Scilab Textbook Companion for Basic Electronics Devices Circuits and Its Fundamentals
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Book Description

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

Exa Example (Solved example)

Eqn Equation (Particular equation of the above book)

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

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

Contents

List of Scilab Codes

Chapter 2

Semiconductor Materials And Junction Diode

Scilab code Exa 2.1 Electron and hole component of current density

```
// Exa 2.1
format('v',9)
clc;
clear;
close;
// Given data
n_i = 1.5 * 10^10;// in /cc
p = n_i;// in /cc
n = n_i;// in /cc
miu_n = 1400;// in cm^2/V-s
miu_p = 450;//in cm^2/V-s
q = 1.6 * 10^-19;// in C
E = 20;// in V/cm
a= 5;// cross section area of Si bar in cm^2
sigma_n = n*q*miu_n;// in mho/cm
sigma_p = n*q*miu_p;// in mho/cm
// Electron current density
Jn = sigma_n*E;// in A
Jn= Jn*10^6;// in  A /cm^2
```

```
disp(Jn,"Electron current density in  A/cm^2 is");
// The hole current density
Jp = sigma_p*E;// in A/cm^2
Jp= Jp*10^6;// in  A/cm^2
disp(Jp,"The hole current density in  A/cm^2 is");
//The total current in the bar
total = (Jn+Jp)*a;//  A/cm^2
disp(total,"The total current in the bar in  A/cm^2
    is");
format('e',8)
// The resistivity of the bar
rho = 1/(n_i*q*(miu_p+miu_n)*10^2);// in ohm-cm
disp(rho,"The resistivity of the bar in ohm-cm is");
```

Scilab code Exa 2.2 Peak output voltage

```
// Exa 2.2
format('v',5)
clc;
clear;
close;
// Given data
V_F = 20;// in V
Vin = V_F;// in V
V_BE = 0.7;// in V
R1 = 500;//resistance in ohm
R2 = 10;// resistance in ohm
// Peak current though the diode
Ifpeak = (V_F-V_BE)/(R1+R2);// in A
Ifpeak = Ifpeak * 10^3;// in mA
disp(Ifpeak,"The peak current through the diode in
   mA is");
R_L = 500;// in ohm
// Peak output voltage
Vpeakout = Ifpeak*10^-3*R_L;// in V
```

```
disp(Vpeakout,"The peak out voltage in V is");
// For ideal diode
Ifpeak = V_F/R_L;// in A
Ifpeak = Ifpeak * 10^3;// in mA
// The peak output voltage for ideal diode
Vpeakout= Ifpeak*10^-3*R_L;// in V
disp(Ifpeak,"The peak current for ideal diode in mA is");
disp(Vpeakout,"The peak output voltage for ideal diode in V is");
```

Scilab code Exa 2.3 Increase in forward current

```
// Exa 2.3
format('v',6)
clc;
clear;
close;
// Given data
t = 27;// in  C
t= t+273;// in  K
q= 1.6*10^-19;// electron charge in C
v = 200*10^-3;// in V
kt_by_q= 0.026;// in V
Io= 3*10^-7;// in A
// For large reverse bias I= Io*(%e^(q*v/(k*t)))
I= Io*(%e^(v/kt_by_q)-1);// in A
I= round(I*10^6);// in  A
disp(I,"The current flowing through the diode in  A is");
Idaso = Io*2^7;// in A
// r_ac = dv/di = 1/( Io*(1/kTdividedq)*(%e^(v/(kTdividedq))) );
r_ac = 1/( Io*(1/kt_by_q)*(%e^(v/(kt_by_q))) );
disp(r_ac,"The ac resistance in ohm is : ");
```

```
kt_by_q = 0.032;// in V
I1 = Idaso * ((%e^(v/(kt_by_q))) - 1);// in A
I1 = I1 * 10^3;// in mA
delI = I1-(I*10^-3);// in mA
disp(delI,"The increase in forward current in mA is"
    );
```

Scilab code Exa 2.4 Slope of the line

```
// Exa 2.4
format('e',9)
clc;
clear;
close;
// Given data
V = 30;//applied forward voltage in V
R_L = 3;//load resistance in  k ohm
R_L = R_L * 10^3;// in ohm
Imax = V/R_L;// maximum diode current in A
Imax = Imax * 10^3;// in mA
slope = -1/R_L;// in mho
plot([V,0],[0,Imax]);
xlabel("V_F in volts");
ylabel("I_F in mA");
title("DC load line");
disp("DC load line shown in figure")
disp(slope,"The slope of the line in mho is");

// Note: There is calculation error to find the
    value of slope because -1/3 k  = -3.33*10^-4 mho,
     not = -3.33*10^-3 mho
```

Scilab code Exa 2.5 Maximum and minimum values of the instantaneous power

```
// Exa 2.5
format('v',6)
clc;
clear;
close;
// Given data
Vp= '[4+0.2*sin(omega*t)]';// in V
Ip= '[4+0.3*sin(omega*t)]';// in mA
//The instantaneous power dissipated , P= Vp*Ip = [4+0.2*sind(wt)]*[4+0.3*sind(wt)]
// and putting , sin^2(omega*t)= 1/2-1/2*cos(2*omega*t)
P= '[16.03+2*sin(omega*t)-0.03*cos(2*omega*t)]*10^-3';// in W
disp(P,"The instantaneous power dissipated in the diode in W is : ")
// Pmax occurs when omega*t=90, so
omega_t= 90;// in
Pmax= [16.03+2*sind(omega_t)-0.03*cosd(2*omega_t)]*10^-3;// in W
disp(Pmax,"The maximum value of instantaneous power dissipated in W is : ")
// Pmin occurs when omega*t=-90, so
omega_t= -90;// in
Pmin= [16.03+2*sind(omega_t)-0.03*cosd(2*omega_t)]*10^-3;// in W
disp(Pmin,"The minimum value of instantaneous power dissipated in W is : ");
// The average power dissipated
Pav=(Pmax+Pmin)/2;// in W
disp(Pav,"The average power dissipated in the diode in W is : ")
```

Scilab code Exa 2.6 Load line

```
// Exa 2.6
format('v',9)
clc;
clear;
close;
// Given data
R_L = 50;// in ohm
V = 10;// in V
R = 5;// in ohm
V_D = (V*R)/(R_L+R);// in V
R_D = (R_L*R)/(R_L+R);// in ohm
I_D = V_D/R_D;// in A
I_D = I_D * 10^3;// in mA
plot([V_D,0],[0,I_D])
xlabel("V_D in volts");
ylabel("I_D in mA");
title("DC load line");
disp("DC load line shown in figure")
slope = -1/R_D;
disp(slope,"The slope of the dc load line is : ");
```

Scilab code Exa 2.7 Value of Is

```
// Exa 2.7
format('e',8)
clc;
clear;
close;
// Given data
V_T= 26*10^-3;// in V
```

```
T = 300;// in K
V = 0.25;// in V
I= 10 * 10^-3;// in A
// I = I_S*( (%e^(V/(n*kTdividedq)))-1 ) = I_S*( (%e^(V/V_T))-1 );
I_S= I/(%e^(V/V_T)-1);// in A
disp(I_S,"The reverse saturate current in amp. is :")
format('v',6)
// For 1 mA current
I = 1;// in mA
I = I*10^-3;// in A
V = (1/38.46)*log(I/I_S);// in V
disp(V,"The bias voltage needed for 1 mA in V is");
// For 100 mA current
I = 100;// in mA
I = I * 10^-3;// in A
V = (1/38.46)*log(I/I_S);// in V
disp(V,"The bias voltage needed for 100 mA in V is");

// Note: Answer in the book is not accurate.
```

Scilab code Exa 2.8 Reverse saturation current

```
// Exa 2.8
format('v',6)
clc;
clear;
close;
// Given data
V_T= 25*10^-3;// in V
// I = Io*( (%e^(V/V_T))-1 );
I = 1;// in mA
I = I * 10^-3;// in A
```

```
V = 0.15;// in V
Io = I/( (%e^((1/V_T)*V))-1 );// in A
Io = Io * 10^6;// in  A
disp(Io,"The reverse saturation current at room temperature in  A is");
// Io doubles for every 10 C -rise in temperature. Thus at 40 C
Io_new= 4*Io;//new value of reverse saturation current in  A
disp(Io_new,"The reverse saturation current at 40 C in  A is");
I = 100;// in mA
I = I * 10^-3;// in A
// I = Io*( (%e^((1/V_T)*V))-1 );
V = (1/40)*log( I/(Io*10^-6) );// in V
disp(V,"The forward bias voltage in V is");
```

Chapter 3

Junction Diode and Their Applications

Scilab code Exa 3.1 Im Idc Irms and Ripple factor

```
// Exa 3.1
format('v',5)
clc;
clear;
close;
// Given data
// V = 50 * snid(omega*t);
Vm = 50;// in V
r_d = 20;// in ohm
R_L = 800;// in ohm
Im = Vm/(r_d+R_L);// in A
Im = Im * 10^3;// in mA
disp(Im,"The value of Im in mA is");
Idc = Im/%pi;// in mA
disp(Idc,"The value of Idc in mA is");
Irms = Im/2;// in mA
disp(Irms,"The value of Irms in mA is");
// The ac power input
P_ac_input = (Irms*10^-3)^2*(r_d+R_L);// in W
```

```
disp(P_ac_input,"The ac power input in W is");
P_dc_output = (Idc*10^-3)^2*R_L;// in W
// The dc power output
disp(P_dc_output,"The dc power output in W is");
// The dc output voltage
V_dc_out = Idc*10^-3*R_L;// in V
disp(V_dc_out,"The dc output voltage in V is");
//The Efficiency of rectification , Eta = ((Idc^2*R_L)*100)/(Irms^2*(R_L+r_d)) = (8/%pi) * ((R_L*100)/(R_L+r_d))
Eta = 8/%pi^2 * ((R_L*100)/(R_L+r_d));// in %
disp(Eta,"The Efficiency of rectification in % is");
ripplefactor = sqrt( (Irms/Idc)^2 -1 );
disp(ripplefactor,"The ripple factor is");

// Note: In the book, the calculation to evaluate the value of efficiency of rectification is wrong.
```

Scilab code Exa 3.2 Required PIV

```
// Exa 3.2
format('v',6)
clc;
clear;
close;
// Given data
Vdc = 120;// in V
Vm = (%pi/2)*Vdc;// in V
disp(Vm,"The peak value of output voltage in V is");
Vpeak = 2*Vm;// in V
disp(Vpeak,"The peak value of voltage at transformer secondary in volts is : ")
Vrms = Vpeak/sqrt(2);// in V
disp(Vrms,"The r.m.s. value of voltage at
```

```
transformer secondary in V is");
R_L = 250;// in k ohm
R_L = R_L * 10^3;// in ohm
Idc = Vdc/R_L;// in A
Idc= Idc*10^6;// in  A
disp(Idc,"The average current delivered to load in A is");
Io = Idc/2;// in  A
disp(Io,"The average current through each of the diode in  A is");
// Peak current through each of the diode in A
I_peak = Vm/R_L;// in A
I_peak= I_peak*10^3;// in mA
disp(I_peak,"The peak current through each of the diode in mA is");
PIV = 2*Vm;// in V
disp(PIV,"The PIV required for each of the diode in V is");
```

Scilab code Exa 3.3 Maximum and minimum value of zener diode current

```
// Exa 3.3
format('v',6)
clc;
clear;
close;
// Given data
V = 120;// in V
Vz = 50;// in V
R = 5;// in k ohm
R = R * 10^3;// in ohm
I = (V-Vz)/R;// in A
R1 = 10;// in k ohm
R1 = R1 * 10^3;// in ohm
I_L = Vz/R1;// in A
```

```
// The maximum value of zener diode current
I_Zmax = I-I_L;// in A
I_Zmax= I_Zmax*10^3;// in mA
disp(I_Zmax,"The maximum value of zener diode
   current in mA is");
V2 = 80;// in V
I = (V2-Vz)/R;// in A
// The minimum value of zener diode current
I_Zmin = I-I_L;// in A
I_Zmin=I_Zmin*10^3;// in mA
disp(I_Zmin,"The minimum value of zener diode
   current in mA is");
```

Scilab code Exa 3.4 Value of R

```
// Exa 3.4
format('v',6)
clc;
clear;
close;
// Given data
R_L = 18;// in ohm
Vz = 18;// in V
V1 = 22;// in V
V2 = 28;// in V
// Minimum voltage across R,
V = V1-Vz;// in V
Izmin = 200;// in mA
I_Lmax = Vz/R_L;// in A
I = I_Lmax+Izmin*10^-3;// in A
R =V/I;// in ohm
disp(R,"The value of R in ohm is : ")
I1 = (V2-Vz)/R;;// in A
// The maximum current through R
Izmax = I1 - 1;// in A
```

```
Izmax= Izmax*10^3;// in mA
disp(Izmax,"The maximum current through R in mA is");
disp("Which is within the limit of Iz (max) provided.")
pd = Vz*Izmax*10^-3;// maximum power dissipated in W
disp(pd,"The maximum power dissipated in W is");
```

Scilab code Exa 3.5 Designing of the circuit

```
// Exa 3.5
format('v',6)
clc;
clear;
close;
// Given data
V1 = 12;// in V
Vz = 10;// in V
V = V1-Vz;// in V
I_Lmax = 10;// in mA
I_Zmin = 0.2;// in mA
I = I_Lmax+I_Zmin;// in mA
R = V/I;// in k ohm
Vz1 = 5;// in V
// The maximum current through R
Imax = Vz1/R;// in mA
disp(Imax,"The maximum current through R in mA is");
// The power rating of zener
power = Vz*Imax;// in mW
disp(power,"The power rating of zener in mW is");
```

Scilab code Exa 3.6 Input and output waveform

```
// Exa 3.6
format('v',6)
clc;
clear;
close;
// Given data
Vo= -6;// in V      (for Vi<=-6.6 V)
Vo= 8;// in V       (for Vi>=8.8 V)
// Vi= 10000*i+100000*i or i= Vi/110000      (i)
Vi= -6.6:0.1:8.8;
// Vo= 100000*i
Vo= 100000*Vi/110000;//      (substituting i from eq(
    i))
plot(Vi,Vo);
xlabel("Vi in volts")
ylabel("Vo in volts")
title("The overall transfer characteristics")
disp("The overall transfer characteristics shown in
    figure.")
```

Scilab code Exa 3.7 Output dc voltage

```
// Exa 3.7
format('v',6)
clc;
clear;
close;
// Given data
Vm = 20;// in V
Idc = 100;// in mA
Idc = Idc * 10^-3;// in A
R_S = 5;// in ohm
R_F = 2;// in ohm
Vdc = ((2*sqrt(2)*Vm)/%pi) - Idc*(R_S+2*R_F);// in V
disp(Vdc,"The output dc voltage at dc load current
```

```
   of 100 mA in V is");
Idc = 200;// in mA
Idc = Idc * 10^-3;// in A
Vdc = ((2*sqrt(2)*Vm)/%pi) - Idc*(R_S+2*R_F);// in V
R_L = Vdc/Idc;// in ohm
// The percentage regulaiton
Per_reg = ((2*R_F+R_S)/R_L)*100;// in %
disp(Per_reg,"The percentage regulation for a full
   load dc current of 200 mA in % is");
Eta = round((8/(%pi^2)) * ( R_L/(2*R_F+R_S+R_L) )
   *100);// in %
disp(Eta,"The efficiency of the rectifier in % is");
```

Scilab code Exa 3.8 Designing of a zener voltage regulator

```
// Exa 3.8
format('v',6)
clc;
clear;
close;
// Given data
Vz = 20;// in V
R_L = 1;// in k ohm
R_L = R_L * 10^3;// in ohm
I_L =Vz/R_L;// in A
V1 = 30;// in V
R_S = (V1-Vz)/I_L;// in ohm
V2 = 50;// in V
// The maximum current through Rs resistor,
I_S = (V2-Vz)/R_S;// in A
I_Smax = V1/R_S;// in A
I_Zmax = I_Smax-I_L;// in A
power = I_Zmax*Vz;// in W
disp(power,"The maximum power rating of the Zener
   diode in W is");
```

Scilab code Exa 3.9 Designing of a zener voltage regulator

```
// Exa 3.9
format('v',6)
clc;
clear;
close;
// Given data
Vz = 20;// in V
V1 = 30;// in V
V2 = 50;// in V
R_L = 2;// in  k ohm
R_L = R_L * 10^3;// in ohm
I_L =Vz/R_L;// in A
I_ZK = 5*10^-3;// in mA
I_Smin = I_L+I_ZK;// in A
R_S = (V1-Vz)/I_Smin;// in ohm
I_Smax = (V2-Vz)/R_S;// in A
I_Zmax = I_Smax-(I_Smin+I_ZK);// in A
// The maximum power rating of the zener diode,
power = I_Zmax*Vz;// in W
disp(power,"The maximum power rating of the zener
    diode in W is");
```

Scilab code Exa 3.10 Value of limiting resistance R1 and R2

```
// Exa 3.10
format('v',6)
clc;
clear;
close;
```

```
// Given data
Vz1= 10;//voltage across zener diode, Z1 in V
Vz2= 5;// voltage across zener diode, Z2 in V
Iz1= 30*10^-3;// current through zener diode, Z1 in
    A
Iz2= 15*10^-3;// current through zener diode, Z1 in
    A
I_knee= 5*10^-3;//knee current of zener diode,Z1 in
    A
R_L=500;//load resistance in ohm
R= 1*10^3;// in ohm
V_B= 25;// in V
// Current through RL,
I_RL= Vz2/R_L;// in A
// Current through R2,
I_R2= Iz2+Vz2/R_L;// in A
// Voltage across resistance R2,
V_R2= Vz1-Vz2;// in V
R2= V_R2/I_R2;// in ohm
disp(R2,"The value of resistance R2 in ohm is : ")
// Current through R1,
I_R1= Iz1+Vz1/R+I_R2;//in A
// Voltage across R1,
V_R1= V_B-Vz1;// in V
R1= V_R1/I_R1;// in ohm
disp(R1,"The value of resistance R1 in ohm is : ")
// Current through R1,
I_R1= I_knee+Vz1/R+I_R2;// in mA
// Voltage across R1,
V_R1= I_R1*R1;// in volts
V_Bmin= Vz1+V_R1;// in V
disp(V_Bmin,"The lowest power supply voltage in
    volts is : ")
```

Chapter 4

BJTs and FETs

Scilab code Exa 4.1 DC load line

```
// Exa 4.1
format('v',6)
clc;
clear;
close;
// Given data
V_CC = 18;// in V
V_BB = 6;// in V
Beta = 75;
I_CO = 100;// in nA
I_CO = I_CO * 10^-9;// in A
R_C = 1;// in k ohm
R_C = R_C * 10^3;// in ohm
V_CE = 9;// in V
I_C = 9;// in mA
I_C = I_C * 10^-3;// in A
// I_C = Beta*I_B + (1+Beta)*I_CO;
I_B = (I_C-((1+Beta)*I_CO))/Beta;// in A
I_B = I_B * 10^3;// in mA
disp(I_B,"The value of I_B in mA is");
V_BE = 0.7;// in V assumed
```

```
R_B = (V_BB-V_BE)/(I_B*10^-3);// in ohm
R_B = R_B * 10^-3;// in k ohm
disp(R_B,"The value of R_B for Si transistor in k ohm is");
V_BE = 0.3;// in V
R_B = (V_BB-V_BE)/(I_B*10^-3);// in ohm
R_B= R_B*10^-3;// in k ohm
disp(R_B,"The value of R_B for Ge transistor in k ohm is");
V_CEQ= V_CC-I_C*R_C;// in V
I_CQ= round(Beta*I_B);// in mA
I_C= V_CC/R_C;// in A
I_C= I_C*10^3;// in mA
plot([V_CC,0],[0,I_C]);
xlabel("V_CC in volts ");
ylabel("I_C in mA")
title("DC load line ")
disp("DC load line shown in figure")
disp("Q point : "+string(V_CEQ)+" volts , "+string(I_CQ)+" mA")
```

Scilab code Exa 4.2 Value of RB RC and IC

```
// Exa 4.2
format('v',5)
clc;
clear;
close;
// Given data
V_BB = 15;// in V
V_CC = 15;// in V
I_CO = 0.1;// in  A
I_CO = I_CO * 10^-6;// in A
Beta = 60;
I_B = 50;// in  A
```

```
I_B = I_B * 10^-6;// in A
V_CE = 8;// in V
I_C = (Beta*I_B)+((1+Beta)*I_CO);// in A
I_C =  round(I_C * 10^3);// in mA
disp("Part (i) : ")
disp(I_C,"The value of I_C in mA is");
R_C = (V_CC-V_CE)/(I_C*10^-3);// in ohm
R_C = R_C * 10^-3;// in k ohm
disp(R_C,"The value of R_C in k ohm is");
V_BE = 0.3;// in V
R_BGe = (V_BB-V_BE)/I_B;// in ohm
R_BGe = R_BGe * 10^-3;// in k ohm
disp(R_BGe,"The value of R_B for Ge in k ohm is");
V_BE = 0.7;// in V
R_BSi = (V_BB-V_BE)/I_B;// in ohm
R_BSi = R_BSi * 10^-3;// in k ohm
disp(R_BSi,"The value of R_B for Si in k ohm is");
P_RC = ((I_C*10^-3)^2)*(7/3)*10^3;// in W
P_RC = P_RC * 10^3;// in mW
disp("Part (ii) : ")
disp(P_RC,"The power dissipations in RC in mW is");
// The power dissipations in the transistor
P_TRANS = V_CE*I_C;// in mW
disp(P_TRANS,"The power dissipations in the transistor in mW is");
disp("Part (iii) : For RC= 1 k , V_CE increase, shifting the Q-point ot right and I_C increase slightly")
```

Scilab code Exa 4.3 NEw value of VCE

```
// Exa 4.3
format('v',6)
clc;
clear;
```

```
close;
// Given data
V_CE = 9;// in V
R_C = 10;// in Mohm
R_C = R_C * 10^6;// in ohm
V = 10;// in V
I_CEO = (V - V_CE)/R_C;// in A
// When R_C is changed to 10 k ohm
R_C = 10;// in k ohm
R_C = R_C * 10^3;// in ohm
V_CE = (V - (I_CEO*R_C));// in V
disp(V_CE,"The new value of V_CE in V is");
```

Scilab code Exa 4.4 DC load line

```
// Exa 4.4
format('v',6)
clc;
clear;
close;
// Given data
V_CC = 20;// in V
V_BB = 10;// in V
V_BE= 0.7;// in V
V_CEsat = 0.3;// in V
R_B = 47;// in k ohm
R_B = R_B * 10^3;// in ohm
R_C = 1;// in k ohm
R_C = R_C * 10^3;// in ohm
I_C =V_CC/R_C;// in A
I_C = I_C * 10^3;// in mA
plot([V_CC,0],[0,I_C]);
xlabel("V_CE in volts");
ylabel("I_C in mA");
title("DC load line")
```

```
I_BQ = (V_BB-V_BE)/R_B;// in A
Beta = 80;
I_CQ = Beta*I_BQ*10^3;// in mA
V_CEQ = V_CC - (I_CQ*10^-3*R_C);// in V
disp("DC load line shown in figure")
disp("Q points : "+string(V_CEQ)+" volts, "+string(
    I_CQ)+" mA")
I_Csat = (V_CC-V_CEsat)/R_C;// in A
I_B = I_Csat/Beta;// in A
V_BE = 0.7;// in V
R_B = (V_BB-V_BE)/I_B;// in ohm
disp(R_B*10^-3,"The value of R_B in k ohm is");
R_C = 500;// in ohm
V_CE = V_CC - (I_Csat*R_C);// in V
disp(V_CE,"The value of V_CE in volts is : ")
disp("The transistor will come out of saturation and
     enter the active region of the transistors.");
```

Scilab code Exa 4.5 Value of bita dc

```
// Exa 4.5
format('v',6)
clc;
clear;
close;
// Given data
Beta_dc = 80;
V_CC = 25;// in V
V_BE = 0.7;// in V
R_B = 180;// in k ohm
R_B = R_B * 10^3;// in ohm
R_E = 200;// in ohm
R_C = 820;// in ohm
I_B = (V_CC-V_BE)/(R_B+((Beta_dc+1)*R_E));// in A
I_C = Beta_dc*I_B;// in A
```

```
V_CG = V_CC - (I_C*R_C);// in V
disp(V_CG,"The voltage between collector and ground in volts is : ")
V_CEsat = 0.3;// in V
// V_CC - V_CEsat = I_Csat*R_C + I_Csat/Beta_dc*(Beta_dc+1)*R_E;
I_C = (V_CC-V_CEsat)/(R_C+R_E);// in A
//I_B = V_CC - ((I_E*R_E)+V_BE)/R_B = V_CC - ((I_C*R_E)+V_BE)/R_B;
I_B = (V_CC-I_C*R_E+V_BE)/R_B;// in A
Beta_dc = I_C/I_B;
disp(Beta_dc,"The value of Beta_dc on which transistor is saturate is");

// Note: There is some difference between the value of Beta_dc in the book and coding output because the correct values of I_C and I_B are  24.215 mA and 0.1158
```

Scilab code Exa 4.7 Value of Beta dc

```
// Exa 4.7
format('v',6)
clc;
clear;
close;
// Given data
Beta_dc = 80;
V_CC = 25;// in V
V_BE = 0.7;// in V
R_B = 180;// in k ohm
R_B = R_B * 10^3;// in ohm
R_E = 200;// in ohm
R_C = 820;// in ohm
I_B = (V_CC-V_BE)/(R_B+((Beta_dc+1)*R_E));// in A
```

```
I_C = Beta_dc*I_B;// in A
V_CG = V_CC - (I_C*R_C);// in V
disp(V_CG,"The voltage between collector and ground
    in volts is : ")
V_CEsat = 0.3;// in V
// V_CC - V_CEsat = I_Csat*R_C + I_Csat/Beta_dc*(
    Beta_dc+1)*R_E;
I_C = (V_CC-V_CEsat)/(R_C+R_E);// in A
//I_B = V_CC - ((I_E*R_E)+V_BE)/R_B = V_CC - ((I_C*
    R_E)+V_BE)/R_B;
I_B = (V_CC-I_C*R_E+V_BE)/R_B;// in A
Beta_dc = I_C/I_B;
disp(Beta_dc,"The value of Beta_dc on which
    transistor is saturate is");

// Note: There is some difference between the value
    of Beta_dc in the book and coding output because
    the correct values of I_C and I_B are 24.215 mA
    and 0.1158
```

Scilab code Exa 4.8 New operating point

```
// Exa 4.8
format('v',6)
clc;
clear;
close;
// Given data
V_CE = 8;// in V
I_C = 1;// in mA
I_C = I_C * 10^-3;// in A
V_CC = 12;// in V
Beta = 100;
R_C = (V_CC-V_CE)/I_C;// in ohm
I_B = I_C/Beta;// in A
```

```
V_BE = 0.3;// in V
R_B = ((V_CC-(I_C*R_C))-V_BE)/I_B;// in ohm
// For Beta= 50;
V_CE= 9.6;// in V
I_C= 0.6;// in mA
R_C= R_C*10^-3;// in k ohm
R_B= R_B*10^-3;// in k ohm
disp(R_C,"The value of R_C in k ohm is");
disp(R_B,"The value of R_B in k ohm is");
disp("New Q point : "+string(V_CE)+" volts , "+string
    (I_C)+" mA")
```

Scilab code Exa 4.9 Value of R1 and R2

```
// Exa 4.9
format('v',6)
clc;
clear;
close;
// Given data
V_BE= 0.7;
bita = 100;
V_CC = 20;// in V
R_E = 1 * 10^3;// in ohm
V_CEQ = 10;// in V
I_CQ = 2* 10^-3;// in A
S_ICO = 10;
I_BQ = I_CQ/bita;// in A
// R_B= R1*R2/(R1+R2)       (i)
// V_B= R2*V_CC/(R1+R2) (ii)
R_B= (S_ICO-1)*R_E;// in ohm
// V_CC= I_CQ*R_C+V_CEQ+(1+bita)*I_C/bita*R_E
R_C= (V_CC-V_CEQ-I_CQ*R_E)/I_CQ;// in ohm
I_B= I_CQ/bita;// in A
V_B= I_B*R_B+V_BE+(1+bita)*R_E*I_B;// in V
```

```
// From eq (i) and (ii)
R2= (V_B*R_B+R_B*(V_CC-V_B))/(V_CC-V_B);// in ohm
R1= R2*R_B/(R2-R_B);// in ohm
R1= R1*10^-3;// in k ohm
R2= R2*10^-3;// in k ohm
disp(R1,"The value of R1 in k ohm is : ")
disp(R2,"The value of R2 in k ohm is : ")
```

Scilab code Exa 4.10 DC load line

```
// Exa 4.10
format('v',6)
clc;
clear;
close;
// Given data
V_CC = 18;// in V
V_BB = 6;// in V
Beta = 75;
I_CO = 100;// in nA
I_CO = I_CO * 10^-9;// in A
R_C = 1;// in k ohm
R_C = R_C * 10^3;// in ohm
V_CE = 9;// in V
I_C = 9;// in mA
I_C = I_C * 10^-3;// in A
// I_C = Beta*I_B + (1+Beta)*I_CO;
I_B = (I_C-((1+Beta)*I_CO))/Beta;// in A
I_B = I_B * 10^3;// in mA
disp(I_B,"The value of I_B in mA is");
V_BE = 0.7;// in V assumed
R_B = (V_BB-V_BE)/(I_B*10^-3);// in ohm
R_B = R_B * 10^-3;// in k ohm
disp(R_B,"The value of R_B for Si transistor in k
    ohm is");
```

```
V_BE = 0.3;// in V
R_B = (V_BB-V_BE)/(I_B*10^-3);// in ohm
R_B= R_B*10^-3;// in k ohm
disp(R_B,"The value of R_B for Ge transistor in k ohm is");
V_CEQ= V_CC-I_C*R_C;// in V
I_CQ= round(Beta*I_B);// in mA
I_C= V_CC/R_C;// in A
I_C= I_C*10^3;// in mA
plot([V_CC,0],[0,I_C]);
xlabel("V_CC in volts ");
ylabel("I_C in mA")
title("DC load line ")
disp("DC load line shown in figure")
disp("Q point : "+string(V_CEQ)+" volts, "+string(I_CQ)+" mA")
```

Scilab code Exa 4.11 Base current

```
// Exa 4.11
format('v',5)
clc;
clear;
close;
// Given data
alpha = 0.9;
I_E = 1;// mA
I_C = alpha * I_E;// in mA
// The base current,
I_B = I_E - I_C;// in mA
disp(I_B,"The value of base current in mA is");
```

Scilab code Exa 4.12 Emitter current

```
// Exa 4.12
format('v',5)
clc;
clear;
close;
// Given data
bita = 50;
I_B= 20;// in  A
I_B=I_B*10^-6;// in A
I_C= bita*I_B;// in A
// The emitter current,
I_E= I_C+I_B;// in A
I_E = I_E * 10^3;// in mA
disp(I_E,"The Emitter current in mA is");
```

Scilab code Exa 4.13 Base current and emitter current

```
// Exa 4.13
format('v',7)
clc;
clear;
close;
// Given data
beta_dc = 90;
// The base current,
I_C = 15;// in mA
I_C = I_C * 10^-3;// in A
I_B = I_C/beta_dc;// in A
I_B= I_B*10^6;// in  A
disp(I_B,"The base current in  A is");
I_B= I_B*10^-6;// in A
// The emitter current,
I_E = I_C + I_B;// in A
I_E = I_E * 10^3;// in mA
disp(I_E,"The Emitter current in mA is");
```

```
alpha_dc = beta_dc/(1+beta_dc);
disp(alpha_dc,"The value of alpha_dc is");
```

Scilab code Exa 4.14 Change in base current

```
// Exa 4.14
format('v',5)
clc;
clear;
close;
// Given data
del_ic = 1.8;// in mA
del_ie = 1.89;// in mA
alpha = del_ic / del_ie;
bita = alpha/(1 - alpha);
// Change in base current,
del_ib = del_ic/bita;// in mA
del_ib = del_ib * 10^3;// in  A
disp(del_ib,"The change in I_B in  A is");
```

Scilab code Exa 4.15 Collector current

```
//Exa 4.15
format('v',7)
clc;
clear;
close;
// Given data
bita = 100;
I_CBO = 4;// in  A
I_B = 40;// in  A
// The collector current,
I_C = (bita * I_B) + ((1+bita) * I_CBO);// in  A
```

```
I_C = I_C * 10^-3;// in msA
disp(I_C,"The collector current in mA is");
```

Scilab code Exa 4.16 Alphadc and beta dc

```
//Exa 4.16
format('v',7)
clc;
clear;
close;
//Given data
I_CEo = 21;// in  A
I_CBO = 1.1;// in  A
// Value of beta_dc
beta_dc = round((I_CEo/I_CBO) - 1);
disp(beta_dc,"Value of beta_dc is");
// The value of alpha_dc
alpha_dc = beta_dc/(1 + beta_dc);
disp(alpha_dc,"The value of alpha_dc is");
```

Scilab code Exa 4.17 Alphadc and emitter current

```
// Exa 4.17
format('v',7)
clc;
clear;
close;
// Given data
I_CBO = 3;//in  A
I_CBO= I_CBO*10^-3;// in mA
I_C= 15;// in mA
// But it is given that I_C= 99.5% of I_E , SO
I_E= I_C/99.5*100;// in mA
```

```
alpha_dc= I_C/I_E;
disp(alpha_dc,"The value of alpha_dc is : ")
disp(I_E,"The value of I_E in mA is : ")
```

Scilab code Exa 4.18 IC and IB

```
//Exa 4.18
format('v',5)
clc;
clear;
close;
//Given data
alpha_dc = 0.99;
I_CBO = 10;// in  A
I_CBO= I_CBO*10^-6;// in A
I_E = 10;// in mA
I_E= I_E*10^-3;// in A
// The collector current,
I_C = (alpha_dc * I_E) + I_CBO;// in A
I_C=I_C*10^3;// in mA
disp(I_C,"The value of I_C in mA is");
I_C=I_C*10^-3;// in A
// The base current,
I_B = I_E - I_C;// in A
I_B = I_B * 10^6;// in  A
disp(I_B,"The value of I_B in  A is");
```

Scilab code Exa 4.19 Base current

```
// Exa 4.19
format('v',5)
clc;
clear;
```

```
close;
format('v',9)
// Given data
alpha_dc = 0.99;
I_C = 6;// in mA
I_C= I_C*10^-3;// in A
I_CBO = 15;// in   A
I_CBO= I_CBO*10^-6;// in A
// The emitter current,
I_E = (I_C - I_CBO)/alpha_dc;// in A
// The base current,
I_B = I_E - I_C;// in A
I_B= I_B*10^6;// in   A
I_B= round(I_B)
disp(I_B,"The value of I_B in   A is");
```

Scilab code Exa 4.20 Emitter current

```
//Exa 4.20
format('v',5)
clc;
clear;
close;
// Given data
alpha_dc = 0.98;
I_CBO = 12;// in   A
I_CBO = I_CBO * 10^-6;// in A
I_B = 120;// in   A
I_B = I_B * 10^-6;// in A
beta_dc = alpha_dc/(1-alpha_dc);
// The emitter current,
I_E = ((1 + beta_dc) * I_B) + ((1 + beta_dc) * I_CBO
    );//in A
I_E = I_E * 10^3;// in mA
disp(I_E,"The value of I_E in mA is");
```

Scilab code Exa 4.21 Base and emitter current

```
// Exa 4.21
format('v',7)
clc;
clear;
close;
// Given data
beta_dc = 90;
// The base current ,
I_C = 15;// in mA
I_C = I_C * 10^-3;// in A
I_B = I_C/beta_dc;// in A
I_B=I_B*10^6;// in  A
disp(I_B,"The base current in  A is");
I_B=I_B*10^-6;// in A
// The emitter current ,
I_E = I_C + I_B;// in A
I_E = I_E * 10^3;// in mA
disp(I_E,"The Emitter current in mA is");
alpha_dc = beta_dc/(1+beta_dc);
disp(alpha_dc,"The value of alpha_dc is");

// Note: There is printing mistake in the book in
   this example.
```

Chapter 5

Transistor Biasing and Small Signal Amplifiers

Scilab code Exa 5.1 h parameters

```
// Exa 5.1
format('v',6)
clc;
clear;
close;
R1= 10;// in ohm
R2= 20;// in ohm
R3=30;// in ohm
v2= 50;// in V
v1= 20;// in V
i1= -2.5;//in V
i2= 1;// in A
h11= R1+(R2*R3/(R2+R3));// in ohm
// h-parameters
disp("h-parameters : ")
disp(h11,"The value of h11 in ohm is : ")
// From vi= h11*i1+h12*V1 and i2= h21*i1+h22*v2
h12= v1/v2;
disp(h12,"The value of h12 is : ")
```

```
h21= i2/i1;
disp(h21,"The value of h21 is : ")
h22= i2/v2;// in mho
disp(h22,"The value of h22 in mho is : ")
```

Scilab code Exa 5.2 h parameters

```
// Exa 5.2
format('v',6)
clc;
clear;
close;
// Given data
R1 = 30;// in ohm
R2 = 40;// in ohm
R3 = 60;// in ohm
R4 = 40;// in ohm
R5 = 70;// in ohm
h11 = (R1+(R2*R5/(R2+R5)));// in ohm
disp(h11,"The numericals values of h11 in ohm is");
h12 =R2*R4/(R4+R5)*1/(R3+R4*R5/(R4+R5))
disp(h12,"The numericals values of h12 is");
h21 =-R4*R2/(R5+R2)*1/(R3+R5*R2/(R5+R2))
disp(h21,"The numericals values of h21 is");
h22 = 1/(R3+(R2*R5/(R2+R5)))
disp(h22,"The numericals values of h22 in mho is");

// Note : In the book the calculated value of h11 i.
    e 30+(40 || 70) = 53 is wrong. correct value is
    55.45 so the answer in the book is wrong.
```

Scilab code Exa 5.3 z parameter

```
// Exa 5.3
format('v',6)
clc;
clear;
close;
// Given data
R1 = 30;// in ohm
R2 = 40;// in ohm
R3 = 60;// in ohm
R4 = 40;// in ohm
R5 = 70;// in ohm
// z-parameters
z11= R1+(R2*(R1+R2)/(R2+(R1+R2)))
disp(z11,"The value of z11 in ohm is : ");
z22= R3+R4*R5/(R4+R5);
disp(z22,"The value of z22 is : ");
z12= R2*R4/(R1+R2+R4);
disp(z12,"The value of z12 is : ");
z21= R2*R4/(R1+R2+R4);
disp(z21,"The value of z21 in mho is : ");
```

Scilab code Exa 5.4 External voltage gain

```
// Exa 5.4
format('v',6)
clc;
clear;
close;
// Given data
Avint = 100;
Ri = 1;// in k ohm
Ro = 200;// in ohm
Ro = Ro * 10^-3;// in k ohm
R_S = 50;// in ohm
R_S = R_S * 10^-3;// in k ohm
```

```
R_L = 2;// in k ohm
// Avext = V_L/V_S =Avint*(Ri/(RiR_S))*(R_L/(R_L+Ro)
    );
Avext = Avint*(Ri/(Ri+R_S))*(R_L/(R_L+Ro));
disp(Avext,"The external voltage gain is");
```

Scilab code Exa 5.5 External current gain

```
// Exa 5.5
format('v',7)
clc;
clear;
close;
// Given data
Ri = 1;// in k ohm
Ro = 80;// in k ohm
Aiint = 150;
R_S = 5;// in k ohm
R_L = 1;// in k ohm
//Aiext = i1/i2 = (R_S/(R_S+Ri)) * (Ro/(Ro+R_L))*
    Aiint;
Aiext = (R_S/(R_S+Ri)) * (Ro/(Ro+R_L))*Aiint;
disp(Aiext,"The external current gain is");
```

Scilab code Exa 5.6 Lower 3 dB frequency

```
// Exa 5.6
format('v',5)
clc;
clear;
close;
// Given data
```

```
// Vo = -R_L*Io = ( (-R_L*Rc)/(Rc+R_L+(1/SC)) )*h_fe
    *Ib;
R_C = 4;// in k ohm
R_L = 2;// in k ohm
R = R_C+R_L;// in k ohm
R= R*10^3;// in ohm
C_L = 10;// in  F
C_L = C_L * 10^-6;// in F
// Vo/Ib =Aos/(S+(1/R*C_L));
f_L = 1/(2*%pi*R*C_L);// in Hz
disp(f_L,"The lower  3-dB frequency in Hz is");
```

Scilab code Exa 5.7 Ai Av Ri Ais and Avs

```
// Exa 5.7
format('v',5)
clc;
clear;
close;
// GIven data
R_L= 10*10^3;// in ohm
h_ie = 1.1;// in k ohm
h_ie = h_ie * 10^3;// in ohm
h_re = 2.5*10^-4;
h_fe = 50;
h_oe = 24;// in  A /V
h_oe = h_oe * 10^-6;// in A/V
R_S = 1;// in k ohm
R_S = R_S * 10^3;// in  ohm
Rc = 10;// in k ohm
Rc = Rc * 10^3;// in ohm
Ai = round(-h_fe/(1+(h_oe*R_L)));
disp(Ai,"The value of Ai is");
Ri = h_ie+(h_re*Ai*R_L);// in ohm
Ri= Ri*10^-3;// k ohm
```

```
disp(Ri,"The value of Ri in k ohm is");
Ri= Ri*10^3;// ohm
Av = (Ai*R_L)/Ri;
disp(Av,"The value of Av is");
Avs = (Av*Ri)/(Ri+R_S);
disp(Avs,"The value of Avs is");
Ais = (Ai*R_S)/(Ri+R_S);
disp(Ais,"The value of Ais is");
```

Scilab code Exa 5.8 Cut off frequency

```
// Exa 5.8
format('v',5)
clc;
clear;
close;
// Given data
I_C = 1 ;// in A
bita= 200;
h_fe = bita;
R_C = 5*10^3;// in ohm
R_E = 2*10^3;// in ohm
R_S =600;// in ohm
R_L = 600;// in ohm
C1=10*10^-6;// in F
C2= C1;// in F
f_L= 20;// in Hz (lower cut-off frequency)
// R1||R2= 6;// in k ohm
r_e = 25/I_C;// in ohm
h_i = bita*r_e;// in ohm
// R_B= R1||R2=6;// in k ohm
R_B= 6*10^3;// in ohm
r_i = 5*10^3;// in ohm
Ri = (R_B*r_i)/(R_B+r_i);// in ohm
// The cut off frequency due to C1
```

```
f1= 1/(2*%pi*(Ri+R_S)*C1);// in Hz
disp(f1,"The cut-off frequency due to C1 in Hz is :
    ")
// The cut off frequency due to C2
f2= 1/(2*%pi*(R_C+R_L)*C2);// in Hz
disp(f2,"The cut-off frequency due to C1 in Hz is :
    ")
// The cut off frequency due to C_E, f_L= (1+h_fe)
    /(2*%pi*C_E*(R_S+h_ie)) or
C_E = (1+h_fe)/(2*%pi*f_L*(R_S+h_i));// in F
C_E =round(C_E * 10^6);// in  F
disp(C_E,"The value of C_E in  F is");
```

Scilab code Exa 5.9 Mid band voltage gain and input impedance

```
// Exa 5.9
format('v',9)
clc;
clear;
close;
// Given data
h_fe = 100;
h_ie = 1;// in k ohm
h_ie = h_ie * 10^3;// in ohm
vo_by_I= -100*10^3;// in ohm
vi_by_I= 1100+101*0.1*10^3;// in ohm
Av= vo_by_I/vi_by_I;
Av= round(Av);
Av= abs(Av);
disp(Av,"The mid-band voltage gain is");
//Ri =Vi/Ii;
Ri= vi_by_I;// in ohm
Ri= Ri*10^-3;// in k ohm
disp(Ri,"The input impedance in k ohm is");
```

Scilab code Exa 5.10 Value of rE Ai and Rin

```
// Exa 5.10
format('v',5)
clc;
clear;
close;
// Given data
V = 5.7;// in V
V_BE = 0.7;// in V
R1 =10 * 10^3;// in ohm
R2 = 100 * 10^3;// in ohm
I_BQ = (V-V_BE)/(R1+R2);// in A
I_BQ = I_BQ * 10^3;// in mA
I_EQ = 100*I_BQ;// in mA
R1= 2;// in k ohm
R_L= 100*10^-3;// in k ohm
disp(I_EQ,"The value of I_EQ in mA is");
V_T = 0.026;// in V assumed
r_E = V_T/(I_EQ*10^-3);// in ohm
disp(r_E,"The value of r_E in ohm is");
Beta = 100;
h_fe= Beta;
r_pi = Beta*r_E;// in ohm
disp(r_pi,"The value of r_pi in ohm is : ")
ib= poly(0,'ib');
vb_by_ib= 0.572+101*1;// in k ohm
Ri= 10;// in k ohm
i1_by_ib= vb_by_ib/Ri;
is_by_ib= 1+i1_by_ib;
iL_by_ib= -h_fe*R1/(R1+R_L);
// Ai= iL/is = iL_by_ib/is_by_ib;
Ai= iL_by_ib/is_by_ib;
Rin= vb_by_ib/is_by_ib;// in k ohm
```

```
disp(Ai,"The value of Ai is : ")
disp(Rin,"The value of Rin in k ohm is : ")
```

Chapter 6

Feedback Amplifiers and Oscillations

Scilab code Exa 6.1 New gain after feedback

```
// Exa 6.1
format('v',6)
clc;
clear;
close;
// Given data
BWf = 5;// in MHz
BWf= BWf * 10^6;// in Hz
Av = 100;
BW = 500;// in kHz
BW = BW * 10^3;// in Hz
// BWf = (1+(B*Av))*BW;
B = ((BWf/BW)-1)/Av;
disp(B,"The amount of negative feed back is");
Avf = Av/(1+(Av*B));
disp(Avf,"The new gain after negative feed back is")
    ;
```

Scilab code Exa 6.2 Av of the basic amplifier

```
// Exa 6.2
format('v',5)
clc;
clear;
close;
// Given data
h11 = 2;// in k ohm
h11 = h11 * 10^3;// in ohm
h12 = 0;
h21 = 80;
h22= 1*10^-3;// in mho
R_L= 10*10^3;// in ohm
B= 10/100;
Ri= 2;// in k ohm
R_Ldesh= (R_L*1/h22)/(R_L+1/h22);// in ohm
Av= h21*R_Ldesh/h11;
disp(Av,"Part (a) : The value of Av of the basic
    amplifier is : ")
D= 1+Av*B;
disp(D,"The value of densitivity factor is : ")
Avf= Av/(1+B*Av);
disp(Avf,"The value of Avf is : ")
Rif= (1+Av*B)*Ri;// in k ohm
disp(Rif,"The value of Rif in k ohm is : ")
```

Scilab code Exa 6.3 Value of RC

```
// Exa 6.3
format('e',8)
clc;
```

```
clear;
close;
// Given data
f_osc = 6.5;// in kHz
f_osc = f_osc * 10^3;// in Hz
// f_osc = 1/(2*%pi*sqrt(6)*RC);
RC = 1/(2*%pi*sqrt(6)*f_osc);// in sec
disp(RC,"The value of RC in sec is : ")
format('v',5)
// Possible selection of R and C may be
R= 1;// in k ohm
C= RC/R;// in mF
C= C*10^3;// in  F
disp("The posible selection of R and C : ")
disp("(a) : "+string(R)+" k  and "+string(C)+"  F")
format('v',6)
R= 10;// in k ohm
C= RC/R;// in mF
C= C*10^3;// in  F
disp("The posible selection of R and C : ")
disp("(a) : "+string(R)+" k  and "+string(C)+"  F")
```

Scilab code Exa 6.4 Reverse transmission factor

```
// Exa 6.4
format('v',6)
clc;
clear;
close;
// Given data
A= 1000;
dA= 100;
dAbyAf= 0.1/100;
```

```
// dAf/Af = 1/|1+B*A| * dA/A or
B= (dA-dAbyAf*A)/(dAbyAf*A^2)
disp(B,"The reverse transmission factor of the
    feedback networks used is : ");
Af = A/(1+(B*A));
disp(Af,"The gain with feed back is");
```

Scilab code Exa 6.5 Output voltage and input voltage

```
// Exa 6.5
format('v',6)
clc;
clear;
close;
// Given data
Vout = 36;// in V
Vs = 0.028;// in V
B = 1.2/100;
A = Vout/Vs;
Af = A/(1+(B*A));
Vo =Af*Vs;// in V
disp(Vo,"The output voltage in V is");
// 1+BA = 7 or
BA= 6;
Af= A/(1+BA);
Vin = Vout/Af;// in V
disp(Vin,"The input voltage in V is");
```

Scilab code Exa 6.6 Value of fLF

```
// Exa 6.6
format('v',6)
clc;
```

```
clear;
close;
// Given data
f_L = 20;// in Hz
f_H = 50;// in kHz
f_H = f_H * 10^3;// in Hz
Ao = 1000;
B = 10/100;
f_HF =f_H*(1+(B*Ao));// in Hz
f_HF = f_HF * 10^-6;// in MHz
disp(f_HF,"The value of f_HF in MHz is");
f_LF = f_L/(1+(B*Ao));// in Hz
disp(f_LF,"The value of f_LF in Hz is");
```

Scilab code Exa 6.7 Wien bridge oscillation

```
// Exa 6.7
format('e',9)
clc;
clear;
close;
// Given data
f_o = 1;// in kHz
f_o = f_o * 10^3;// in Hz
// f_o = 1/(2*%pi*Rc);
RC = 1/(2*%pi*f_o);
disp(RC,"The value of RC is : ")
disp("So R and C can be choosen as 15.9 k  and 0.01  F respectively.")
```

Scilab code Exa 6.8 Av of the basic amplifier

```
// Exa 6.8
```

```
format('v',5)
clc;
clear;
close;
// Given data
h11 = 2;// in k ohm
h11 = h11 * 10^3;// in ohm
h12 = 0;
h21 = 80;
h22= 1*10^-3;// in mho
R_L= 10*10^3;// in ohm
B= 10/100;
Ri= 2;// in k ohm
R_Ldesh= (R_L*1/h22)/(R_L+1/h22);// in ohm
Av= h21*R_Ldesh/h11;
disp(Av,"Part (a) : The value of Av of the basic
    amplifier is : ")
D= 1+Av*B;
disp(D,"The value of densitivity factor is : ")
Avf= Av/(1+B*Av);
disp(Avf,"The value of Avf is : ")
Rif= (1+Av*B)*Ri;// in k ohm
disp(Rif,"The value of Rif in k ohm is : ")
```

Scilab code Exa 6.9 Value of vo by vs Ri and Ro

```
// Exa 6.9
format('v',6)
clc;
clear;
close;
// Given data
h_ie = 1.5 * 10^3;// in ohm
h_fe = 100;
// R = R1||R2 = 20;// in k ohm
```

```
R = 20 * 10^3;// in ohm
R_E = 560;// in ohm
R_S = 600;// in ohm
Avf = (h_fe*R_E)/(h_ie+(h_fe*R_E));
VoByVs = Avf;
disp(VoByVs,"The value of midband voltage gain (vo/
    vs) is :");
Ri = h_ie + ((1+h_fe)*R_E);// in ohm
Ri= Ri*10^-3;// in k ohm
disp(Ri,"The value of input impedance (Ri) in k ohm
    is : ")
Ri= Ri*10^3;// in ohm
Ro = (R_S+h_ie)/(1+h_fe);// in ohm
disp(Ro,"The value of output impedance (Ro) in ohm
    is : ")
R_desh_i = (R*Ri)/(R+Ri);// in ohm
R_desh_i=R_desh_i*10^-3;// in k ohm
disp(R_desh_i,"The value of R''i in k ohm is");
// For load resistance of 10 k ohm
R_L = 10;// in k ohm
R_L = R_L * 10^3;// in ohm
R_desh_o = (Ro*R_L)/(Ro+R_L);// in ohm
disp(R_desh_o,"The value of R''o for load resistance
     of 10 k ohm  in ohm is");
// For load resistance of 220 ohm
R_L = 220;// in ohm
R_desh_o = (Ro*R_L)/(Ro+R_L);// in ohm
disp(R_desh_o,"The value of R''o for load resistance
     of 220 ohm  in ohm is");

// Note: There is a calculation mistake to evaluate
    the value of R_desh_i (R'i)
```

Scilab code Exa 6.10 Voltage gain input resistance

```
// Exa 6.10
format('v',6)
clc;
clear;
close;
// Given data
h_fe = 50;
h_ie = 1.2;// in k ohm
h_ie  = h_ie * 10^3;// in ohm
R_C = 1;// in k ohm
R_C = R_C * 10^3;// in ohm
R_E = 200;// in ohm
R_B = 2;// in k ohm
R_B = R_B * 10^3;// in ohm
Av = (-h_fe*R_C)/h_ie;
disp(Av,"The voltage gain (Av) is");
Ri = (h_ie*R_B)/(h_ie+R_B);// in ohm
disp(Ri,"The input resistance (Ri) in ohm is");
// vi= vs (on neglecting Rs), hence i_E= i_B+h_fe*i_B = (1+h_fe)*i_B                (i)
// vo= -i_C*R_C = -h_fe*i_B*R_C             (As i_C= h_fe*i_B)                (ii)
// From eq (i) : vi= i_B*h_ie+i_E*R_E= i_B*(h_ie+(1+h_fe)*R_E)                (iii)
//  i_L= i_B                (iv)
// Avf = (h_fe*i_B*R_C)/(i_B*(h_ie+(1+h_fe)*R_E));
Avf = (-h_fe*R_C)/( h_ie+(1+h_fe)*R_E );
disp(Avf,"The voltage gain (Avf) is");
Rif = (R_B*(h_ie + ((1+h_fe)*R_E)))/(R_B+(h_ie + ((1+h_fe)*R_E)));// in ohm
Rif= Rif*10^-3;// in k ohm
disp(Rif,"The input resistance (Rif) in k ohm is");
```

Chapter 7

Operational Amplifiers

Scilab code Exa 7.1 Output voltage

```
// Exa 7.1
format('v',6)
clc;
clear;
close;
// Given data
Ac = 35;//common mode gain in dB
Ac = 10^(Ac/20);
CMRR = 72;// in dB
CMRR = 10^(CMRR/20);
// CMRR = Ad/Ac
Ad = CMRR*Ac;
V1 = 0.16;// in mV
V2 = 0.18;// in mV
// Common mode signal
Vc = 1/2*(V1+V2);// in mV
// Difference mode signal
Vd = V2-V1;// in mV
// The output voltage
Vo = Ac*Vc+Ad*Vd;// in mV
Vo= Vo*10^-3;// in V
```

```
disp(Vo,"The output voltage in V is");
```

Scilab code Exa 7.6 Output voltage

```
// Exa 7.6
format('v',5)
clc;
clear;
close;
// Given data
Ro = 10;// in k ohm
R1 = 10;// in k ohm
R2 = 2.2;// in k ohm
R3 = 3.3;// in k ohm
V1 = 6;// in V
V2 = -3;// in V
V3 = -0.75;// in V
// Output voltage ,
Vo = -( ((Ro/R1)*V1) + ((Ro/R2)*V2) + ((Ro/R3)*V3) )
    ;// in V
disp(Vo,"The value of Vo in V is");
```

Scilab code Exa 7.8 Open loop voltage gain

```
// Exa 7.8
format('v',7)
clc;
clear;
close;
// Given data
R = 100;// in k ohm
R = R * 10^3;// in ohm
C = 2;// in  F
```

```
C = C * 10^-6;// in F
f = 10;// in kHz
f = f * 10^3;// in Hz
omega = 2*%pi*f;// in Krad
// The open loop voltage gain,
A = R*omega*C;
disp(A,"The open loop voltage gain is");
format('e',9)
//The feedback function, B is evaluated as, A_F = −R/Z_C*( 1/(1+(1/(A*B))) );
B = 1/( sqrt( 1+((R*omega*C)^2) ) );
disp(B,"The feed back function is");
format('v',7)
//A_F = −R/Z_C*(1/( 1+(1/(A*B)) ));
Av = 10^3;
A_F = round(A*(1/(1+(1/(Av*B)))));
disp(A_F,"The overall gain is");

// Note: The open loop voltage gain in the book is not accurate.
```

Scilab code Exa 7.9 Value of constant A1 and A2

```
// Exa 7.9
format('v',7)
clc;
clear;
close;
// GIven data
R1 = 10;// in k ohm
R2 = 100;// in k ohm
R3 = 10.1;// in k ohm
R4 = 99;// in k ohm
// Vdaso = Vo2 = V2*(−R2/R1)
//Vdaso = Vo1 = V1*(R4/(R3+R4))*(1+(R2/R1))
```

```
//Vo = Vo1+Vo2 = (V1*(R4/(R3+R4))*(1+(R2/R1))) - (V2
    *(-R2/R1))
//Vo = (R2/R1) * ( -V2 + ( 1+(R1/R2) )/(1+(R3/R4))*
    V1 )
A1 = (1+(R1/R2))/(1+(R3/R4))*(R2/R1);// (on
    comparing vo= A1*V1+A2*V2)
disp(A1,"The value of A1 is");
A2 = -R2/R1;
disp(A2,"The value of A2 is");
```

Scilab code Exa 7.10 CMRR in dB

```
// Exa 7.10
format('v',6)
clc;
clear;
close;
// Given data
Ad = 100000;
Ac = 25;
CMRR = Ad/Ac;
CMRR_indB= 20*log10(CMRR);// in dB
disp(CMRR_indB,"Part (a) : The value of CMRR in dB
    is");
format('e',8)
R2 = 100;// in k ohm
R1 = 10;// in k ohm
V_B = 0.18;// in mV
V_A = 0.16;// in mV
// The output from the amplifier,
Vo = ((R2/R1)*(V_B-V_A)*10^-3) + ((R2/R1)*V_B
    *10^-3*(1/CMRR));// in V
disp(Vo,"Part (b) : The output from the amplifier in
     V is");
V_B = 2.00018;// in V
```

```
V_A = 2.00016;// in V
// The output from the amplifier ,
Vo = ((R2/R1)*(V_B-V_A)) + ((R2/R1)*V_B*(1/CMRR));//
    in V
disp(Vo,"Part (c) : The output from the amplifier in
    V is");
```

Scilab code Exa 7.12 Output voltage

```
// Exa 7.12
format('v',9)
clc;
clear;
close;
// Given data
R1 = 10;// in k ohm
Rf = 30;// in k ohm
Vs = 4;// in V
V_A = 2;// in V
V_B = 2;// in V
I = (Vs-V_B)/(R1);// in mA
Vo = (-I*Rf)+V_B;// in V
// The output voltage ,
disp(Vo,"The value of Vo in V is");
```

Scilab code Exa 7.13 Voltage gain and input resistance

```
// Exa 7.13
format('v',6)
clc;
clear;
close;
// Given data
```

```
h_fe = 50;
h_ie = 1.2;// in k ohm
h_ie  = h_ie * 10^3;// in ohm
R_C = 1;// in k ohm
R_C = R_C * 10^3;// in ohm
R_E = 200;// in ohm
R_B = 2;// in k ohm
R_B = R_B * 10^3;// in ohm
Av = (-h_fe*R_C)/h_ie;
disp(Av,"The voltage gain (Av) is");
Ri = (h_ie*R_B)/(h_ie+R_B);// in ohm
disp(Ri,"The input resistance (Ri) in ohm is");
// vi= vs (on neglecting Rs), hence i_E= i_B+h_fe*i_B = (1+h_fe)*i_B                    (i)
// vo= -i_C*R_C = -h_fe*i_B*R_C            (As i_C= h_fe*i_B)                    (ii)
// From eq (i) : vi= i_B*h_ie+i_E*R_E= i_B*(h_ie+(1+h_fe)*R_E)                    (iii)
//  i_L= i_B                    (iv)
// Avf = (h_fe*i_B*R_C)/(i_B*(h_ie+(1+h_fe)*R_E));
Avf = (-h_fe*R_C)/( h_ie+(1+h_fe)*R_E );
disp(Avf,"The voltage gain (Avf) is");
Rif = (R_B*(h_ie + ((1+h_fe)*R_E)))/(R_B+(h_ie + ((1+h_fe)*R_E)));// in ohm
Rif= Rif*10^-3;// in k ohm
disp(Rif,"The input resistance (Rif) in k ohm is");
```

Chapter 8

Digital Logic and Combinational Circuits

Scilab code Exa 8.1 Hexadecimal number 3BF ino binary

```
// Exa 8.1
format('v',9)
clc;
clear;
close;
// Given data
str= '3BF';// given number in hexadecimal to convert
    into binary
str_in_dec= hex2dec(str);// decimal equivalent
str_in_bin= dec2bin(str_in_dec);// binary equivalent
disp(str_in_bin,"The binary equivalent of 3BF is : "
   )

// Note : The answer in the book is wrong because
   binary equivalent of B = 1011 and in the book
   they used 1101 which is wrong.
```

Scilab code Exa 8.2 Convert octal into binary

```
// Exa 8.2
format('v',9)
clc;
clear;
close;
// Given data
str= '527';// given number in octal to convert into binary
str_in_dec= oct2dec(str);// decimal equivalent
str_in_bin= dec2bin(str_in_dec);// binary equivalent
disp(str_in_bin,"The binary equivalent of 527 is : ")
```

Scilab code Exa 8.3 Convert octal into hexadecimal number

```
// Exa 8.3
format('v',9)
clc;
clear;
close;
// Given data
str= '256';// given number in octal to convert into hexadecimal
str_in_dec= oct2dec(str);// decimal equivalent
str_in_hex= dec2hex(str_in_dec);// hexadecimal equivalent
disp(str_in_hex,"The hexadecimal equivalent of 256 is : ")
```

Scilab code Exa 8.4 Convert decimal into octal

```
// Exa 8.4
format('v',9)
clc;
clear;
close;
// Given data
str= 450;// given number in decimal to convert into
    octal
str_in_oct= dec2oct(str);// octal equivalent
disp(str_in_oct,"The octal equivalent of 450 is : ")
```

Scilab code Exa 8.9 Maximum permissible value of RB

```
// Exa 8.9
format('v',6)
clc;
clear;
close;
// Given data
R_C= 1;// in k ohm
V_CC= 5;// in V
V_CEsat= 0;// in V
V_BE= 0.7;// in V
bita_min= 50;
bita_max= 100;
// For the transistor to go to saturation,
I_C= (V_CC-V_CEsat)/R_C;// in mA
bita= bita_min;// for driving the transistor into
    saturation
I_Bmin= I_C/bita;//minimum base current in mA
// So, (V_CC-V_BE)/R_B >= I_B or
R_B= (V_CC-V_BE)/I_Bmin;// in k ohm
disp(R_B,"The maximum permissible value of R_B in k
    ohm is : ")
// For actual calculation one may take V_CEsat= 0.3
```

```
V
V_CEsat= 0.3;// in V
I_C= (V_CC-V_CEsat)/R_C;// in mA
bita= bita_min;// for driving the transistor into
    saturation
I_Bmin= I_C/bita;//minimum base current in mA
// So, (V_CC-V_BE)/R_B >= I_B or
R_B= (V_CC-V_BE)/I_Bmin;// in k ohm
disp("For actual calculation at V_CE(sat) = 0.3 V,
    the maximum value ")
disp(R_B,"of R_B in k ohm is : ")
```

Chapter 12

Memory Systems

Scilab code Exa 12.1 Capacity of memory chip

```
// Exa 12.1
format('v',6)
clc;
clear;
close;
// Given data
RAMbit= 2*4;//K bit RAM IC chip
// The capacity of the memory chip,
Capacity = RAMbit*2^10;// in bits
disp(Capacity,"The capacity (or density) of the
   memory chip in bits is");
```

Scilab code Exa 12.2 Required address bits

```
// Exa 12.2
format('v',6)
clc;
clear;
```

```
close;
// Given data
// (a) For 1024 number of bits
No_of_bits= 1024;// bits
Req_add_bits= log(No_of_bits)/log(2);
disp(Req_add_bits,"Address bits required for a memory that has 1024 number of bits");

// (b) For 256 number of bits
No_of_bits= 256;// bits
Req_add_bits= log(No_of_bits)/log(2);
disp(Req_add_bits,"Address bits required for a memory that has 256 number of bits");

// (c) For 4098 number of bits
No_of_bits= 4096;// bits
// 2^12= 4096, 2^13= 8192, where 4096<4098<8192 or 2^12<4098<2^13, hence
Req_add_bits= 13;
disp(Req_add_bits,"Address bits required for a memory that has 4098 number of bits");

// d) For 16384 number of bits
No_of_bits= 16384;// bits
Req_add_bits= log(No_of_bits)/log(2);
disp(Req_add_bits,"Address bits required for a memory that has 16384 number of bits");
```

Scilab code Exa 12.3 Bits of storage and lines in address bus

```
// Exa 12.3
format('v',6)
clc;
clear;
close;
```

```
// Given data
memory = 16;// in K
memory= memory*1024;// in bits
// Number of bits of storage ,
Req_add_bits= log(memory)/log(2);
disp(Req_add_bits,"Number of bits of storage is : ")
disp(Req_add_bits,"Number of lines in address bus is
    : ")
```

Scilab code Exa 12.4 Number of address line

```
// Exa 12.4
format('v',6)
clc;
clear;
close;
// Given data
memory= 16;// in K
wordBit= 8;
// Number of address
N= log((memory/wordBit)*1024)/log(2);
disp(N,"The number of address lines is : ")
```

Scilab code Exa 12.5 Memory cell

```
// Exa 12.5
format('v',8)
clc;
clear;
close;
// Given data
memory= 16;// in K
memory= memory*1024;// in bits
```

```
// Number of words
N1= memory;
disp(N1,"The number of words is : ")
N2= 32;// number of bits per word
disp(N2,"The number of bits per word is : ")
// Number of memory cell
N3= N2*memory;
disp(N3,"The number of memory cell is : ")
```

Scilab code Exa 12.6 Total number of memory cells

```
// Exa 12.6
format('v',9)
clc;
clear;
close;
// Given data
N1= 16;// address input
inputs= 4;
outputs= 4;
// Total number of memory cells
N2= 2^N1*2^inputs;
disp(N2,"Total number of memory cells is : ")
```