "+string((rb))+"ohm");//
     correction in the book
10 //(2)
11 basevoltag=1;
12 rb=100*10^3;
13 reveri=(-0.1+basevoltag)/rb;
14 q=reveri/(2*10^-6);
15 w=q^10;
16 u=log(w)
17 t=25+(u/log((2)));
18 disp("baseresistance    =    "+string((rb))+"ohm");
19 disp("temperature    =    "+string((t))+"celsius");
```

Scilab code Exa 4.6 example 6

```
1 //pagenumber 205 example 6
2 clear
3 //given
4 vbe=0.8;//volt
5 beta1=100;
6 vce=0.2;//volt
7 rb=200*10^3;//ohm
8 bascur=(6-vbe)/rb;
9 colres=(10-vce)/(beta1*bascur);
10 disp("min resistance    =    "+string((colres))+"ohm")
     ;
```

Scilab code Exa 4.7 example 7

```
1 //pagenumber 206 example 7
2 clear
3 beta1=100;
4 colres=3*10^3;//collector resistance //ohm
5 rb=8*10^3;//ohm
6 r1=500;//ohm
7 voltag=5;//volt
8 //(1)
9 ib=(-voltag+0.7)/((1+beta1)*r1+(rb));
10 ic=beta1*ib;
11 vce=(-10-ic*(colres)+r1*(ib+ic));
12 vcb=vce+0.7;
13 //(2)
14 volmin=-0.2+abs(ib+ic)*r1;
15 re=-(0.7+rb*ib+voltag)/((1+(beta1))*ib);
16 disp("in saturation mode")
17 disp("vo = "+string((volmin))+"volt");//
   correction in the book
18 disp("emitter resistance < "+string((re))+"ohm")
   ;
```

Scilab code Exa 4.9 example 9

```
1 //example 9
2 clear
3 vcc=12;//volt
4 rb=12*10^3;//ohm
5 colres=2*10^3;//ohm
6 beta1=100;
7 vb=0.7;//volt
8 vce=0.1;//volt
```

```
9
10 for q=1:2
11     if q==1 then
12         vbb=1;
13     else
14         vbb=12;
15     end
16     ib=(vbb-vb)/rb;
17     ic=beta1*ib;
18     ie=ic+ib;
19     vce=vcc-ic*colres;
20     if q==2 then
21         ic=(vcc-0.1)/colres;
22     end
23
24     disp("the operating point at vbb = "+string
          ((vbb))+"volt ic = "+string((ic))+"ampere
           vce = "+string((vce))+" volt");
25 end
26 beta1=ic/ib;
27
28 disp("beta at saturation = "+string((beta1)));
```

Scilab code Exa 4.10 example 10

```
1 //example 10
2 clear
3
4
5
6 disp("rb/re<<1");
```

Scilab code Exa 4.11 example 11

```
1  //example 11
2  clear
3  vbe=0.65;//volt
4  colres=2*10^3;//ohm
5  voltag=10;//volt
6  i1=voltag/10;
7  q=(1.65-vbe)/(1*10^3);
8
9
10 disp("current    =    "+string((q))+"ampere");
```

Scilab code Exa 4.12 example 12

```
1  //example 12
2  clear
3  vcc=12;//volt
4  r1=10*10^3;//ohm
5  colres=1*10^3;//ohm
6  re=5*10^3;//ohm
7  rb=5*10^3;//ohm
8  beta1=100;
9  vbe=0.7;//volt
10 basvol=vcc*10/20;
11 ib=((basvol-vbe)/(rb+beta1*rb));
12 ic=beta1*ib;
13 vce=vcc-ic*(colres+re);
```

```
14 disp("vce    =    "+string((vce))+"volt");
15 disp("collector  current    =    "+string((ic))+"ampere
      ");
```

Scilab code Exa 4.13 example 13

```
1  //example 13
2  clear
3  colres=330;//ohm
4  re=0.1*10^3;//ohm
5  vcc=12;//volt
6  vce=0.2;//volt
7  revcur=18*10^-3//ampere
8  ib=0.3*10^-3;//ampere
9  stability=10;
10 beta1=100;
11 colres=0.330;//ohm
12 re=0.1*10^3;//ohm
13 vbe=0.2;
14 rb=(((1+beta1)*re)/10-((1+beta1)*re))/(1-10.1);
15 vb=2+ib*rb;
16 w=vcc/vb;
17 q=w-1;
18 r1=1.2*10^3;
19 r=q*1.2*10^3;
20 disp("r1    =    "+string((q))+"times  r2");
21 disp("if  r2  is  1200ohm");
22 disp("r1    =    "+string((r))+"ohm");
23
24 disp("r2    =    "+string((r1))+"ohm");
```

Scilab code Exa 4.14 example 14

```
1 //example 14
2 clear
3 alpha1=0.99;
4 ib=25*10^-6;//ampere
5 icb=200*10^-9;//ampere
6 beta1=alpha1/(1-alpha1);
7 ic=beta1*ib+(beta1+1)*icb;
8 disp("collector current = "+string((ic))+"ampere
    ");
9 ie1=(ic-icb)/alpha1;
10 disp("emitter current = "+string((ie1))+"ampere"
    );
11 ic=beta1*ib;
12 disp("collector current with ib = "+string((ic))
    +"ampere");
13 ie=ic/alpha1;
14 disp("emitter current = "+string((ie))+"ampere")
    ;
15 w=(ie1-ie)/ie1;
16 disp("error = "+string((w)));
```

Scilab code Exa 4.15 example 15

```
1 //example 15
2 clear
3 vcc=26;//volt
```

```
colres=20*10^3;//ohm
re=470;//ohm
beta1=45;
vce=8;//volt
ib=(vcc-vce)/((1+beta1)*(colres+re));
ic=beta1*ib;
r1=((vcc-colres*(ib+ic)-re*(ib+ic)-(0.7)))/ib;
disp("resistance    =    "+string((r1))+"ohm");
stability=(1+beta1)/(1+(beta1*re)/(re+colres));
disp("stability    =    "+string((stability)));//
   correction in the book
```

Scilab code Exa 4.16 example 16

```
//example 16
clear
vcc=1.5//volt in book should be changed as 1.5
colres=1.5*10^3;//ohm
emresi=0.27*10^3;//ohm
r1=2.7*10^3;//ohm
r=2.7*10^3;//ohm
beta1=45;
basre1=690;//ohm
voltag=r*vcc/(r*r1);
basres=(r*r1)/(r+r1);
vbe=0.2;
for q= 1:2
    if q==2 then
        disp("resistance    =    "+string((basre1))+"
           ohm");
        basres=basres+basre1;
    end
    bascur=(((voltag+vbe)))/(basres+(45*(emresi)));
```

```
19      colcur=beta1*bascur;
20      vce=(vcc+colcur*colres+(bascur+colcur)*emresi);
21      disp("current   =   "+string((colcur))+"ampere")
           ;
22      disp("vce   =   "+string((vce))+"volt");
23  end
```

Scilab code Exa 4.17 example 17

```
1  //example 17
2  clear
3  beta1=25;
4  colres=2.5*10^3;//ohm
5  vcc=10;//volt
6  vce=-5;//volt
7  ic=-(vcc+vce)/colres;
8  ib=ic/beta1;
9  rb=vce/ib;
10 stability=(1+beta1)/((1+beta1)*((colres)/(colres+rb)
      ));
11 disp("base resistance   =   "+string((rb))+"ohm");//
      correction in book
12 disp("stability   =   "+string((stability)));
```

Scilab code Exa 4.18 example 18

```
1  //example 18
2  clear
3  therre=8;//celsius per watts
```

```
4 tepera=27;//celsius ambient temperature
5 potran=3;//watt
6 tejunc=tepera+(therre*potran);
7 disp("junction temperature = "+string((tejunc))+
    "celsius");
```

Scilab code Exa 4.19 example 19

```
1 //example.19
2 clear
3 ambtep=40;//celsius
4 juntep=160;//celsius
5 hs_a=8;
6 j_c=5;
7 c_a=85;
8 j_a=(j_c)+(c_a*hs_a)/(c_a+hs_a);
9 podiss=(juntep-ambtep)/j_a;
10 disp("dissipation = "+string((podiss))+"watt");
```

Scilab code Exa 4.21 example 21

```
1 //example 21
2 clear
3 emicur=1*10^-3;//ampere
4 colcur=0.995*10^-3;//ampere
5 alpha1=colcur/emicur;
6 beta1=alpha1/(1-alpha1);
7 disp("alpha = "+string((alpha1)));
8 disp("beta = "+string((beta1)));
```

Scilab code Exa 4.22 example 22

```
1 //example 22
2 clear
3 beta1=100;
4 alpha1=beta1/(beta1+1);
5
6 disp("alpha    =    "+string((alpha1)));
```

Scilab code Exa 4.23 example 23

```
1 //example.23
2 rb=200*10^3;//ohm
3 rc=2*10^3;//ohm
4 vcc=20;//volt
5 ib=(vcc)/(rb+200*rc);
6 ic=200*ib;
7 disp("ic    =    "+string((ic))+"ampere");//correction
      in book
```

Scilab code Exa 4.24 example 24

```
1 //example 24
```

```
clear
alpha1=0.98;
revcur=1*10^-6;//ampere
emicur=1*10^-3;//ampere
colcur=alpha1*emicur+revcur;
bascur=emicur-colcur;
disp("collector current   =   "+string((colcur))+"
   ampere");
disp("base current   =   "+string((bascur))+"ampere"
   );
```

Scilab code Exa 4.25 example 25

```
//example 25
clear
colcur=100*10^-3;//ampere
ouresi=20;//ohm
r=200;//ohm
r1=100;//ohm
vcc=15;//volt
basvol=((r1)/(r+r1))*vcc;
em1res=basvol/colcur;
vce=vcc-(ouresi+em1res)*colcur;
disp("vce   =   "+string((vce))+"volt");
disp("emitter resistance   =   "+string((em1res))+"
   ohm");
```

Scilab code Exa 4.26 example 26

```
1  //example 26
2  colres=1*10^3;//ohm
3  beta1=50;
4  vbe=0.3;//volt
5  vcc=6;//volt
6  rb=10*10^3;//ohm
7  re=100;//ohm
8  em1cur=((vcc-vbe)*(beta1+1))/((rb+((beta1+1)*re)));
9  for q=1:2
10     if q==2 then
11         colres=1*10^3;
12         vce=vcc-(colres+re)*em1cur;
13         ic=vcc/(colres+re);
14         disp("collector to emitter   =   "+string((
               vce))+"volt");
15         disp("collector current   =   "+string((ic))
               +"ampere");
16     end
17     if q==1 then
18         colres=50;
19         rb=100;
20         vce=vcc-(colres+rb)*em1cur;
21         disp("emitter current   =   "+string((em1cur
               ))+"ampere");
22         disp("collector to emitter   =   "+string((
               vce))+"volt");
23     end
24 end
```

Scilab code Exa 4.27 example 27

```
1  //example 27
2  clear
```

```
beta1=99;
stability=5;
vbe=0.2;//volt
colres=2.5*10^3;//ohm
vce=6;//volt
ven=5.5;//volt
vcc=15;//volt
vcn=vce+ven;
colvol=vcc-vcn;//voltage across collector resistance
ic=colvol/colres;
ib=ic/beta1;
colre1=ven/ic;
rb=stability*colre1/(1-(stability/(1+beta1)));//
   correction in the book taken collector resistance
    as 3.13*10^3ohm but it is 3.93*10^3ohm
v1=(ib*rb)+(vbe)+((ib+ic)*colre1);
r=rb*vcc/v1;
r1=r*v1/(vcc-v1);
disp("resistance    =    "+string((colre1))+"ohm");
disp("resistance r1    =    "+string((r))+"ohm");
disp("resistance r2    =    "+string((r1))+"ohm");
```

Scilab code Exa 4.28 example 28

```
//example 28
clear
beta1=50;
vbb=5;//volt
rb=10*10^3;//ohm
colres=800;//ohm
re=1.8*10^3;//ohm
vcc=5;//volt
ib=(0.7-vbb)/((rb)+(beta1+1)*re);//correction in
```

```
    book
re=beta1*ib;
ie=(ib+re);
vce=vcc-colres*re-re*ie;
vcb=(vce-0.7);
disp("base current    =    "+string((ib))+"ampere");
disp("collector current    =    "+string((re))+"ampere
    ");
disp("emitter current    =    "+string((ie))+"ampere")
    ;
disp("vcb    =    "+string((vcb))+"volt");//correction
     in book
disp("the collector base junction is reverse biased
    the transistor in active region");
```

Scilab code Exa 4.29 example 29

```
//example 29
clear
r=40*10^3;//ohm
r1=5*10^3;//ohm
colres=r1;
beta1=50;
em1res=1*10^3;//ohm
vcc=12;//volt
rth=r*r1/(r+r1);
v1=r1*vcc/(r1+r);
bascur=(v1-0.3)/(rth+(beta1*em1res));
colcur=beta1*bascur;
vce=vcc-(colres+em1res)*colcur;
disp("collector current    =    "+string((colcur))+"
    ampere");
disp("collector emitter voltage    =    "+string((vce)
```

```
)+" volt");
```

Scilab code Exa 4.30 example 30

```
1 //example 30
2 colcur=8*10^-3;//ampere
3 re=500;//ohm
4 vce=3;//volt
5 beta1=80;
6 vcc=9;//volt
7 ib=colcur/beta1;
8 rb=(vcc-(1+beta1)*(ib*re))/ib;
9 disp(" base resistance = "+string((rb))+"ohm");
```

Scilab code Exa 4.31 example 31

```
1 //example 31
2 clear
3 vcc=10;//volt
4 basres=1*10^6;//ohm
5 colres=2*10^3;//ohm
6 em1res=1*10^3;//ohm
7 beta1=100;
8 bascur=vcc/(basres+(beta1+1)*(em1res));
9 colcur=beta1*bascur;
10 em1cur=colcur+bascur;
11 disp("base current = "+string((bascur))+"ampere"
   );
```

```
12 disp("collector current   =   "+string((colcur))+"
     ampere");//correction in book
13 disp("emitter current   =   "+string((em1cur))+"
     ampere");//correction in book
```

Scilab code Exa 4.32 example 32

```
1 //example 32
2 alpha1=0.99;
3 rebacu=1*10^-11;//ampere
4 colres=2*10^3;//ohm
5 vcc=10;//volt
6 bascur=20*10^-6;//ampere
7 beta1=alpha1/(1-alpha1);
8 i1=(1+beta1)*rebacu;
9 colcur=beta1*bascur+i1;
10 em1cur=-(bascur+colcur);
11 vcb=vcc-colcur*colres;
12 vce=vcb-0.7;
13 disp("collector current   =   "+string((colcur))+"
     ampere");
14 disp("emitter current   =   "+string((em1cur))+"
     ampere");
15 disp("collector emitter voltage   =   "+string((vce)
     )+"volt");
```

Scilab code Exa 4.33 example 33

```
1 //pagenumber 220 example 33
```

```
clear
beta1=100;
revcur=20*10^-9;//ampere
colres=3*10^3;//ohm
rb=200*10^3;//ohm
vbb=5;//volt
vcc=11;//volt
em1res=2*10^3;//ohm
ib=(vbb-0.7)/rb;
ic=beta1*ib;
ie=ib+ic;
disp("base current   =   "+string((ib))+"ampere");
disp("collector current   =   "+string((ic))+"ampere
   ");
disp("emitter current   =   "+string((ie))+"ampere")
   ;//question asked only currents
//2*10^3 ohm added to emitter
ib=-(0.7-vcc)/(rb+((1+beta1)*em1res));
ic=beta1*ib;
ie=ib+ic;
disp("base current   =   "+string((ib))+"ampere");//
   correction in book
disp("collector current   =   "+string((ic))+"ampere
   ");
disp("emitter current   =   "+string((ie))+"ampere")
   ;//question asked only currents
```

Scilab code Exa 4.34 example 34

```
//pagenumber 221 example 34
clear
em1cur=2*10^-3;//ampere
v1=12;//volt
```

```
5  vcc=12;//volt
6  format(12);
7  colres=5*10^3;//ohm
8  em1res=v1/em1cur;
9  colcur=em1cur;
10 voltag=colcur*colres;//ic*r
11 v1=vcc-(colres*colcur);
12 disp("emitter current   =   "+string((em1cur))+"
      ampere");
13 disp("collector current   =   "+string((colcur))+"
      ampere");
14 disp("voltage   =   "+string((voltag))+"volt");
15 disp("vcb   =   "+string(abs(v1))+"volt");
16 disp("emitter resistance   =   "+string((em1res))+"
      ohm");
```

Scilab code Exa 4.35 example 35

```
1  //example 35
2  clear
3  vbb=4;//volt
4  ib=50*10^-6;//ampere
5  for q=[0 0.7 4 12];
6      if q==0 then
7          rb=(vbb-q)/ib;
8          disp("resistance at "+string((q))+"volt   "+
              string((rb))+"ohm");
9      elseif q==0.7
10         rb=(vbb-q)/ib;
11         disp("resistance at "+string((q))+"volt   "+
              string((rb))+"ohm");
12     elseif q==4
13         disp("vbb at 12volt");
```

```
14          q=0;
15          vbb=12;
16          rb=(vbb-q)/ib;
17          disp("resistance at "+string((q))+"volt    "+
               string((rb))+"ohm");
18      else
19          q=0.7;
20          vbb=12;
21          rb=(vbb-q)/ib;
22
23
24          disp("resistance at "+string((q))+"volt    "+
               string((rb))+"ohm");
25      end
26  end
```

Scilab code Exa 4.36 example 36

```
1  //example 36
2  clear
3  ic=5.2*10^-3;//ampere
4  ib=50*10^-6;//ampere
5  icb=2*10^-6;//ampere
6  beta1=(ic-icb)/(ib+icb);
7  disp("beta    =    "+string((beta1)));
8  ie=ib+ic;
9
10 disp("ie    =    "+string((ie))+"ampere");
11 alpha1=(ic-icb)/ic;
12 disp("alpha    =    "+string((alpha1)));
13
14
15
```

```
16 ic=10*10^-3;//ampere
17 ib=(ic-(beta1+1)*(icb))/beta1;
18
19
20 disp("ib    =    "+string((ib))+"ampere");//correction
       in the book
```

Scilab code Exa 4.37 example 37

```
1  //example 37
2  clear
3  beta1=160;
4  vb=-0.8;//volt
5  re=2.5*10^3;//ohm
6  vcc=10;//volt
7  for q=[160 80]
8      ib=(vcc-vb)*10^2/((re)*(1+q)*400);
9      ic=q*ib;
10     colres=1.5*10^3;//ohm
11     disp("collector current at beta "+string((q))+"
           =    "+string((ic))+"ampere");//correction
         in the book
12     ie=(1+beta1)*ib;
13     vce=-(vcc-colres*ic-re*ie);
14     disp("vce at beta "+string((q))+"    =    "+string
         ((vce))+"volt");//correction in the book
15 end
```

Scilab code Exa 4.38 example 38

```
1  //pagenumber 222 example 38
2  clear
3  vb=0.7;//volt
4  vce=7;//volt
5  ic=1*10^-3;//ampere
6  vcc=12;//volt
7  beta1=100;
8  colres=(vcc-vce)/ic;
9  ib=ic/beta1;
10 //rb
11 rb=(vcc-vb-ic*colres)/ib;
12 disp("rb    =    "+string((rb))+" ohm");
13 //stability
14 stability=(1+beta1)/(1+beta1*(colres/(colres+rb)));
15 disp("stability    =    "+string((stability)));
16 //beta=50
17 beta1=50;
18 disp("new point");
19 ib=(vcc-vb)/(beta1*colres+rb);
20 ic=beta1*ib;
21 disp("ic    =    "+string((ic))+" ampere");
22 vce=vcc-(ic*colres);
23 disp("vce    =    "+string((vce))+" volt");
```

Scilab code Exa 4.39 example 39

```
1  //pagenumber 223 example 39
2  clear
3  vcc=16;//volt
4  colres=3*10^3;//ohm
5  re=2*10^3;//ohm
6  r1=56*10^3;//ohm
7  r2=20*10^3;//ohm
```

```
alpha1=0.985;
vb=0.3;//volt
//coordinates
beta1=alpha1/(1-alpha1);
v1=vcc*r2/(r1+r2);
rb=r2/(r1+r2);
ic=(v1-vb)/((rb/beta1)+(re/beta1)+re);
disp("new point");
disp("vce    =    "+string((v1))+" volt");
disp("ic    =    "+string((ic))+" ampere");
```

Scilab code Exa 4.40 example 40

```
//pagenumber 224 example 40
clear
vce=12;//volt
ic=2*10^-3;//ampere
vcc=24;//volt
vb=0.7;//volt
beta1=50;
colres=4.7*10^3;//ohm
//re
re=((vcc-vce)/(ic))-colres;
disp("re    =    "+string((re))+" ohm");
//r1
ib=ic/beta1;
v1=ib*3.25*10^3+vb+(ib+1.5*10^3);
r1=3.25*18*10^3/2.23;
disp("r1    =    "+string((r1))+" ohm");
//r2
r2=26.23*2.23*10^3/(18-2.3);
disp("r2    =    "+string((r2))+" ohm");
```

Scilab code Exa 4.41 example 41

```
1 //pagenumber 225 example 41
2 clear
3 colres=3*10^3;//ohm
4 rb=150*10^3;//ohm
5 beta1=125;
6 vcc=10;//volt
7 v1=5;//volt
8 vb=0.7;//volt
9 ib=(v1-vb)/rb;
10 disp("ib    =    "+string((ib))+" ampere");
11 ic=beta1*ib;
12 ie=ic+ib;
13 disp("ic    =    "+string((ic))+" ampere");
14 disp("ie    =    "+string((ie))+" ampere");//
   correction in the book in question to find only
   currents
```

Scilab code Exa 4.42 example 42

```
1 //pagenumber 226 example 42
2 clear
3 beta1=50;
4 vb=0.6;//volt
5 vcc=18;//volt
6 colres=4.3*10^3;//ohm
7 ic=1.5*10^-3;//ampere
```

```
vce=10;//volt
stability=4;
r1=(vcc-vce)/ic;
re=r1-colres;
w=(beta1+1)*(stability)*re/(1+beta1-stability);
disp("re    =    "+string((re))+"ohm");
disp("rb    =    "+string((w))+"ohm");//correction in
    the book
```

Scilab code Exa 4.43 example 43

```
//pagenumber 226 example 43
re=100;//ohm
beta1=100;
rb=1*10^3;//ohm
stability=(1+beta1)/(1+beta1*(re/(re+rb)));
r1=3.8//r2
disp("r1    =    3.8*r2");//correction in the book not
    given in question
```

Scilab code Exa 4.45 example 45

```
//pagenumber 228 example 45
clear
icb=2*10^-6;//ampere
vbb=1;//volt
r1=50*10^3;//ohm
//current increases every 10celsius rb at 75celsius
vb=-0.1;//volt
```

```
icb=2^6*10^-6;//at 75celsius
rb=(vb+vbb)/icb;
disp("rb at 75 celsius = "+string((rb))+"ohm");
icb=(vb+vbb)/r1;
disp("icb = "+string((icb))+"ampere");
w=(log10(icb*10^6)*20/log10(2))-25;
disp("temperature at which current till max = "+
   string((w))+"celsius");
```

Scilab code Exa 4.46 example 46

```
//pagenumber 228 example 46
clear
vb=0.8;//volt
beta1=100;
vce=0.2;//volt
vcc=10;//volt
rb=200*10^3;//ohm
//collector resistance
ib=(5-0.7)/rb;
colres=(vcc-vce)/(beta1*ib);
disp("min collector resistance = "+string((
   colres))+"ohm");
```

Scilab code Exa 4.47 example 47

```
//pagenumber 229 example 47
clear
alpha1=0.98;
```

```
4  alph11=0.96;
5  vcc=24;//volt
6  colres=120;//ohm
7  ie=100*10^-3;//ampere
8  beta1=alpha1/(1-alpha1);
9  bet11=alph11/(1-alph11);
10 ib2=ie/(1+bet11);
11 ie1=-ib2;
12 disp("ib2    =    "+string((ib2))+"ampere");
13 disp("ie1    =    "+string((ie1))+"ampere");
14
15
16 ic2=bet11*ib2;
17 ib1=ib2/(1+beta1);
18 ic1=beta1*ib1;
19 disp("ic2    =    "+string((ic2))+"ampere");
20 disp("ib1    =    "+string((ib1))+"ampere");
21 disp("ic1    =    "+string((ic1))+"ampere");
22 ic=ic1+ic2;
23 vce=vcc-ic*colres;
24 ib=ib1;
25 w=ic/ib;
26 q=-ic/ie;
27 disp("ic    =    "+string((ic))+"ampere");
28 disp("ic/ib    =    "+string((w)));
29 disp("ic/ie    =    "+string((q)));//correction in the
       book
30 disp("vce    =    "+string((vce))+"volt");
```

Chapter 5

BJT Amplifier

Scilab code Exa 5.1 example 1

```
1  //pagenumber 283 example 1
2  clear
3  ic=1*10^-3;//ampere
4  vcc=5;//volt
5  colres=2*10^3;//ohm
6  r1=1.4*10^3;//ohm
7  re=100;//ohm
8  beta1=100;
9  rb=100;//ohm
10 v1=0.026;
11 c1=25*10^-6;//farad
12 g1=ic/v1;
13 freque=10*10^3;//hertz
14 xc=1/(2*freque*3.14*c1);
15 volgai=-beta1*colres/(r1+0.1*10^3+2.5*10^3);
16 disp("voltage gain    =    "+string((volgai)));
17 ri=(0.1+2.5)*10^3-imag((xc)*(1+beta1));
18 disp("input resistance    =    "+string((ri))+"ohm");
19 //ce removed
```

```
20 volgai=-beta1*colres/((r1+0.1*10^3+2.5*10^3)
     +(101/1000)*10^3*100);
21 disp("ce removed");
22 disp("voltage gain    =    "+string((volgai)));
23 ri=(0.1+2.5)*10^3+100*101/1000*10^3;
24 disp("input resistance    =    "+string((ri))+"ohm");
```

Scilab code Exa 5.2 example 2

```
1 //pagenumber 285 example 2
2 clear
3 ic=1.3*10^-3;//ampere
4 colres=2*10^3;//ohm
5 re=500;//ohm
6 v1=0.026;//volt
7 beta1=100;
8 vcc=15;//volt
9 c1=10*10^-6;//farad
10 ib=ic/beta1;
11 ri=0.01/ib;
12 volgai=beta1*colres*ib/0.01;
13 disp("voltage gain    =    "+string((volgai))+"<180");
14 disp("voltage gain reduced ce removed");
15 disp("when cb is    short circuited the voltage gain
     increased");
```

Scilab code Exa 5.3 example 3

```
1 //pagenumber 286 example 3
```

```
clear
colres=4*10^3;//ohm
r1=4*10^3;//ohm

rb=20*10^3;//ohm
r=1*10^3;//ohm
hie=1.1*10^3;//ohm

//current gain
ri=rb*hie/(rb+hie);
curgai=(1/2.04)*(rb/(rb+(hie)))*(-50*colres/(colres
   +(r1)));
disp("current gain    =    "+string((curgai)));
//voltage gain
volgai=curgai*r1/r;
disp("voltage gain    =    "+string((volgai)));
//transconductance
conduc=volgai/r1;
disp("transconductance    =    "+string((conduc))+"
   ampere per volt");
//transresistance
resist=volgai*r;
disp("transresistance    =    "+string((resist))+"ohm"
   );
//input resistance
disp("input resistance    =    "+string((ri))+"ohm");
//output resistance
resist=40*10^3*colres/(40*10^3+colres);



disp("output resistance    =    "+string((resist))+"
   ohm");
```

Scilab code Exa 5.4 example 4

```
1 //pagenumber 287 example 4
2 clear
3 ib=20*10^-6;//ampere
4 beta1=500;
5 re=10;//ohm correction in the book
6 r1=4.7*10^2;//ohm correction in the book
7 ic=ib*beta1;
8 voltag=ic*r1;//voltage drop at 4.7*10^3ohm
9 vc=(10-voltag);
10 rb=(vc-0.6)/ib;
11 disp("rb = "+string((rb))+"ohm");
12 //re included
13 voltag=ic*re;//voltage drop at re
14 vb=(0.6+voltag);
15 rb=(vc-vb)/ib;
16 disp("rb including emitter resistance = "+string
   ((rb))+"ohm");
```

Scilab code Exa 5.5 example 5

```
1 //pagenumber 288 example 5
2 clear
3 av=12480;
4 fedbac=8;//decibel
5 volgai=20*log10(av);//gain without fedback
6 volga1=volgai-fedbac;
7 beta1=((av/5000)-1)/av;
8
9 disp("voltage gain with fedback = "+string((
   volga1))+"decibel");
10 disp("beta = "+string((beta1)));
```

Scilab code Exa 5.6 example 6

```
1 //pagenumber 288 example 6
2 beta1=100;
3 r1=1.5*10^3;//ohm
4 vcc=10;//volt
5 r=100*10^3;//ohm
6 vb=((vcc)/(r+10*10^3))*10*10^3;
7 ie=0.3/100;
8 ib=ie/beta1;
9 disp("collector current = "+string((ie))+"ampere
    ");
10 disp("emitter current = "+string((ie))+"ampere")
    ;
11 disp("base current = "+string((ib))+"ampere");
```

Scilab code Exa 5.7 example 7

```
1 //pagenumber 268 example 7
2 clear
3 hie=800;//ohm
4 he=50*10^-6;//mho
5 hfe=-55;
6 z1=2*10^3;//ohm
7 curgai=hfe/(1+he*z1);
8 zi=hie
9 volgai=curgai*z1/zi;
```

```
powgai=volgai*curgai;
//if hoe neglected
av=137.5;
hfe=-55;
w=((av-abs(volgai))*100)/abs(volgai);
ap=hfe*(-av);
w1=((ap-powgai)*100)/powgai;
disp("voltage gain    =    "+string((volgai)));


disp("power gain    =    "+string((powgai)));
disp("error without hoe    =    "+string((w)));
disp("error    =    "+string((w1)));
```

Scilab code Exa 5.8 example 8

```
//pagenumber 289 example 8
clear
rb=5*10^3;//ohm
vcc=20;//volt
r=10*10^3;//ohm
colres=5*10^3;//ohm
vb=vcc*r/(r+r);
beta1=50;
v1=0.6;//volt
ib=(vb-v1)/(1+beta1*colres);
ic=beta1*ib;
vc=vcc-ic*1*10^3;
vce=vc-rb*(ic+ib);
disp("emitter current    =    "+string((ic+ib))+"
   ampere");
disp("vc    =    "+string((vc))+"volt");
disp("collector emitter voltage    =    "+string((vce)
```

```
)+" volt");
```

Scilab code Exa 5.9 example 9

```
1  //pagenumber 290 example 9
2  clear
3  hib=25;//ohm
4  hfb=0.999;
5  hob=10^-6;//ohm
6  colres=10*10^3;//ohm
7  //voltage gain
8  curgai=hfb/(1+hob*colres);
9  zi=hib+hob*colres*curgai;
10 volgai=curgai*colres/(zi);
11 disp("voltage gain    =    "+string((volgai)));//
   correction in the book
```

Scilab code Exa 5.10 example 10

```
1  //pagenumber 290 example 10
2  clear
3  re=1*10^3;//ohm
4  hie=100;//ohm
5  hfe=100;
6  //voltage gain
7  volgai=1/((1+(hie/(2*(1+hfe)*re))));
8  //ri
9  ri=(hie/2)+(1+hfe)*re;
10 disp("voltage gain    =    "+string((volgai)));
```

```
11 disp("input resistance    =    "+string((ri))+"ohm");
```

Scilab code Exa 5.11 example 11

```
1  //pagenumber 292 example 11
2  clear
3  beta1=90;
4  re=2*10^3;//ohm
5  rb=240*10^3;//ohm
6  vcc=20;
7  ib=(vcc-0.7)/(rb+(1+beta1)*(re));
8  ic=beta1*ib;
9  vce=vcc-(ib+ic)*re;
10 disp("emitter current    =    "+string((ib+ic))+"
     ampere");
11 disp("vce    =    "+string((vce))+"volt");
```

Scilab code Exa 5.12 example 12

```
1  //pagenumber 292 example 12
2  clear
3  hfe=110;
4  hie=1.6*10^3;//ohm
5  hoe=20*10^-6;//ohm
6  colres=4.7*10^3;//ohm
7  hre=2*10^-4;
8  r1=470*10^3;//ohm
9  curgai=-hfe/(1+hoe*colres);
10 ri=hie+hre*curgai*colres;
```

```
volgai=curgai*colres/ri;
y1=hoe-((hfe*hre)/(hie+1*10^3))
z1=1/y1;
disp("voltage gain    =    "+string((volgai)));
disp("current gain    =    "+string((curgai)));
disp("impedance    =    "+string((z1))+"ohm");
r0=z1*colres/(z1+colres);
curgai=-hfe;
ri=hie;
disp("parameters using approxmiate");
volgai=curgai*(colres)/ri;
disp("voltage gain    =    "+string((volgai)));//
   correction in the book
disp("current gain    =    "+string((curgai)));
disp("impedance    =    "+string((z1))+"ohm");
```

Scilab code Exa 5.13 example 13

```
//pagenumber 293 example 13
clear
re=1*10^3;//ohm
hie=1000;//ohm
hfe=99;
//inptut resistance
ri=hie+((1+hfe)*(hie+1+hfe*re));


disp("input resistance    =    "+string((ri))+"ohm");
   //correction in the book
//voltage gain
volgai=((1+hfe)*(1+hfe)*re)/ri;
disp("voltage gain    =    "+string((volgai)));

```

```
15
16 //current gain
17 curgai=-((1+hfe)*(1+hfe));
18
19
20 disp("current gain    =    "+string((curgai)));
```

Scilab code Exa 5.14 example 14

```
1 //pagenumber 294 example 14
2 clear
3 hie=2*10^3;//ohm
4 beta1=100;
5 colres=5*10^3;//ohm
6 volgai=beta1*colres/hie;
7 disp("voltage gain    =    "+string((volgai))+"<180");
8 disp("input impedance    =    "+string((hie))+"ohm");
9 disp("current gain    =    "+string((beta1)));
```

Scilab code Exa 5.15 example 15

```
1 //pagenumber 294 example 15
2 clear
3 colres=4.7*10^3;//ohm
4 beta1=150;
5 r1=12*10^3;//ohm
6 vcc=15;//volt
7 re=1.2*10^3;//ohm
8 rac=colres*r1/(colres+r1);
```

```
r=2*10^3;//ohm
//voltage gain
volgai=beta1*rac/r;
disp("voltage gain    =    "+string((volgai)));
r1=75*10^3;//ohm
r2=7.5*10^3;//ohm
//input impedance
zin=(r1*r2)/(r1+r2);
zin=zin*r/(zin+r);
disp("input impedance    =    "+string((zin)));
//coordinates
vb=vcc*r2/(r1+r2);
ie=vb/re;
vce=vcc-((colres+re)*(ie));
disp("coordinates ic    =    "+string((ie))+"ampere
   vce    =    "+string((vce))+"volt");
```

Scilab code Exa 5.16 example 16

```
//pagenumber 296 example 16
clear
r1=2000;//ohm
r=900;//ohm
hie=1200;//ohm
hre=2*10^-4;
hfe=60;
hoe=25*10^-6;//ampere per volt
curgai=(hfe)/(1+hoe*r1);
disp("current gain    =    "+string((curgai)));
ri=hie+(curgai*r1);
disp("input impedance    =    "+string((ri))+"ohm");
volgai=curgai*r1/ri;
disp("voltage gain    =    "+string((volgai)));
```

```
admita=1/ri;
admita=hoe-(-hfe*hre)/(hie+r);
r=1/admita;
disp("output resistance    =    "+string((r))+"ohm");
```

Scilab code Exa 5.17 example 17

```
//pagenumber 296 example 17
clear
hfe=60;
hie=500;//ohm
ic=3*10^-3;//ampere
zi=hie;
rb=220*10^3;//ohm
colres=5.1*10^3;//ohm
z=colres;
volgai=-hfe*colres/hie;
curgai=-hfe;
vcc=12;//volt
ib=(vcc-0.6)/rb;
ie=hfe*ib;
re=0.026/ie;
zi=hfe*re;
z=colres;
volgai=-colres/re;
curgai=-hfe;
disp("voltage gain    =    "+string((volgai)));
disp("current gain    =    "+string((curgai)));
disp("input impedance    =    "+string((zi))+"ohm");
disp("output impedance    =    "+string((z))+"ohm");
```

Scilab code Exa 5.18 example 18

```
1  //pagenumber 297 example 18
2  clear
3  hie=3.2*10^3;//ohm
4  hfe=100;
5  r=40*10^3;//ohm
6  r1=4.7*10^3;//ohm
7  colres=4*10^3;//ohm
8  rb=r*r1/(r+r1);
9  zi=hie*rb/(hie+rb);
10 z=colres;
11 re=1.2*10^3;//ohm
12 volgai=-hfe*colres/hie;
13 disp("input impedance   =   "+string((zi))+"ohm");
14 disp("output impedance   =   "+string((z))+"ohm");
15 disp("voltage gain   =   "+string((volgai)));
16 curgai=-hfe*rb/(rb+hie);
17 disp("current gain   =   "+string((curgai)));
18 hie=833;
19 //(1) load open
20 vi=1;
21 ib=vi/hie;
22 volgai=hfe*ib*1.5*10^3;
23 //load closed
24 hoe=50;
25 r2=2*10^3;//ohm
26 ib=vi/(r2+hie);
27 vb=1.682;
28 ib=(vb-0.6)/(rb+(1+hfe)*(re));
29 ic=hfe*ib;
30 ie=ic+ib;
```

```
31 re=0.026/ie;
32 zi=rb*hfe*re/((rb)+(hfe*re));
33 disp("parameters in re");
34 disp("input impedance   =   "+string((zi))+"ohm");
35 z=colres;
36 disp("output impedance   =   "+string((z))+"ohm");
37 volgai=colres/(-re);
38 disp("voltage gain   =   "+string((volgai)));
39 curgai=-hfe*rb/(rb+hfe*re);
40 disp("current gain   =   "+string((curgai)));
```

Scilab code Exa 5.19 example 19

```
1 //pagenumber 299 example 19
2 clear
3 hfe=120;
4 hie=0.02;//ohm
5 r1=5.8*10^3;//ohm
6 r=27*10^3;//ohm
7 colres=1.5*10^3;//ohm
8 re=330*10^3;//ohm
9 vcc=10;//volt
10 vb=vcc*r1/(r1+r);
11 rb=(r*r1)/(r+r1);
12 ib=(vb-0.7)/(rb+((1+hfe)*re));
13 volgai=-hfe*ib*2*10^3;
14 disp("voltage gain   =   "+string((volgai)));//
   correction in the book
```

Scilab code Exa 5.20 example 20

```
1 //pagenumber 300 example 20
2 clear
3 freque=6*10^6;//hertz
4 hfe=50;
5 r1=500;//ohm
6 g=0.04
7 rbb=100;//ohm
8
9
10 c1=10*10^-12;//farad
11 r=1000;//ohm
12 rbe=hfe/g;
13 ce=g/(2*3.14*freque);
14 c1=ce+c1*(1+g*r);
15 hie=rbb+rbe;
16 resist=(r1+rbb)*rbe/(r1+rbb+rbe);
17 frequ2=1/(2*3.14*resist*c1);
18 curgai=-hfe*r1/(r1+hie);
19 volgai=(-hfe*r)/(r1+hie);
20 q=volgai*frequ2;
21 disp("upper frequency voltage gain = "+string(
   abs(q))+"hertz");//correction in the book
22 q=curgai*frequ2;
23 disp("upper current gain = "+string(abs(q))+"
   hertz");
```

Scilab code Exa 5.21 example 21

```
1 //pagenumber 301 example 21
2 clear
3 hie=1*10^3;//ohm
```

```
4  hre=2*10^-4;
5  hoe=25*10^-6;//ampere per volt
6  hfe=50;
7  colres=1*10^3;//ohm
8  curgai=-hfe/(1+hoe*colres);
9  disp("current gain    =    "+string((curgai)));
10 ri=hie-hfe*hre/(hoe+1/colres);
11 disp("input resistance    =    "+string((ri))+"ohm");
12 volgai=curgai*colres/ri;
13 disp("voltage gain    =    "+string((volgai)));
14 y1=hoe-((hfe*hre)/(hie+800));
15 r1=1/y1;
16 disp("output resistance    =    "+string((r1))+"ohm");
17 //approximate
18 disp("approximate");
19 curgai=-hfe;
20 disp("current gain    =    "+string((curgai)));
21 ri=hie;
22 disp("input resistance    =    "+string((ri))+"ohm");
23 volgai=-hfe*colres/hie;
24 disp("voltage gain    =    "+string((volgai)));
```

Scilab code Exa 5.22 example 22

```
1  //example 22
2  clear
3  rb1=7.5*10^3;//ohm
4  rb2=6.8*10^3;//ohm
5
6  rb3=3.3*10^3;//ohm
7  re=1.3*10^3;//ohm
8  colres=2.2*10^3;//ohm
9  beta1=120;
```

```
10 vcc=18;//volt
11 vb1=rb3*vcc/(rb3+rb2+rb1);
12 ie1=(vb1-0.7)/(re);
13 re1=0.026/ie1;
14 re2=0.026/ie1;
15 volgai=colres/re2;
16 disp("voltage gain    =    "+string((volgai)));
```

Scilab code Exa 5.23 example 23

```
1 //pagenumber 302 example 23
2 clear
3 vcc=5;//volt
4 colres=250;//ohm
5 v1=5;//volt
6 rb=25*10^3;//ohm
7 beta1=200;
8 vbs=0.8;//volt
9 vcon=0.3;//volt
10 icon=(vcc-vcon)/colres;
11 ibon=icon/beta1;
12 ibs=(v1-vbs)/rb;
13 ic=(vcc-0.2)/colres;
14 beta1=ic/ibs;
15 disp("forced beta    =    "+string((beta1)));
```

Scilab code Exa 5.24 example 24

```
1 //pagenumber 303 example 24
```

```
clear
vb=0.6;//volt
beta1=100;
ic=1*10^-3;//ampere
vce=2.5;//volt
re=300;//ohm
vcc=5;//volt
ib=ic/beta1;
ie=ic+ib;
ve=ie*re;
vce=vce+ve;
r3=(vcc-vce)/ic;
vb=ve+vb;
r1=(vcc-vb)/(vb/(10*10^3)+(ib));
disp("resistance r1    =    "+string((r1))+"ohm");
disp("resistance r3    =    "+string((r3))+"ohm");
```

Scilab code Exa 5.25 example 25

```
//pagenumber 304 example 25
clear
vce2=7.5;//volt
vb=0.7;//volt
beta1=200;
v1=25;//volt
r1=10*10^3;//ohm
vcc=15;//volt
i1=(vcc-vb)/r1;
r=(vcc-vce2)/i1;
z1=beta1*v1/i1;
z=v1/i1;
disp("input impedance q1    =    "+string((z))+"ohm");
   //correction in the book
```

```
14 disp("input impedance q2    =    "+string((z1))+"ohm")
   ;
```

Scilab code Exa 5.26 example 26

```
1 //pagenumber 305 example 26
2 clear
3 beta1=99;
4 r1=1*10^3;//ohm
5 g=beta1/r1;
6 r=r1*((r1+r1)/(100))/((r1+((r1+r1)/(100))));
7 disp("make input    =    0");
8 disp("ground dc");
9
10
11 disp("output resistance    =    "+string((r))+"ohm");
```

Scilab code Exa 5.27 example 27

```
1 //pagenumber 305 example 27
2 clear
3 ic=0.5*10^-3;//ampere
4 rb=100*10^3;//ohm
5 v1=0.026;//volt
6 r1=50;//ohm
7 colres=1*10^3;//ohm
8 g=ic/v1;
9 volgai=g*colres;
```

```
10 disp("output resistance    =    "+string((colres))+"
     ohm");
11 disp("input resistance very low");//not given in the
     book
12 disp("voltage gain    =    "+string((volgai)));
```

Scilab code Exa 5.28 example 28

```
1  //pagenumber 306 example 28
2  clear
3  re=4*10^3;//ohm
4  r1=4*10^3;//ohm
5  hie=1.1*10^3;//ohm
6  resist=10*10^3;//ohm
7  hfe=50;
8  rb=10*10^3;//ohm
9  r=1*10^3;//ohm
10 colres=5*10^3;//ohm
11 //(1) current gain
12 ri=rb*hie/(rb+hie);
13 curgai=(1/2.04)*((rb)/(rb+hie))*((-hfe*colres)/(
     colres+r1));
14 disp("current gain    =    "+string((curgai)));
15 //(2) voltage gain
16 volgai=curgai*r1/r;
17 disp("voltage gain    =    "+string((volgai)));
18 //(3) tranconductance
19 conduc=volgai/r1;
20 disp("transconductance    =    "+string((conduc))+"
     ampere per volt");
21 //transresistance
22 resist=resist*volgai;
23 disp("transresistance    =    "+string((resist))+"ohm"
```

```
    );
24 disp("input resistance    =    "+string((ri))+"ohm");
25 r=(40*10^3*colres)/(40*10^3+colres);
26 disp("output resistance    =    "+string((r))+"ohm");
```

Scilab code Exa 5.29 example 29

```
1  //pagenumber 307 example 29
2  clear
3  beta1=500;
4  ib=20*10^-6;//ampere
5  re=100;//ohm
6  ic=beta1*ib;
7  vc=ic*0.47*10^3;//voltage drop across collector
       resistance
8  v1=(10-vc);
9  vb=v1-0.6;
10 rb=vc/ib;
11 disp("base resistance    =    "+string((rb))+"ohm");
12 ve=re*ic;
13 disp("base resistance with re");
14 b=0.6+0.1;
15 rb=(v1-b)/ib;
16 disp("base resistance    =    "+string((rb))+"ohm");
```

Scilab code Exa 5.30 example 30

```
1  //pagenumber 308 example 30
2  clear
```

```
beta1=100;
re=100;//ohm
vcc=10;//volt
colres=1.5*10^3;//ohm
r=100*10^3;//ohm
r1=10*10^3;//ohm
vb=vcc*r1/(r1+r);
ie=0.3/re;
ib=ie/beta1;
disp("collector current   =   "+string((ie))+"ampere
   ");
disp("base current   =   "+string((ib))+"ampere");
disp("emitter current   =   "+string((ie))+"ampere")
   ;
```

Chapter 6

BJT at high frequency

Scilab code Exa 6.1 example 1

```
1  //pagenumber 337 example 1
2  clear
3  colcur=10*10^-3;//ampere
4  vce=10;//volt
5  hie=500;//ohm
6  hoe=4*10^-5;
7  hfe=100;
8  hre=1*10^-4;
9  fqu=50*10^6;//hertz
10 q=3*10^12;//farad
11 voltag=26*10^-3;//volt
12 g=colcur/voltag;
13 gbe=g/hfe;
14 gbc=gbe*hre;
15 rbb=hie-260;
16 oucond=hoe-(1+hfe)*gbc;
17 cbe=g/(2*3.14*fqu);
18 rbc=1/gbc;
19 rce=1/oucond;
```

```
20 disp("transconductance g = "+string((g))+"ampere
   /volt");
21 disp("input conductance gbe = "+string((gbe))+"
   ampere/volt");
22 disp("feedback conductance gbc = "+string((gbc))
   +"ampere/volt");
23 disp("base spread resistance rbb = "+string((rbb
   ))+"ohm");
24 disp("output conductance = "+string((oucond))+"
   ampere/volt");
25 disp("transition capacitance cbe = "+string((cbe
   ))+"farad");
26 disp("rbc = "+string((rbc))+"ohm");//correction
    as 2.6mega ohm
27 disp("rce = "+string((rce))+"ohm");
```

Scilab code Exa 6.2 example 2

```
1 //pagenumber 337 example 2
2 clear
3 colcur=5*10^-3;//ampere
4 vce=10;//volt
5 hfe=100;
6 hie=600;//ohm
7 cugain=10;
8 fqu=10*10^6;//hertz
9
10 tracat=3*10^-12;//farad
11 voltag=26*10^-3;//volt
12 fbeta1=((((hfe^2)/(cugain^2))-1)/fqu^2)^(1/2);
13 fbeta1=1/fbeta1;
14 fq1=hfe*fbeta1;
15 cbe=colcur/(2*3.14*fq1*voltag);
```

```
16 rbe=hfe/(colcur/voltag);
17 rbb=hie-rbe;
18 disp("fbeta    =    "+string((fbeta1))+"hertz");
19 disp("f    =    "+string((fq1))+"hertz");
20 disp("cbe    =    "+string((cbe))+"farad");
21 disp("rbe    =    "+string((rbe))+"ohm");
22 disp("rbb    =    "+string((rbb))+"ohm");
```

Scilab code Exa 6.3 example 3

```
1 //pagenumber 338 example 3
2 clear
3 w=1*10^-4;//centimetre
4 em1cur=2*10^-3;//ampere
5 q=47;
6 voltag=26*10^-3;//volt
7 cde=(em1cur*w^2)/(voltag*2*q);
8 fq1=(em1cur)/(2*3.14*cde*voltag);
9 disp("cde    =    "+string((cde))+"farad");
10 disp("frequency    =    "+string((fq1))+"hertz");
```

Scilab code Exa 6.6 example 6

```
1 //pagenumber 339 example 6
2 clear
3 w=5*10^-4;//centimetre
4 em1cur=2*10^-3;//ampere
5 q=47;
6 voltag=26*10^-3;//volt
```

```
re=voltag/em1cur;
fq1=2*q/(w^2*2*3.14);
cde=(em1cur*w^2)/(voltag*2*q);
w=(w^2)/(2*q);
disp("re    =    "+string((re))+"ohm");
disp("falpha    =    "+string((fq1))+"hertz");
disp("cde    =    "+string((cde))+"farad");


disp("w    =    "+string((w))+"second");
```

Scilab code Exa 6.8 example 8

```
//pagenumber example 8
clear
w=10^-6;//centimetre
em1cur=4*10^-3;//ampere
voltag=26*10^-3;//volt
q=47;
cde=(em1cur*w^2)/(voltag*2*q);
fq1=(em1cur)/(2*3.14*cde*voltag);
disp("f    =    "+string((fq1))+"hertz");
disp("cde    =    "+string((cde))+"farad");//
   correction in book 0.0016pico farad
```

Chapter 7

Field Effect Transistor

Scilab code Exa 7.1 example 1

```
1  //pagenumber 370 example 1
2  clear
3  rd=12*10^3;//ohm
4  r=1*10^6;//ohm
5  resour=470;//ohm
6  vdd=30;//volt
7  idss=3*10^-3;//ampere
8  vd=2.4;//volt
9
10 vgs=[0.24 2.175 1.41];
11 vgs=roots(vgs);
12 vgs=0.7;
13 id=idss*((1-(vgs/vd)))^2;
14 vds=vdd-id*(rd+resour);
15 g=(2*idss/vd)*(1-((vgs/vd)));
16 volgai=-g*rd;
17 disp("vgs    =    "+string((vgs))+"volt");
18 disp("id    =    "+string((id))+"ampere");
19 disp("vds    =    "+string((vds))+"volt");
```

```
20 disp("voltage gain    =    "+string((volgai)));
```

Scilab code Exa 7.2 example 2

```
1  //pagenumber 371 example 2
2  clear
3  idss=1*10^-3;//ampere
4  pinvol=1;//volt
5  q=10;//volt
6  rd=56*10^3;//ohm
7  vdd=24;//volt
8  dracur=(vdd-q)/rd;
9  vgs=0.5;
10 r1=vgs/dracur;
11 disp("r1    =    "+string((r1))+"ohm");
```

Scilab code Exa 7.4 example 4

```
1  //pagenumber 372 example 4
2  clear
3  ids=4*10^-3;//ampere
4  vp=4;//volt
5  r=1.3*10^3//ohm
6  r1=200*10^3;//ohm
7  vdd=60;//volt
8  drares=18*10^3;//ohm
9  soresi=4*10^3;//ohm
10 rth=(r*r1)/(r+r1);
11 vth=r1*(1-vdd)/(1500*10^3);
```

```
12 id=-2.25*10^-3;
13 vds=-vdd-(drares+soresi)*id;
14 disp("id    =    "+string(abs(id))+"ampere");
15 disp("vds    =    "+string(abs(vds))+"volt");
```

Scilab code Exa 7.5 example 5

```
1 //pagenumber 373 example 5
2 clear
3 idss=10*10^-3;//ampere
4 pinvol=-1;//volt
5 ids=6.4*10^-3;//ampere
6 vgs=-(sqrt(ids/idss)-(1))*pinvol;
7 r=pinvol/ids;
8
9
10 disp("source resistance    =    "+string(abs(r))+"ohm"
   );
```

Scilab code Exa 7.6 6

```
1 //pagenumber 374 example 6
2 clear
3 v1=2;//volt
4 vgs=4;//volt
5 voltag=5;//volt
6 q=5*10^-3;//ampere per volt square
7 id=q*(vgs-v1);
8 durati=10^-7*log(4);
```

```
9
10 disp("duration    =    "+string((durati))+"second");
```

Scilab code Exa 7.7 example 7

```
1 //pagenumber 7 example 7
2 clear
3 idss=1*10^-3;//ampere
4 pinvol=-5;//volt
5 tracon=(2*idss)/abs(pinvol);
6 disp("max transconductance    =    "+string((tracon))+
    "mho");
```

Scilab code Exa 7.8 example 8

```
1 //pagenumber 376 example 8
2 clear
3 vdd=10;//volt
4 beta1=10^-4;//ampere per square volt
5 ids=0.5*10^-3;//ampere
6 voltag=1;//volt
7 vgs=(sqrt(ids/beta1)+(1));
8 rd=(vdd-vgs)/ids;
9
10 disp("vgs    =    "+string((vgs))+"volt");
11 disp("rd    =    "+string((rd))+"ohm");
```

Scilab code Exa 7.9 example 9

```
1  //pagenumber 376 example 9
2  clear
3  v1=2;//volt
4  ids=4*10^-3;//ampere
5
6  rd=910;//ohm
7  r1=3*10^3;//ohm
8  r=12*01^6;//ohm
9  r11=8.57*10^6;//ohm
10 vdd=24;//volt
11 vg=vdd*(r11/(r+(r11)));
12 id=3.39*10^-3;
13 vgsq=vg-id*r1;
14 vdsq=vdd-id*(rd+r1);
15 vdgq=vdsq-vgsq;
16 disp("point "+string(vdsq)+">"+string(v1)+"volt");
17 disp("vds greater than 2volt the point in pinch");
```

Chapter 8

FET Amplifier

Scilab code Exa 8.1 example 1

```
1  //pagenumber 399 example 1
2  clear
3  freque=5*10^3;//hertz
4  //(1)
5  g=2*10^-3;//ampere per volt
6  rd=10*10^3;//ohm
7  r1=30*10^3;//ohm
8  r12=r1*r1/(r1+r1);
9  volgai=-(g*r12*rd)/(r12+rd);
10 disp("voltage gain    =    "+string((volgai)));//
     correction r12 should be taken as 15*10^3ohm in
     book
11 //(2) capacitance included
12 c=0.025*10^-6;//farad
13 frequ1=1/((2*3.14*(((rd*r1)/(rd+r1))+r1))*c);
14 volgai=(volgai/(sqrt((1+(frequ1/freque)^2))));
15
16 disp("voltage gain    =    "+string((volgai)));
```

Scilab code Exa 8.2 example 2

```
1 //pagenumber 400 example 2
2 clear
3 rd=80*10^3;//ohm
4 r1=8*10^3;//ohm
5 rd12=5*10^3;//ohm
6 rd1=rd*r1/(rd+r1);
7 u=30;
8 volgai=-(u*rd1)/(rd1+rd12);
9
10 disp("voltage gain    "+string((volgai)));
```

Scilab code Exa 8.3 example 3

```
1 //pagenumber 401 example 3
2 clear
3 r1=60*10^3;//ohm
4 volgai=-17.7;
5 rg=80*10^3;//ohm
6 volgai=((volgai*rg)/(1-volgai))/((rg/(1-volgai))+r1)
    ;
7 disp("voltage gain    =    "+string((volgai)));
```

Scilab code Exa 8.6 example 6

```
1 //pagenumber 405 example 6
2 clear
3 vds=14;//volt
4 idq=3*10^-3;//ampere
5 vdd=20;//volt
6 g=2*10^-2;
7 rd=50*10^3;//ohm
8 vgs=-1.5;//volt
9 w=(vdd-vds)/idq;
10 r1=-vgs/idq;
11 r2=w-r1;
12 inpres=1/(1-(0.8*((r1)/(r1+r2))));
13 volgai=(r1+r2)/(r1+r2+(1/(g)));
14 disp("r1    =    "+string((r1))+"ohm");
15 disp("effective input resistance    =    "+string((
   inpres))+"r3ohm");
16 disp("r2    =    "+string((r2))+"ohm");
17
18
19 disp("voltage gain    =    "+string((volgai))+"av'");
```

Scilab code Exa 8.7 example 7

```
1 //pagenumber 405 example 7
2 clear
3 rg=40*10^3;//ohm
4 voltag=(1-6*50)*3.3*10^3/(5.3*10^3);
5
6 disp("output voltage    =    "+string((voltag))+"volt"
   );//correction in the book
```

Scilab code Exa 8.9 example 9

```
1  //pagenumber 406 example 9
2  clear
3  u=50;
4  rd=10*10^3;//ohm
5  cgs=5*10^-12;//farad
6  cgd=2*10^-12;//farad
7  cds=2*10^-12;//farad
8  freque=3;//decibel
9  g=u/rd;
10 volgai=-u*rd/(rd+rd);
11 req=rd*rd/(rd+rd);
12 frequ1=1/(2*3.14*cgd*req);
13 disp("voltage gain    =    "+string((volgai)));//
       correction in book
14 disp("frequency    =    "+string((frequ1))+"hertz");
15 capac1=cgd*(1+g);
16 disp("output capacitance    =    "+string((capac1))+"
       farad");
17
18
19
20 disp("req    =    "+string((req))+"ohm");
```

Chapter 9

Multistage Amplifier

Scilab code Exa 9.1 example 1

```
1 //pagenumber 424 example 1
2 clear
3 //(1) frequency
4 freque=100*10^3*sqrt(2^(1/3)-(1));
5 frequ2=100*10^3/sqrt(2^(1/3)-(1));
6 disp("frequency1    =    "+string((freque))+"hertz");
7 disp("frequency2    =    "+string((frequ2))+"hertz");
8 //(2)frequency
9 freq11=100*10^6;//hertz
10 freq12=150*10^6;//hertz
11 freq13=200*10^6;//hertz
12 freq21=100*10^3;//hertz
13 freq22=150*10^3;//hertz
14 freq23=200*10^3;//hertz
15 frequ1=sqrt(freq11^2+freq12^2+freq13^2);
16 disp("frequency    =    "+string((frequ1))+"hertz");//
     correction in the book 269.25mega hertz
17 frequ1=1/sqrt((1/(freq21^2))+(1/(freq22^2))+(1/(
     freq23^2)));
```

```
18
19
20 disp("frequency   =   "+string((frequ1))+"hertz");//
   correction in the book
```

Scilab code Exa 9.2 example 2

```
1 //pagenumber 424 example 2
2 clear
3 freque=60;//hertz
4 frequ1=freque*0.484;
5 cb=1/(frequ1*2*3.14*10^3);
6 disp("coupling capacitance   =   "+string((cb))+"/r'
   ");
```

Scilab code Exa 9.3 example

```
1 //pagenumber 425 example 3
2 clear
3 g=10*10^-3;//ampere per volt
4 rd=5.5*10^3;//ohm
5 rg=1*10^6;//ohm
6 //(1) cb frequency 1decibel to 10hertz
7 ri=rg;
8 r1=(rd*8*10^3)/(rd+8*10^3);
9 cb=10^-6/(3.14*5.07);
10 disp("cb   =   "+string((cb))+"farad");
11 //(2) cb
12 cb=(cb*(5)/(3.52));
```

```
13 disp("cb    =    "+string((cb))+"farad");
14 //(3) gain
15 a1=g^2*(3.26^2);
16 disp("gain of each stage    =    "+string((a1)));//
      correction in the book
```

Scilab code Exa 9.4 example 4

```
1 //pagenumber 427 example 4
2 clear
3 freque=40*10^3;//hertz
4 frequ1=freque/0.507;
5 disp("upper frequency    =    "+string((frequ1))+"
      hertz");
6 frequ1=freque/1.96;
7 disp("lower frequency    =    "+string((frequ1))+"
      hertz");
```

Scilab code Exa 9.5 example 5

```
1 //pagenumber 427 example 5
2 clear
3 g=2.6*10^-3;//ampere per volt
4 rd=7.7*10^3;//ohm
5 rd1=12*10^3;//ohm
6 cb=0.005*10^-6;//farad
7 //(1) voltage gain
8 volgai=g*((1/rd)+1/rd1+1/(1*10^3));
9 volgai=(20*(log10(10.8)))*3;
```

```
10 disp("overal voltage gain   =   "+string((volgai))+"
     decibel");//correction in the book
11 //(2) lower frequency
12 r=rd*rd1/(rd+rd1);
13 freque=1/((2*3.14)*(r+1*10^6)*cb);
14 disp("lower frequency of each   =   "+string((freque
     ))+"hertz");
15 //(3) overal lower frequency
16 freque=freque*1.96;
17 disp("lower frequency overal   =   "+string((freque)
     )+"hertz");
```

Scilab code Exa 9.6 example 6

```
1 //pagenumber 429 example 6
2 clear
3 hfe=50;
4 hie=1.1*10^3;//ohm
5 //(1) gain
6 r1=2*10^3;//ohm
7 volgai=-hfe*r1/(hie);
8 r11=25*10^3*hie/(25*10^3+hie);
9 r11=r1*r11/(r1+r11);
10 volga1=-hfe*r11/hie;
11 volgai=volgai*volga1;
12 disp("voltage gain   =   "+string((volgai)));
13 freque=20;//hertz
14 ri=25*10^3*hie/(25*10^3+hie);
15 cb=1/(2*3.14*(ri+r1)*(freque));
16 disp("cb   =   "+string((cb))+"farad");
17 cb=1/(2*3.14*3.05*10^3*10/3.14);
18 disp("cb   <=   "+string((cb))+"farad");
```

Scilab code Exa 9.8 example 8

```
1 //pagenumber 432 example 8
2 clear
3 theta1=atand(0.1);
4 disp("theta1    =    "+string((theta1)));
5 disp("phase constant 10f1<=f<=0.1f11");
```

Chapter 10

Negative Feedback Amplifiers

Scilab code Exa 10.1 example 1

```
1 //pagenumber 467 example 1
2 clear
3 av=1000;
4 chvoga=0.001;//change in voltage gain
5 beta1=1/((chvoga)/(100/av))-1;
6 beta1=beta1/av;
7 fegain=(av)/(1+(av*(beta1)));
8 disp("reverse transmission = "+string((beta1)));
9
10 disp("gain with feedback = "+string((fegain)));
```

Scilab code Exa 10.2 example 2

```
1 //pagenumber 467 example 2
2 clear
```

```
3 voltag=36;//volt
4 w=0.07;//harmonic distortion
5 inpvol=0.028;//volt
6 beta1=0.012;
7 a=voltag/inpvol;
8 fegain=a/(1+beta1*a);//correction in book
9 volta1=fegain*inpvol;
10 disp("output voltage   =   "+string((volta1)));
11 //decrease of gain 9
12 inpvol=9*inpvol;
13
14
15
16 disp("input voltage   =   "+string((inpvol))+"volt")
   ;
```

Scilab code Exa 10.3 example 3

```
1 //pagenumber 468 example 3
2 clear
3 volgain=2000;//voltage gain
4 outpower=20;//watts
5 inpsig=10*10^-3;//volts
6 fedbac=40;//decibel
7 fedgai=volgain/100;
8 outvol=volgain*inpsig;//output voltage
9 inpvol=outvol/fedgai;//required input
10 //10 second harmonic distortion
11 distor=(10/100);
12 disp("required input   =   "+string((inpvol))+"volt"
   );
13
14
```

```
15
16 disp("harmonic distortion    =    "+string((distor)));
```

Scilab code Exa 10.5 example 5

```
1 //pagenumber 469 example 5
2 clear
3 fedgai=60;//decibel
4 outimp=10*10^3;//ohm
5 outim1=500;//ohm modified impedance
6 fedgai=1000;
7 fedbac=((outimp/outim1)-(1))/fedgai;
8 //10 change in gain
9 overga=1/((1+(fedgai*fedbac))/0.1);//over gain
10 disp("feedback factor    =    "+string((fedbac)));
11 disp("over gain    =    "+string((overga)));
```

Scilab code Exa 10.6 example 6

```
1 //pagenumber 470 example 6
2 clear
3 colres=4*10^3;//ohm
4 r=4*10^3;//ohm
5 basres=20*10^3;//ohm
6 r1=1*10^3;//ohm
7 hie=1.1*10^3;
8 hfe=50;
9 hoe=(40*10^3);
10 ri=basres*hie/(basres+hie);
```

```
11 curgai=((r1/(r1+ri)))*((basres/(basres+hie)))*((-hfe
     *colres)/(colres+r));
12 volgai=curgai*r/r1;
13 tranco=volgai/r;
14 tranre=r1*volgai;
15 outres=hoe*colres/(hoe+colres);
16 disp("current gain    =    "+string((curgai)));
17 disp("voltage gain    =    "+string((volgai)));
18 disp("transconductance    =    "+string((tranco))+"
     ampere per volt");
19 disp("transresistance    =    "+string((tranre))+"ohm"
     );
20 disp("input resistance    =    "+string((ri))+"ohm");
21 disp("output resistance    =    "+string((outres))+"
     ohm");
```

Chapter 11

Sinusoidal Oscillators

Scilab code Exa 11.2 example 2

```
1  //pagenumber 514 example 2
2  clear
3  macapa=900*10^-12;//farad
4  micapa=90*10^-12;//farad
5  r=100*10^3;//ohm
6  //(a) frequency range
7  fremin=1/(2*3.14*r*macapa);
8  disp("min frequency    =    "+string((fremin))+"hertz"
       );
9  fremax=1/(2*3.14*r*micapa);
10 disp("max frequency    =    "+string((fremax))+"hertz"
       );
11 //(b) r3
12 r=10*10^3;//ohm
13 r3=2*r;
14 disp("resistance r3    =    "+string((r3))+"ohm");
```

Scilab code Exa 11.3 example 3

```
1 //pagenumber 516 example 3
2 clear
3 c1=0.004*10^-6;//farad
4 c2=0.03*10^-6;//farad
5 induct=4*10^-3;//henry
6 //min voltage
7 mivolt=c2/c1;
8 disp("min voltage   >=   "+string((mivolt))+"volt");
9 //frequency
10 freque=(((1/(2*3.14)))*sqrt((c1+c2)/(induct*c1*c2)))
   ;
11 disp("frequency   =   "+string((freque))+"hertz");
```

Scilab code Exa 11.5 example 5

```
1 //pagenumber 517 example 5
2 clear
3 induct=500*10^-6;//henry
4 induc1=5000*10^-6;//henry
5 mutuin=300*10^-6;//henry
6 c1=150*10^-12;//farad
7 //(a) frequency
8 indcto=induct+induc1+2*mutuin;
9 freque=1/((2)*3.14*sqrt(indcto*c1));
10 //(b) condition
11 r=10*10^3;//ohm
```

```
12 conduc=8*10^-3;//ampere per volt
13 r1=50*10^3;//ohm
14 r'=r*r1/(r+r1);
15 volgai=conduc*r';
16 disp("frequency   =   "+string((freque))+"hertz");
17 ratio1=(induc1+mutuin)/(induct+mutuin);
18 ratio1=ratio1*volgai;
19 disp("ratio1 greater than 1 so oscillations possible
   ");
```

Scilab code Exa 11.6 example 6

```
1 //pagenumber 518 example 6
2 clear
3 cgs=5*10^-12;//farad
4 cds=1*10^-12;//farad
5 conduct=10*10^-3;//ampere per volt
6 rd=50*10^3;//ohm
7 r=10*10^6;//ohm
8 induct=0.5;//henry
9 c1=0.05*10^-12;//farad
10 rse=1*10^3;//ohm
11 c=1*10^-12;//farad
12 //(1) c11
13 c11=((((cds*cgs)/(cds+cgs))+1)*c1)/(((cds*cgs)/(cds+
   cgs))+1+c1);
14 disp("resonanting capacitance   =   "+string((c11))+
   "farad");
15 //(2) frequency
16 freque=((sqrt(2))/(2*3.14*sqrt(induct*c11)));
17 disp("resonant frequency   =   "+string((freque))+"
   hertz");
18 //(3) frequency parallel
```

```
19
20 freque=1/(2*3.14*sqrt(((induct*c*c1))/(c+c1)));
21 disp("parallel resonant frequency   =   "+string((
      freque))+"hertz");
22 //frequency series
23 freque=1/((2*3.14*sqrt(induct*c1)));
24 disp("series resonant frequency   =   "+string((
      freque))+"hertz");
25 qualit=((induct/c1)^(0.5))/rse;
26 disp("quality factor   =   "+string((qualit)));//
      correction in book
27 //(4) loop gain
28 abeta1=conduct*rd*cds/cgs;
29 disp("loop gain   =   "+string((abeta1)));
30 //(5)
31 w=r*(cds+cgs);
32 disp("bias   =   "+string((w))+"second");
```

Scilab code Exa 11.7 example 7

```
1 //pagenumber 519 example 7
2 clear
3 c=200*10^-12;//farad
4 c1=1000*10^-12;//farad
5 induct=100*10^-6;//henry
6 //(1) frequency
7 ceq=(c*c1)/(c+c1);
8 freque=1/(2*3.14*(sqrt(induct*ceq)));
9 disp("frequency   =   "+string((freque))+"hertz");//
      correction in the book
10 gaimin=c1/c;
11 disp("gain   =   "+string((gaimin)));
```

Scilab code Exa 11.8 example 8

```
1 //pagenumber 520 example 8
2 clear
3 induc1=0.4*10^-3;//henry
4 c=0.004*10^-6;//farad
5 freque=120*10^3;//hertz
6 induct=((1/(4*3.14^2*freque^2*c)))-induc1;
7 disp("inductance    =    "+string((induct))+"henry");
```

Scilab code Exa 11.9 example 9

```
1 //pagenumber 520 example 9
2 clear
3 induct=0.33;//henry
4 c=0.065*10^-12;//farad
5 c1=1*10^-12;//farad
6 r=5.5*10^3;//ohm
7 //(1) series resonant frequency
8 freque=(1/(2*(3.14)))*sqrt(1/((induct)*c));
9 disp("frequency    =    "+string((freque))+"hertz");
10 //(2)exceed of frequency
11 ratio1=sqrt((1+(c/c1)))
12 disp("ratio parallel series    =    "+string((ratio1))
     );//correction in the book
13 //(3) quality factor
14 qualit=(1/r)*sqrt(induct/c);
15
```

```
16 disp("quality factor    =    "+string((qualit)));
```

Chapter 12

Power Electronic Devices

Scilab code Exa 12.1 example 1

```
1 //pagenumber 553 example 1
2 clear
3 slope1=130;
4 trivol=15;//volt
5 d=0.5;//watts
6 ig=sqrt(d/slope1);
7 vg=slope1*ig;
8 r=(trivol-vg)/ig;
9
10 disp("source resistance    =    "+string((r))+"ohm");
```

Scilab code Exa 12.2 example 2

```
1 //pagenumber 553 example 2
2 clear
```

```
3 latcur=50*10^-3;//ampere
4 durpul=50*10^-6;//second
5 induct=0.5;//henry
6 r=20;//ohm
7 voltag=100;//volt
8 w=induct/r;
9 inpcur=-(voltag/r)*((1)-exp(-durpul/w));
10 disp("current    =    "+string(abs(inpcur))+"ampere");
11 disp("input current less than required current");
```

Scilab code Exa 12.3 example 3

```
1 //pagenumber 554 example 3
2 clear
3 latcur=4*10^-3;//ampere
4 induct=0.1;//henry
5 voltag=100;//volt
6 durmin=induct*latcur/voltag;
7 disp("min duration    =    "+string((durmin))+"second"
   );
```

Scilab code Exa 12.4 example 4

```
1 //pagenumber 554 example 4
2 clear
3 slope1=3*10^3;
4 egs=10;//volt
5 d=0.012;//watts
6 ig=sqrt(d/slope1);
```

```
7 vg=slope1*ig;
8 r=(egs-vg)/ig;
9
10 disp("source resistance    =    "+string((r))+"ohm");
     //it is not given in the book
```

Scilab code Exa 12.5 example 5

```
1 //pagenumber 554 example 5
2 clear
3 slope1=16;
4 durmax=4*10^-6;//second
5 curmin=500*10^-3;//ampere
6 voltag=15;//volt
7 //(1) resistance
8 vg=slope1*curmin
9 r=(voltag-vg)/curmin;
10 //(2)
11 d=vg*curmin;
12 freque=0.3/(d*durmax);
13 disp("resistance    =    "+string((r))+"ohm");
14
15
16 disp("frequency    =    "+string((freque))+"hertz");
```

Scilab code Exa 12.6 example 6

```
1 //pagenumber 555 example 6
2 clear
```

```
3 c1=20*10^-12;//farad
4 limcur=16*10^-3;//ampere
5 w=(limcur/c1)*10^-6;//convert second to microsecond
6 disp("change of voltage = "+string((w))+"volt
    per microsecond");
```

Scilab code Exa 12.7 example 7

```
1 //pagenumber 555 example 7
2 clear
3 ratcur=3000;//ampere
4 freque=50;//hertz
5 i=sqrt(ratcur^2/2);
6 disp("current = "+string((i))+"ampere");
7 i=((ratcur)/sqrt(2))^2/(2*freque);
8 disp("current = "+string((i))+"ampere square
    second");
```

Scilab code Exa 12.9 example 9

```
1 //pagenumber 556 example 9
2 clear
3 voltag=30;//volt
4 w=0.51;
5 i1=10*10^-6;//ampere
6 v1=3.5;//volt
7 curen1=10*10^-3;//ampere
8 freque=60;//hertz
9 tridun=50*10^-6;//second
```

```
pinvol=w*voltag+0.6;
r=(voltag-pinvol)/i1;
disp("max limit resistance    =    "+string((r))+"ohm"
   );
r=(voltag-v1)/(curen1);
disp("min limit resistance    =    "+string((r))+"ohm"
   );
capac1=0.5*10^-6;//farad
r=(1/freque)*(1/(capac1*log(1/(1-w))));
disp("resistance    =    "+string((r))+"ohm");
rb2=10^4/(w*voltag);
rb1=tridun/capac1;
disp("rb1    =    "+string((rb1))+"ohm");
disp("rb2    =    "+string((rb2))+"ohm");
disp("peak voltage    =    "+string((pinvol))+"volt");
```

Scilab code Exa 12.10 example 10

```
//pagenumber 557 example 10
clear
re=1*10^3;//ohm
i1=5*10^-3;//ampere

voltag=re*i1+2;
disp("voltage    =    "+string((voltag))+"volt");


disp("this voltage makes to off");
```

Chapter 13

Cathode Ray Oscilloscope

Scilab code Exa 13.1 example 1

```
1 //pagenumber 578 example 1
2 clear
3 quanti=3*10^17;
4 voltag=10*10^3;//volt
5 distan=40*10^-3;//metre per minute
6 w=quanti*1.6*10^-19*voltag
7 w=w/60;//per second
8
9
10 disp("power to electrons    =    "+string((w))+"watts"
   );
```

Scilab code Exa 13.2 example 2

```
1 //pagenumber 578 example 2
2 clear
3 sensit=5;// per centimetre
4 q=50*10^-6;//second per centimetre
5 petope=5.4;//centimetre
6 horiax=8.4;//centimetre
7 voltag=petope*sensit;
8 voltag=voltag/((2)*sqrt(2));
9 //one cycle
10 horiax=(horiax/2)*q;
11 freque=1/horiax;
12 disp("input voltage   =   "+string((voltag))+"volt")
     ;
13 disp("frequency   =   "+string((freque))+"hertz");
14
15
16 disp("vm1coswt vm2sinwt squaring and adding gives
     ellipse");
```

Scilab code Exa 13.3 example 3

```
1 //pagenumber 579 example 3
2 clear
3 voltag=1000;//volt
4 //(1) velocity
5 vx=sqrt(2*1.6*10^-19*(voltag)/(9.11*10^-31));
6 disp("velocity x   =   "+string((vx))+"metre per
     second");
7 vox=1*10^5;//metre per second intial velocity
8 vx=sqrt((vox)+((2*1.6*10^-19*voltag)
     /(2.01*1.66*10^-27)));
9
10 disp("velocity x   =   "+string((vx))+"metre per
```

```
second");
```

Scilab code Exa 13.4 example 4

```
1  //pagenumber 580 example 4
2  clear
3  voltag=2000;//volt
4  d=15;//centimetre
5  d1=3;//centimetre
6  r1=((d^2+d1^2)/(6))*10^-2;//centimetre to metre
7  vox=sqrt(2*1.6*10^-19*(voltag)/(9.11*10^-31));
8  b=vox/((1.6*10^-19*r1)/(9.11*10^-31));
9
10 disp("transverse magnetic field = "+string((b))+
   "weber per metre square");
```

Scilab code Exa 13.5 example 5

```
1  //pagenumber 581 example 5
2  clear
3  voltag=2000;//volt
4  d=2*10^-2;//metre
5  //(1) frequency
6  vx=sqrt(2*1.6*10^-19*(voltag)/(9.11*10^-31));
7  durati=d/vx;
8  freque=1/(2*durati);
9  disp("max frequency "+string((freque))+"hertz");
10 //(2)
11 durati=60*durati;
```

```
12 disp("duration electron between the plates   =   "+
     string((durati))+"second");//correction in book
```

Scilab code Exa 13.7 example 7

```
1 //pagenumber 582 example 7
2 clear
3 voltag=800;//volt
4
5
6 q=1.6*10^-19;//coulomb
7 m=9.11*10^-31;//kilogram
8 vox=sqrt(2*q*voltag/m);
9
10 disp("max velocity   "+string((vox))+"metre per
     second");
```

Scilab code Exa 13.8 example 8

```
1 //pagenumber 582 example 8
2 clear
3 voltag=2000;//volt
4 d=1.5*10^-2;//centimetre
5 d1=5*10^-3;//metre
6 distan=50*10^-2;//metre
7 //(1) velocity
8 vox=sqrt(2*1.6*10^-19*(voltag)/(9.11*10^-31));
9 //(2) sensitivity
10 defsen=distan*d/(2*d1*voltag);
```

```
11 //deflection factor
12 g=1/defsen;
13 disp("velocity    =    "+string((vox))+"metre per
      second");
14 disp("sensitivity    =    "+string((defsen))+"metre
      per volt");
15
16 disp("deflection factor    =    "+string((g))+"volt
      per metre");//correction in the book
```

Scilab code Exa 13.9 example 9

```
1 //pagenumber 582 example 9
2 clear
3 voltag=2000;//volt
4 d=50*10^-3;//metre
5 //(1) velocity
6 vox=sqrt(2*1.6*10^-19*(voltag)/(9.11*10^-31));
7 disp("velocity    =    "+string((vox))+"metre per
      second");
8 //(2) fc
9 fc=vox/(4*d);
10
11 disp("fc    =    "+string((fc))+"hertz");
```

Scilab code Exa 13.10 example 10

```
1 //pagenumber 582 example 10
2 clear
```

```
3 y=2.5;//divisions
4 y1=1.25;//divisions
5 y=y1/y;
6 w=asind(y);
7 disp("phase angle    =    "+string((w))+"degre");
```