Scilab Textbook Companion for Electronics Engineering by P. Raja[1]

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Book Description

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

Exa Example (Solved example)

Eqn Equation (Particular equation of the above book)

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

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

Contents

List of Scilab Codes

Chapter 1

Impact Load And Stresses

Scilab code Exa 1.1 Barrier potential

```
// Exa 1.1
clc;
clear;
close;
// Given data
T1 = 25;// in degree C
T2 = 100;// in degree C
del_T = T2-T1;// in degree C
V= 0.7;// barrier potential t 25 C in V
del_V = -(2)*del_T;// in mV
del_V= del_V*10^-3;// in V
V_B = V- abs(del_V);// in V
disp(V_B,"(i) When the junction temperature is 100
    C , the barrier potential of a silicon diode in
   V is");
T2 = 0;// in degree C
del_T = T2-T1;// in degree C
del_V = -(2)*del_T;// in mV
del_V= del_V*10^-3;//in V
V_B = V+del_V;// in V
disp(V_B,"(ii) When the junction temperature is 0
```

```
    C , the barrier potential of a silicon diode in
    V is");
```

Scilab code Exa 1.2 Saturation current

```
// Exa 1.2
clc;
clear;
close;
// Given data
T1 = 25;// in degree C
T2 = 100;// in degree C
del_T = T2-T1;// in degree C
I_S = (2)^7 *5;// in nA
I_S = (1.07)^5*I_S;// in nA
disp(round(I_S),"The saturation current at 100
    degree C in nA is");
```

Scilab code Exa 1.3 Load voltage and current

```
// Exa 1.3
clc;
clear;
close;
// Given data
V_L = 10;// in V
R_L = 1*10^3;// in
I_L = V_L/R_L;// in A
I_L = I_L*10^3;// mA
disp(V_L,"The load voltage in volts is : ")
disp(I_L,"The load current in mA is");
```

Scilab code Exa 1.4 Load voltage and current

```
// Exa 1.4
clc;
clear;
close;
// Given data
v1 = 10;// in V
v2 = 0.7;// in V
V_L = v1-v2;// in V
disp(V_L,"The load voltage in V is");
R_L = 1*10^3;// in
I_L = V_L/R_L;// in A
disp(I_L*10^3,"The load current in mA is");
P_D = v2*I_L;// in watt
disp(P_D*10^3,"The diode Power in mW is");
```

Scilab code Exa 1.5 Load voltage and current

```
// Exa 1.5
clc;
clear;
close;
// Given data
R_L1 = 1*10^3;// in ohm
R_L2 = 0.23;// in ohm
R_T = R_L1+R_L2;// in ohm
v1 = 10;// in V
v2 = 0.7;// in V
V_T = v1-v2;// in V
I_L = V_T/R_T;// in A
disp(I_L*10^3,"The load current in mA is");
```

```
V_L = I_L*R_L1;// in V
disp(V_L,"The load voltage in V is");
```

Scilab code Exa 1.6 Value of Vo I1 ID1 and ID2

```
// Exa 1.6
clc;
clear;
close;
// Given data
V_o = 0.7;// in V
disp(V_o,"The value of V_o in V is");
E = 10;// in V
V_D = V_o;// in V
R = 330;// in ohm
I1 = (E - V_D)/R;// in A
I1 = I1*10^3;// in mA
disp(I1,"The value of I1 in mA is");
I_D1 = I1/2;// in mA
disp(I_D1,"The value of I_D1 in mA is");
I_D2 = I_D1;// in mA
disp(I_D2,"The value of I_D2 in mA is");
```

Scilab code Exa 1.7 Value of Vo and ID

```
// Exa 1.7
clc;
clear;
close;
// Given data
V_i = 12;// in V
V_D1 = 0.7;// in V
V_D2 = 0.3;// in V
```

```
R = 5.6*10^3;// in ohm
V_o  = V_i - V_D1 - V_D2;// in V
disp(V_o,"The value of Vo voltage in V is");
I_D = V_o/R;// in A
I_D = I_D*10^3;// in mA
disp(I_D,"The value of I_D in mA is");
```

Scilab code Exa 1.8 Value of current

```
// Exa 1.8
clc;
clear;
close;
// Given data
V1 = 24;// in V
V2 = 6;// in V
V_D1 = 0.7;// in V
R = 3*10^3;// in ohm
I = (V1 - V2 - V_D1)/R;// in A
I = I * 10^3;// in mA
disp(I,"The current in mA is");
```

Scilab code Exa 1.9 Diode current

```
// Exa 1.9
clc;
clear;
close;
// Given data
r= 20;// in
R_B= 15;// in
V_K1= 0.2;// in V
V_K2= 0.6;// in V
```

```
V= 100;// in V
R1= 10*10^3;// in
// Vo= V_K1+r*I1 = V_K2+R_B*I2
// Resulting current I= I1+I2 or
// (V-Vo)/(R1) = (Vo-V_K1)/r + (Vo-V_K2)/R_B
Vo= (r*R_B*V+R1*R_B*V_K1+R1*r*V_K2)/(R1*R_B+R1*r+r*R_B);// in V
I1= (Vo-V_K1)/r;// in A
I2= (V_K2-Vo)/R_B;// in A
disp(I1*10^3,"The value of I1 in mA is : ")
disp(I2*10^3,"The value of I2 in mA is : ")
```

Scilab code Exa 1.10 DC resistance levels

```
// Exa 1.10
clc;
clear;
close;
// Given data
I_D = 10;// in mA
I_D = I_D * 10^-3;// in A
V_D = 0.5;// in V
r_F1 = V_D/I_D;// in ohm
disp(r_F1,"The value of r_F1 in ohm is");
I_D = 20;// in mA
I_D = I_D * 10^-3;// in A
V_D = 0.8;// in V
r_F2 = V_D/I_D;// in ohm
disp(r_F2,"The value of r_F2 in ohm is");
I_D = -1;// in  A
I_D = I_D * 10^-6;// in A
V_D = -10;// in V
r_R = V_D/I_D;// in ohm
disp(r_R*10^-6,"The value of r_R in Mohm is");
```

```
// Note: There is calculation error to evaluate the
   value of r_F1. So the asnwer in the book is wrong
   .
```

Scilab code Exa 1.11 Value of ID VD2 and Vo

```
// Exa 1.11
clc;
clear;
close;
// Given data
R= 5.6*10^3;// in
I_D = 0;// in A
V_D = 0;// in V
E= 12;// in V
Vo= I_D*R;// in V
disp(I_D,"The value of I_D in A is :");
disp(Vo,"The value of Vo in V is");
V_D1 = 0;// in V
V_D2 = E -V_D1 - Vo;// in  V
disp(V_D2,"The value of V_D2 in V is");
```

Scilab code Exa 1.12 Value of I1 I2 and ID2

```
// Exa 1.12
clc;
clear;
close;
// Given data
E = 20;// in V
V_D1 = 0.7;// in V
V_D2 = 0.7;// in V
V2 = E - V_D1  - V_D2;// in V
```

```
R1 = 3.3*10^3;// in ohm
R2 = 5.6*10^3;// in ohm
I2 = V2/R2;// in A
I2 = I2*10^3;// in mA
disp(I2,"The current through resistor R2 in mA is ")
    ;
I1 = V_D2/R1;
I1 = I1 * 10^3;// in mA
disp(I1,"The current through resistor R1 in mA is");
I_D2 = I2-I1;// in mA
disp(I_D2,"The current through diode D2 in mA is");
```

Scilab code Exa 1.13 Output voltage

```
// Exa 1.13
clc;
clear;
close;
// Given data
V1 = 12;// in V
V2 = 0.3;// in V
V_o = V1-V2;// in V
disp(V_o,"The output voltage in V is");
```

Scilab code Exa 1.14 Value of ID

```
// Exa 1.14
clc;
clear;
close;
// Given data
disp("Part (a) Analysis using approximate diode
    model")
```

```
V_D = 0.7;// in V
disp(V_D,"The value of V_D in V is");
E = 30;// in V
V_R = E-V_D;// in V
disp(V_R,"The value of V_R in V is");
R = 2.2 * 10^3;// in ohm
I_D = V_R/R;
I_D = I_D * 10^3;// in mA
disp(I_D,"The value of I_D in mA is");
disp("Part (b) Analysis using ideal diode model")
V_D = 0;// in V
disp(V_D,"The value of V_D in V is");
V_R = E;// in V
disp(V_R,"The value of V_R in V is");
I_D = V_R/R;
I_D = I_D * 10^3;// in mA
disp(I_D,"The value of I_D in mA is");
```

Scilab code Exa 1.15 Value of current

```
// Exa 1.15
clc;
clear;
close;
// Given data
V1 = 20;// in V
V2 = 0.7;// in V
V = V1-V2;// in V
R = 20;// in ohm
I = V/R;// in A
disp(I,"The current through resistance in A is");
```

Scilab code Exa 1.16 Output voltage

```
// Exa 1.16
clc;
clear;
close;
// Given data
R1= 2;// in k
R2= 2;// in k
V=19;// in V
V_o = (V*R1)/(R1+R2);// in V
disp(V_o,"The output voltage in V is");
```

Scilab code Exa 1.17 Value of Vo and ID

```
// Exa 1.17
clc;
clear;
close;
// Given data
V1 = 0.7;// in V
V2 = 5;// in V
V_o = V1-V2;// in V
R = 2.2*10^3;// in ohm
I_D = -V_o/R;
I_D = I_D * 10^3;// in mA
disp(V_o,"The output voltage in volts is : ")
disp(I_D,"The current through diode in mA is");
```

Scilab code Exa 1.18 Output voltage and diode current

```
// Exa 1.18
clc;
clear;
close;
```

```
// Given data
V_gamma = 0.7;// in V
R1 = 5*10^3;// in ohm
R2 = 10*10^3;// in ohm
V=5;// in V
disp("Part (a)")
I_R2 = (V-V_gamma-(-V))/(R1+R2);// in A
I_D2 = I_R2;// in A
disp(I_D2*10^3,"The value of I_D1 and I_D2 in mA is"
    );
V_o = V - (I_D2 * R1);// in V
disp(V_o,"The value of Vo in V is");
V_A = V_o - V_gamma;// in V
disp(V_A,"The value of V_A in V is");
disp("Part (b)")
V_I = 4;// in V
V_A= V_I-V_gamma;// in V
Vo= V_A+V_gamma;// in V
I_R1= (V-Vo)/R1;// in A
I_D2= I_R1;// in A
disp(I_D2*10^3,"The value of I_D2 in mA is : ")
I_R2= (V_A-(-V))/R2;// in A
I_D1= I_R2-I_R1;// in A
disp(I_D1*10^3,"The value of I_D1 in mA is : ")
disp(Vo,"The value of Vo in volts is : ")
```

Scilab code Exa 1.19 Total current

```
// Exa 1.19
clc;
clear;
close;
// Given data
V_S = 6;// in V
V_D = 0.7;// in V
```

```
R = 10;// in K ohm
R = R*10^3;// in ohm
I_T = (V_S-V_D)/R;// in A
disp(I_T*10^6,"The total current in  A is");
```

Scilab code Exa 1.20 Total current

```
// Exa 1.20
clc;
clear;
close;
// Given data
V_S = 5;// in V
V_D = 0.7;// in V
R1 = 1.2 * 10^3;// in ohm
R2 = 2.2 * 10^3;// in ohm
I_T = (V_S-V_D)/(R1+R2);
I_T = I_T * 10^3;// in mA
disp(I_T,"The total circuit current in mA is");
```

Scilab code Exa 1.21 Total current

```
// Exa 1.21
clc;
clear;
close;
// Given Data
V_S = 4;// in V
V_D1 = 0.7;// in V
V_D2 = 0.7;// in V
R = 5.1*10^3;// in ohm
I_T = (V_S-V_D1-V_D2)/R;// in A
disp(round(I_T*10^6),"The total current in  A is");
```

Scilab code Exa 1.22 Total current

```
// Exa 1.22
clc;
clear;
close;
// Given data
V_S = 10;// in V
R1 = 1.5*10^3;// in ohm
R2 = 1.8*10^3;// in ohm
I_T = V_S/(R1+R2);// in A
disp(I_T*10^3,"Using the ideal diode, the total
    current in mA is ");
V_D1 = 0.7;// in V
V_D2 = 0.7;// in V
I_T = (V_S-V_D1-V_D2)/(R1+R2);// in A
disp(I_T*10^3,"Using the pracitcal diode, the total
    current in mA is");
```

Scilab code Exa 1.23 Value of Vo I1 ID1 and ID2

```
// Exa 1.23
clc;
clear;
close;
// Given data
V_S = 5;// in V
V2 = 3;// in V
R = 500;// in ohm
I_D2 = (V_S-V2)/R;// in A
I_D2 = I_D2 * 10^3;// in mA
disp(I_D2,"The diode current in mA is");
```

Scilab code Exa 1.24 Diode current

```
// Exa 1.24
clc;
clear;
close;
// Given data
V_S = 2;// in V
R = 100;// in ohm
I_D = V_S/R;
I_D = I_D * 10^3;// in mA
disp("Part (a)")
disp(I_D,"The diode current in mA is");
V_K = 0.7;// in V
I_D1 = (V_S-V_K)/R;
I_D1 = I_D1*10^3;// in mA
disp("Part (b)")
disp(I_D1,"The diode current in mA is");
R_f = 30;// in ohm
I_D2 = (V_S - V_K)/(R+R_f);
I_D2 = I_D2 * 10^3;// in mA
disp("Part (c)")
disp(I_D2,"The diode current in mA is");
```

Scilab code Exa 1.25 Value of Vo1 and Vo2

```
// Exa 1.25
clc;
clear;
close;
// Given data
```

```
R1= 1;// in  k
R2= 0.47;// in  k
V_o1 = 0.7;// in V
disp(V_o1,"The value of Vo1 in V is");
V_o2 = 0.3;// in V
disp(V_o2,"The value of Vo2 in V is");
I1 = (20-V_o1)/R1;// in mA
I2 = (V_o2-V_o1)/R2;// in mA
I = I1 + I2;// in mA
disp(I,"The current in mA is");
```

Scilab code Exa 1.26 Output voltage and diode current

```
// Exa 1.26
clc;
clear;
close;
// Given data
V1 = 10;// in V
V2 = 0.7;// in V
R1 = 1*10^3;// in ohm
R2 = 2*10^3;// in ohm
I = (V1-V2)/(R1+R2);// in A
V_o = I * R2;// in V
disp(V_o,"The output voltage in V is");
I_D = I/2;// in A
disp(I_D*10^3,"The diode current in mA is");
```

Scilab code Exa 1.27 Output voltage and diode current

```
// Exa 1.27
clc;
clear;
```

```
close;
// Given data
V1 = 20;// in V
V2 = 0.7;// in V
R = 4.7*10^3;// in ohm
I = (V1-V2)/R;// in A
I_D = I/2;// in A
disp(I_D*10^3,"The diode current in mA is");
V_o = I_D*R;// in V
disp(V_o,"The output voltage in V is");
```

Scilab code Exa 1.28 Output voltage and diode current

```
// Exa 1.28
clc;
clear;
close;
// Given data
V1 = 15;// in V
V2 = 0.7;// in V
V3 = 5;// in V
R = 2.2;// in K ohm
I_D = (V1-V2+V3)/R;// in mA
disp(I_D,"The diode current in  mA is");
V_o = (R * I_D) - V3;// in V
disp(V_o,"The output voltage in V");
```

Scilab code Exa 1.29 Current and output voltage

```
// Exa 1.29
clc;
clear;
close;
```

```
// Given data
V1 = 16;// in V
V2 = 0.7;// in V
V3 = V2;// in V
V4 = 12;// in V
R = 4.7;// in K ohm
I = (V1-V2-V3-V4)/R;// in mA
disp(I,"The current in mA is");
V_o = (I * 10^-3 * R * 10^3) + V4;// in V
disp(V_o,"The output voltage in V is");
```

Chapter 2

Diode Applications

Scilab code Exa 2.1 Average current and load voltage

```
// Exa 2.1
clc;
clear;
close;
// Given data
R_L = 1000;// in ohm
N2byN1= 4;
Vi= '10*sin(omega*t)'
// V2= N2byN1*V1
// V2= 40*sin(omega*t)
Vm= N2byN1*10;// in V
V_Lav= Vm/%pi;// in V
disp(V_Lav,"The average load voltage in volts is : "
  )
Im= Vm/R_L;// in A
I_dc= Im/%pi;// in A
I_av = I_dc;// in A
I_av= I_av*10^3;// in mA
disp(I_av,"Average load current in mA is");
V_Lrms = Vm/2;// in V
disp(V_Lrms,"RMS load voltage in V is");
```

```
I_rms = V_Lrms/R_L;// in A
I_rms= I_rms*10^3;// in mA
disp(I_rms,"RMS load current in mA is");
Eta = I_av^2/I_rms^2*100;// in %
disp(Eta,"Efficiency in % is");
V2rms= Vm/sqrt(2);// in V
TUF = ((I_av )^2)/(V2rms*I_rms)*100;// in %
disp(TUF,"Transformer utilization factor in % is");
Gamma= sqrt(V_Lrms^2-I_av^2)/V_Lav*100;
disp(round(Gamma),"Ripple factor in % is");
```

Scilab code Exa 2.2 Average RMS and peak value of current

```
// Exa 2.2
clc;
clear;
close;
// Given data
R_L = 1;// in K ohm
R_L = R_L * 10^3;// in ohm
V_m = 15;// in V
V_i = '15*sin(314*t)';
I_m= V_m/R_L;// in A
I_dc = I_m/%pi;// in A
I_dc = I_dc * 10^3;// in mA
disp(I_dc,"Average current through the diode in mA
    is");
I_drms = V_m/(2*R_L);
I_drms = I_drms * 10^3;// in mA
disp(I_drms,"RMS current in mA is");
I_m = V_m/R_L;
I_m = I_m*10^3;// in mA
disp(I_m,"Peak diode current in mA is");
PIV = 2*V_m;// in V
disp(PIV,"Peak inverse voltage in V is");
```

Scilab code Exa 2.3 Required PIV

```
// Exa 2.3
clc;
clear;
close;
// Given data
R1 = 2.2*10^3;// in ohm
R2 = 4.7*10^3;// in ohm
R_AB = (R1*R2)/(R1+R2);// in ohm
Vi = 20;// in V
V_o = (Vi * R_AB)/(R_AB+R1);// in V
PIV= Vi;// in volts
disp(V_o,"The output voltage in V is");
disp(PIV,"Peak inverse voltage in volts is : ")
```

Scilab code Exa 2.4 Required PIV

```
 // Exa 2.4
clc;
clear;
close;
// Given data
V_in  = 10;// in V
R1 = 2000;// in ohm
R2 = 2000;// in ohm
V_o = V_in * (R1/(R1+R2) );// in V
// Vdc= 5/(T/2)*integrate('sin(omega*t)','t',0,T/2)
   and omega*T= 2*%pi, So
Vdc= -5/%pi*(cos(%pi)-cos(0));// in V
disp(Vdc,"The value of Vdc in volts is : ");
```

```
PIV= V_in/2;// in V
disp(PIV,"The PIV value in volts is : ")
```

Scilab code Exa 2.4.2 Peak magnitude of output waveform

```
 // Exa 2.4.2  (again 2.4)
clc;
clear;
close;
// Given data
V_in  = 10;// in V
R_L = 2000;// in ohm
R1 = 100;// in ohm
V_R= 0.7;// in V
V_o = V_in * ( (R_L)/(R1+R_L) );// in V
disp(V_o,"The peak magnitude of the positive output
   voltage in V is");
Vo=-V_R;// in V
disp(Vo,"The peak magnitude of the negative output
   voltage in V is : ")
```

Scilab code Exa 2.7 Average load voltage

```
// Exa 2.7
clc;
clear;
close;
// Given data
V=240;// in V
R= 1;// in k
R=R*10^3;// in
Vsrms= V/4;// in V
Vm= sqrt(2)*Vsrms;// in V
```

```
V_Ldc= -Vm/%pi;// in V
disp(V_Ldc,"The value of average load voltage in
    volts is : ")
```

Scilab code Exa 2.8 DC output voltage

```
// Exa 2.8
clc;
clear;
close;
// Given data
V = 220;// in V
f=50;// in Hz
N2byN1=1/4;
R_L = 1;// in kohm
R_L= R_L*10^3;// in ohm
V_o = 220;// in V
V_s = N2byN1*V_o;// in V
V_m = sqrt(2) * V_s;// in V
V_Ldc = (2*V_m)/%pi;// in V
disp(V_Ldc,"Average load output voltage in V is");
P_dc = (V_Ldc)^2/R_L;// in W
disp(P_dc,"DC power delivered to load in watt is");
PIV = V_m;// in V
disp(PIV,"Peak inverse Voltage in V is");
f_o = 2*f;// in Hz
disp(f_o,"Output frequency in Hz is");
```

Scilab code Exa 2.10 RMS value of signal voltage

```
// Exa 2.10
clc;
clear;
```

```
close;
// Given data
R_L = 20;// in ohm
I_Ldc = 100;// in mA
R2 = 1;// in ohm
R_F = 0.5;// in ohm
I_m = (%pi * I_Ldc)/2;// in mA
V_m = I_m*10^-3*(R2+R_F+R_L);// in V
V_srms = V_m/sqrt(2);// in V
disp(V_srms,"RMS value of secondary signal voltage in V is");
P_Ldc = (I_Ldc*10^-3)^2*R_L;// in Watt
disp(P_Ldc,"power delivered to load in Watt is");
PIV = 2*V_m;// in V
disp(PIV,"Peal inverse voltage in V is");
P_ac = (V_m)^2/(2*(R2+R_F+R_L));// in Watt
disp(P_ac,"Input power in Watt is");
Eta = P_Ldc/P_ac*100;// in %
disp(Eta,"Conversion efficiency in % is");
```

Scilab code Exa 2.16 AC voltage

```
// Exa 2.16
clc;
clear;
close;
// Given data
V_dc = 12;// in V
R_L = 500;// in ohm
R_F = 25;// in ohm
I_dc = V_dc/R_L;// in A
V_m = I_dc * %pi * (R_L+R_F);// in V
V_rms = V_m/sqrt(2);// in V
V  = V_rms;// in V
disp(round(V),"The voltage in V is");
```

Scilab code Exa 2.17 PIV

```
// Exa 2.17
clc;
clear;
close;
// Given data
V_dc = 100;// in V
V_m = (V_dc*%pi)/2;// in V
PIV = 2*V_m;// in V
disp(PIV,"Peak inverse voltage for center tapped FWR
    in V is");
PIV1 = V_m;// in V
disp(PIV1,"Peak inverse voltage for bridge type FWR
   in V is");
```

Scilab code Exa 2.19 Required PIV rating

```
// Exa 2.19
clc;
clear;
close;
// Given data
V_Gamma = 0.7;// in V
R_f = 0;// in ohm
V_rms = 120;// in V
V_max = sqrt(2)*V_rms;// in V
R_L = 1;// in K ohm
R_L = R_L * 10^3;// in ohm
I_max = (V_max - (2*V_Gamma))/R_L;// in A
I_dc = (2*I_max)/%pi;// in mA
```

```
V_dc = I_dc * R_L;// in V
disp(V_dc,"The dc voltage available at the load in V is");
PIV = V_max;// in V
disp(PIV,"Peak inverse voltage in V is");
disp(I_max*10^3,"Maximum current through diode in mA is : ")
P_max = V_Gamma * I_max;// in W
disp(P_max*10^3,"Diode power rating in mW is");
```

Scilab code Exa 2.20 Value of current

```
// Exa 2.20
clc;
clear;
close;
// Given data
V1 = 10;// in V
V2 = 0.7;// in V
V3 = V2;// in V
V = V1-V2-V3;// in V
R1 = 1;// in ohm
R2 = 48;// in ohm
R3 = 1;// in ohm
R = R1+R2+R3;// in ohm
I = V/R;// in A
I = I * 10^3;// in mA
disp(I,"Current in mA is");
```

Scilab code Exa 2.21 AC and DC power output

```
// Exa 2.21
clc;
```

```
clear;
close;
// Given data
V_m = 50;// in V
r_f = 20;// in ohm
R_L = 800;// in ohm
I_m = V_m/(R_L+r_f);// in A
I_m = I_m * 10^3;// in mA
disp(round(I_m),"The value of Im in mA is");
I_dc = I_m/%pi;// in mA
disp(I_dc,"The value of I_dc in mA is");
I_rms = I_m/2;// in mA
disp(I_rms,"The value of Irms in mA is");
P_ac = (I_rms * 10^-3)^2 * (r_f + R_L);// in Watt
disp(P_ac,"AC power input in Watt is");
V_dc = I_dc * 10^-3*R_L;// in V
disp(V_dc,"DC output voltage in V is");
P_dc = (I_dc * 10^-3)^2 * (r_f + R_L);// in Watt
Eta = (P_dc/P_ac)*100;// in %
disp(Eta,"The efficiency of rectification in % is");

// Note: There is calculation error to evaluate the ac power input (i.e. P_ac), so the value of Eta is also wrong
```

Scilab code Exa 2.22 Peak value of current

```
// Exa 2.22
clc;
clear;
close;
// Given data
R_L = 1;// in K ohm
R_L = R_L * 10^3;// in ohm
r_d = 10;// in ohm
```

```
V_m = 220;// in V
I_m = V_m/(r_d+R_L);// in A
disp(I_m,"Peak value of current in A is");
I_dc = (2*I_m)/%pi;// in A
disp(I_dc,"DC value of current in A is");
Irms= I_m/sqrt(2);// in A
r_f = sqrt((Irms/I_dc)^2-1)*100;// in %
disp(r_f,"Ripple factor in % is");
Eta = (I_dc)^2 * R_L/((Irms)^2*(R_L+r_d))*100;// in
    %
disp(Eta,"Rectification efficiency in % is");
```

Scilab code Exa 2.23 Peak load voltage

```
// Exa 2.23
clc;
clear;
close;
// Given data
V_s = 12;// in V
R_L = 5.1;// in k ohm
R_L = R_L * 10^3;// in ohm
R_s = 1;// in K ohm
R_s = R_s * 10^3;// in ohm
V_L = (V_s*R_L)/(R_s+R_L);// in V
disp(V_L,"Peak load voltage in V is");
```

Scilab code Exa 2.24 Load current

```
// Exa 2.24
clc;
clear;
close;
```

```
// Given data
V_s = 10;// in V
R_L = 100;// in ohm
I_L = V_s/R_L;// in A
disp(I_L,"The load current during posotive half
   cycle in A is");
I_D2 = 0;// in A
R2 = R_L;// in ohm
I_L1 = -(V_s)/(R2+R_L);// in A
disp(I_L1,"The load current during negative half
   cycle in A is");
```

Scilab code Exa 2.25 Value of Vdc

```
// Exa 2.25
clc;
clear;
close;
// Given data
V_m = 50;// in V
V_dc = (2*V_m)/%pi;// in V
disp(V_dc,"The dc voltage in V is");
```

Scilab code Exa 2.26 DC voltage

```
// Exa 2.26
clc;
clear;
close;
// Given data
R1 = 1.1;// in K ohm
R2 = 2.2;// in K ohm
Vi= 170;// in V
```

```
V_o = (Vi*R1)/(R1+R2);// in V
disp(V_o,"The output voltage in V is");
V_dc = (2*V_o)/%pi;// in V
disp(V_dc,"The dc voltage in V is");
```

Chapter 3

Special Purpose Diodes

Scilab code Exa 3.1 Zener current

```
// Exa 3.1
clc;
clear;
close;
// given data
V1 = 18;// in V
V2 = 10;// in V
R = 270;// in ohm
I_S = (V1-V2)/R;// in A
V_L = 10;// in V
R_L = 1;// in K ohm
R_L = R_L*1000;// in ohm
I_L = V_L/R_L;// in A
I_Z = I_S-I_L;// in A
disp(I_Z*10^3,"The zener current in mA is");
```

Scilab code Exa 3.5 Load voltage

```
// Exa 3.5
clc;
clear;
close;
// Given data
I_Z = 2*10^-3;// in A
R_Z = 8.5;// in V
del_VL = I_Z*R_Z;// in V
V1 = 10;// in V
disp(del_VL,"Change in load voltage in V is");
V_L = V1 + del_VL;// in V
disp(V_L,"The load voltage in V is");

// Note: There is calculation error to evaluate the
   value of del_VL. So the answer in the book is
   wrong.
```

Scilab code Exa 3.6 The value of VL VR IZ and PZ

```
// Exa 3.6
clc;
clear;
close;
// Given data
R_L = 1.2;// in K ohm
R_L = R_L * 10^3;// in ohm
V_i = 16;// in V
R_i = 1;// in K ohm
R_i = R_i * 10^3;// in ohm
V = (R_L * V_i)/(R_L + R_i);// in V
V_L = V;// in V
disp(V_L,"The load voltage in V is");
V_R = V_i - V_L;// in V
disp(V_R,"The voltage in V is");
I_Z = 0;// A
```

```
disp(I_Z,"The zener diode current in A is");
V_Z = 10;// in V
P_Z = V_Z*I_Z;// in W
disp(P_Z,"Power dissipation in watt is");
```

Scilab code Exa 3.7 Resistance of device

```
// Exa 3.7
clc;
clear;
close;
// Given data
I_Z1 = 20;// in mA
I_Z1= I_Z1*10^-3;// in A
I_Z2 = 30;// in mA
I_Z2= I_Z2*10^-3;// in A
V_Z1 = 5.6;// in V
V_Z2 = 5.75;// in V
del_IZ = I_Z2-I_Z1;// in A
del_VZ = V_Z2-V_Z1;// in V
r_Z = del_VZ/del_IZ;// in ohm
disp(r_Z,"Resistance of zener diode in ohm is");
```

Scilab code Exa 3.8 Range of RL and IL

```
// Exa 3.8
clc;
clear;
close;
// Given data
R = 1;// in K ohm
R = R * 10^3;// in ohm
V_Z = 10;// in V
```

```
V_i = 50;// in V
I_ZM = 32;// in mA
I_ZM= I_ZM*10^-3;// in A
R_Lmin = (R*V_Z)/(V_i-V_Z);// in ohm
disp(R_Lmin,"The minimum value of R_L in ohm is : ")
V_R = V_i-V_Z;// in V
I_R = V_R/R;// in A
I_Lmin = I_R-I_ZM;// in A
disp(I_Lmin*10^3,"The minimum value of I_L in mA is
    : ");
R_Lmax = V_Z/I_Lmin;// in ohm
disp(R_Lmax*10^-3,"The maximum value of R_L in kohm
    is");
```

Scilab code Exa 3.9 Range of value of Vi

```
// Exa 3.9
clc;
clear;
close;
// Given data
V_Z = 20;// in V
R_L = 1.2;// in K ohm
R_L = R_L * 10^3;// in ohm
R = 220;// in ohm
I_ZM = 60;// in mA
I_ZM= I_ZM*10^-3;// in A
Vi_min = (R_L + R)/R_L*V_Z;// in V
disp(Vi_min,"The minimum value of Vi in V is");
V_L= V_Z;// in V
I_L= V_L/R_L;// in A
Vi_max= (I_ZM+I_L)*R+V_Z;// in V
disp(Vi_max,"The maximum value of Vi in V is");
```

Scilab code Exa 3.10 Zener diode operation

```
// Exa 3.10
clc;
clear;
close;
// Given data
V1 = 18;// in V
V2 = 270;// in V
R = 1;// in K ohm
R = R*1000;// in ohm
V = (V1*R)/(V2+R);// in V
disp(V,"The open circuit voltage in volts is");
if V>=10 then
    disp("The zener diode is operating in the
       breakdown region.")
end
```

Scilab code Exa 3.11 Value of VL IL IZ and IR

```
// Exa 3.11
clc;
clear;
close;
// Given data
R_L = 300;// in ohm
R = 200;// in ohm
V_i = 20;// in V
V = (R_L/(R_L+R))*V_i;// in V
disp(V,"The value of V_L in Volts is");
V_L = 10;// in V
V_Z= V_L;// in V
```

```
I_L = V_L/R_L;// A
disp(I_L*10^3,"The value of I_L in mA is");
I_R = (V_i-V_L)/R;// in A
disp(I_R*10^3,"The value of I_R in mA is");
I_Z = I_R-I_L;// in A
disp(I_Z*10^3,"The value of I_Z in mA is");
// Formula V_Z= R_L*V_i/(R_L+R)
R_L= R*V_Z/(V_i-V_Z);// in ohm
disp(R_L,"The value of R_L in ohm is : ")
```

Scilab code Exa 3.12 Range of input voltage

```
// Exa 3.12
clc;
clear;
close;
// Given data
V_Z = 5;// in V
I_Zmin = 2;// in mA
I_Zmin= I_Zmin*10^-3;// in A
I_Zmax = 20;// in mA
I_Zmax=I_Zmax*10^-3;// in A
R_L = 1;// in kohm
R_L = R_L * 10^3;// in ohm
I_L = V_Z/R_L;// in A
I = I_L + I_Zmin;// in A
Vin_min = V_Z + (I*R_L);// in V
disp(Vin_min,"The minimum input voltage in V is");
I = I_L + I_Zmax;// in A
Vin_max = V_Z + I* R_L;// in V
disp(Vin_max,"The maximum input voltage in V is");
```

Scilab code Exa 3.13 Design a zener voltage regulator

```
// Exa 3.13
clc;
clear;
close;
// Given data
V_in1 = 18;// in V
V_in2 = 22;// in V
V_o = 6;// in V
I_L = 50;// in mA
I_L= I_L*10^-3;// in A
I_Zmin = 5;// in mA
I_Zmin= I_Zmin*10^-3;// in A
P_Z = 0.5;// in Watt
V_Z= 6;// in V
I_Zmax = P_Z/V_Z;// in A
disp(I_Zmax*10^3,"Zener diode current in mA is");
R_S1 = (V_in2 - V_Z)/(I_L+I_Zmax);// in ohm
disp(R_S1,"The minimum value of Rs in ohm is");
R_S2 = (V_in1-V_Z)/(I_L+I_Zmin);// in ohm
disp(R_S2,"The maximum value of Rs in ohm is");
```

Scilab code Exa 3.14 Range of Vi

```
// Exa 3.14
clc;
clear;
close;
// Given data
R_S = 91;// in ohm
V_Z = 8;// in V
P_Z = 400;// in mW
P_Z= P_Z*10^-3;// in W
R_L = 0.22;// in K ohm
R_L = R_L * 10^3;// in ohm
I_L = V_Z/R_L;// in A
```

```
I_Z = P_Z/V_Z;// in A
disp(I_Z*10^3,"The value of I_Zmax in mA is : ")
Vin_min = (V_Z*(R_S+R_L))/R_L;// in V
disp(Vin_min,"The minimum input voltage in V is");
I_R = I_L + I_Z;// in A
Vin_max = V_Z + (I_R*R_S);// in V
disp(Vin_max,"The maximum input voltage in V is");
```

Scilab code Exa 3.15 The value of RS and RL

```
// Exa 3.15
clc;
clear;
close;
// Given data
V_L = 12;// in V
I_Lmin = 0;// in mA
I_Lmin =I_Lmin *10^-3;// in A
I_Lmax = 200;// in mA
I_Lmax =I_Lmax *10^-3;// in A
I_Zmin = 5;// in mA
I_Zmin= I_Zmin*10^-3;// in A
I_Zmax = 200;// in mA
I_Zmax= I_Zmax*10^-3;// in A
V_i = 16;// in V
V_Z = V_L;// in V
disp(V_Z,"The value of V_Z in V is");
R_Lmin = V_L/I_Lmax;// in ohm
disp(R_Lmin,"The minimum value of R_L in ohm is");
// R_L2 = V_L/I_Lmin;// in ohm
disp("The maximum value of R_L in ohm is");
disp("infinite")
I_Z = I_Zmin+I_Zmax;// in A
disp(I_Z*10^3,"The zener current in mA is");
P_Zmax = V_Z*I_Z;// in Watt
```

```
disp(P_Zmax,"The maximum value of Pz in Watt is");
R_S = (V_i-V_L)/(I_Zmin+I_Lmax);// in ohm
disp(R_S,"The value of R_S in ohm is ");
```

Scilab code Exa 3.16 The value of VL IL IZ and IR

```
// Exa 3.16
clc;
clear;
close;
// Given data
V_in = 20;// in V
R_S = 220;// in ohm
V_Z = 10;// in V
P_Z = 400;// in mW
// Part (I)
R_L = 200;// in ohm
disp("Part (I) For R_L= 200   ")
V_L = V_Z;// in V
disp(V_L,"Load voltage in V is");
I_L = V_L/R_L;// in A
disp(I_L,"Load current in A is");
I_R = (V_in-V_Z)/R_S;// in A
disp(I_R,"The current through resistor in A is");
I_Z = I_R-I_L;// in A
disp(I_Z,"The value of I_Z in A is");
// Part (II)
R_L = 50;// in ohm
disp("Part (II) For R_L= 50   ")
V_L = V_Z;//
disp(V_L,"Load voltage in V is");
I_L = V_L/R_L;// in A
disp(I_L,"Load current in A is");
I_R = (V_in-V_Z)/R_S;// in A
disp(I_R,"The current through resistor in A is");
```

```
I_Z = I_R-I_L;// in A
disp(I_Z,"Zener current in A is");
disp("For both values of R_L, the current I_R is less than I_L and I_Z is negative. It shows that given circuit can not work successfully as a voltage regulator")
```

Scilab code Exa 3.17 Safe voltage range of V

```
// Exa 3.17
clc;
clear;
close;
// Given data
I_Zmin = 1;// in mA
I_Zmin=I_Zmin*10^-3;// in A
I_Zmax = 5;// in mA
I_Zmax=I_Zmax*10^-3;// in A
I_Lmin = 0;// in mA
I_Lmin=I_Lmin*10^-3;// in A
I_Lmax = 4;// in mA
I_Lmax=I_Lmax*10^-3;// in A
R = 5;// in kohm
R = R * 10^3;// in ohm
V_Z = 50;// in V
disp("Part (A)")
V_max = (I_Zmax+ I_Lmin)*R+V_Z;// in V
disp(V_max,"The maximum Voltage in V is");
V_min = (I_Zmin+I_Lmax)*R + V_Z;// in V
disp(V_min,"The minimum Voltage in V is");
disp("Part (B)")
V_L = 50;// in V
V_in = 75;// in V
R_L = 15;// in kohm
R_L= R_L*10^3;// in ohm
```

```
I_L = V_L/R_L;// in A
V_max = (I_Zmax+I_L)*R+V_Z;// in V
disp(round(V_max),"The maximum Voltage in V is");
V_min = (I_Zmin+I_L)*R+V_Z;// in V
disp(round(V_min),"The minimum Voltage in V is");
```

Scilab code Exa 3.18 Range of load currents

```
// Exa 3.18
clc;
clear;
close;
// Given data
V_S = 7.5;// in V
V_Z = 5;// in V
R_S = 4.75;// in ohm
I_Zmin= 0.05;// in A
I_Zmax=1.0;// in A
I_S = (V_S-V_Z)/R_S;// in A
I_Lmax= I_S-I_Zmin;// in A
disp(I_Lmax,"The maximum value of load current in A is : ")
// when
V_S= 10;// in V
I_S = (V_S-V_Z)/R_S;// in A
I_Lmin= I_S-I_Zmax;// in A
disp(I_Lmin,"The minimum value of load current in A is : ")
disp("Thus, the range of load current for regulation is "+string(I_Lmin)+" <= I_L <= "+string(I_Lmax)+" A")
```

Chapter 4

Bipolar Junction Transistors

Scilab code Exa 4.1 Current gain and base current

```
// Example 4.1
clc;
clear;
close;
// Given data
I_C= 0.9;// in mA
I_E=1;// in mA
alpha = I_C/I_E;
disp(alpha,"Current gain is : ")
// Formula I_E= I_B+I_C
I_B= I_E-I_C;// in mA
disp(I_B,"The base current in mA is : ")
```

Scilab code Exa 4.2 Base current

```
// Example 4.2
clc;
clear;
```

```
close;
// Given data
alpha= 0.97;
I_E=1;// in mA
// Formula alpha = I_C/I_E;
I_C= alpha*I_E;// in mA
// Formula I_E= I_B+I_C
I_B= I_E-I_C;// in mA
disp(I_B,"The base current in mA is : ")
```

Scilab code Exa 4.3 The value of bita

```
// Example 4.3
clc;
clear;
close;
// Given data
// Part (i)
a= 0.90;
B=a/(1-a);
disp(B,"At alpha= 0.90, the value of Bita is : ")
// Part (ii)
a= 0.99;
B=a/(1-a);
disp(B,"At alpha= 0.99, the value of Bita is : ")
```

Scilab code Exa 4.4 Alpha rating

```
// Example 4.4
clc;
clear;
close;
// Given data
```

```
bita= 50;
I_E= 10;// in mA
I_B= 200*10^-3;// in mA
alfa= bita/(1+bita)
disp(alfa,"The value of alfa is : ")
I_C= alfa*I_E;// in mA
disp(I_C,"The value of I_C in mA using the value of alpha is : ")
I_C= bita*I_B;// in mA
disp(I_C,"The value of I_C in mA using the value of bita is : ")
```

Scilab code Exa 4.5 The value of IB IC VCE and PD

```
// Example 4.5
clc;
clear;
close;
// Given data
V_BB= 10;// in V
V_CC= 10;// in V
V_BE= 0.7;// in V
R_B= 1;// in M
R_B= R_B*10^6;// in
R_C= 2;// in k
R_C= R_C*10^3;// in
bita= 300;
I_B= (V_BB-V_BE)/R_B;// in A
I_C= bita*I_B;// in A
V_CE= V_CC-I_C*R_C;// in V
P_D= V_CE*I_C;// in W
disp(I_B*10^6,"The value of I_B in  A is : ")
disp(I_C*10^3,"The value of I_C in mA is : ")
disp(V_CE,"The value of V_CE in volts is : ")
disp(P_D*10^3,"The value of P_D in mW is :")
```

Scilab code Exa 4.6 Collector current

```
// Example 4.6
clc;
clear;
close;
// Given data
bita= 100;
V_BE= 0;// in V
V_BB= 15;// in V
R_B= 470;// in k
R_B= R_B*10^3;// in
V_CC= 15;// in V
R_C= 3.6;// in k
R_C= R_C*10^3;// in
I_B= (V_BB-V_BE)/R_B;// in A
I_C= bita*I_B;// in A
V_CE= V_CC-I_C*R_C;// in V
I_E= I_C+I_B;// in A
disp(I_B*10^6,"The base current in  A is : ")
disp(I_C*10^3,"The collector current in mA is : ")
disp(V_CE,"The value of V_CE in volts is : ")
disp(I_E*10^3,"The emitter current in mA is ; ")
```

Scilab code Exa 4.7 Collector emitter voltage

```
// Example 4.7
clc;
clear;
close;
// Given data
```

```
bita= 100;
V_BE= 0.7;// in V
V_BB= 15;// in V
R_B= 470;// in  k
R_B= R_B*10^3;// in
V_CC= 15;// in V
R_C= 3.6;// in  k
R_C= R_C*10^3;// in
I_B= (V_BB-V_BE)/R_B;// in A
I_C= bita*I_B;// in A
V_CE= V_CC-I_C*R_C;// in V
disp(I_B*10^6,"The base current in   A is : ")
disp(I_C*10^3,"The collector current in mA is : ")
disp(V_CE,"The value of V_CE in volts is : ")
```

Scilab code Exa 4.8 DC load line and operating point

```
// Example 4.8
clc;
clear;
close;
// Given data
V_CC= 15;// in V
V_BE= 0.7;// in V
R_C= 1;// in  k
R_C= R_C*10^3;// in
R_E= 2;// in  k
R_E= R_E*10^3;// in
R1= 10;// in  k
R1= R1*10^3;// in
R2= 5;// in  k
R2= R2*10^3;// in
V_CE= 0:0.1:V_CC
I_C= (V_CC-V_CE)/(R_C+R_E)*10^3;// in mA
plot(V_CE,I_C);
```

```
xlabel("V_CE in volts");
ylabel("I_C in mA");
title("DC load line");
V_B= V_CC*R2/(R1+R2);// in V
I_E= (V_B-V_BE)/R_E;// in A
I_C= I_E;// in A
I_CQ= I_C;// in A
V_CE= V_CC-I_C*(R_C+R_E);// in V
disp("Q-point is : "+string(V_CE)+" V, "+string(I_CQ*10^3)+" mA")
disp("DC load line shown in figure")
```

Scilab code Exa 4.9 Emitter current

```
// Example 4.9
clc;
clear;
close;
// Given data
V_BB= 1.8;// in V
V_BE= 0.7;// in V
R1= 10;// in k
R2= 2.2;// in k
R_E= 1;// in k
bita= 200;
R= R1*R2/(R1+R2);// in k
R=R*10^3;// in
R_E= R_E*10^3;// in
I_E= (V_BB-V_BE)/(R_E+R/bita);// in mA
disp(I_E*10^3,"The emitter current in mA is : ")
disp("This is extremely close to 1.1 mA, the value we get with the simplified analysis.")
```

Scilab code Exa 4.10 Design a fixed bias circuit

```
// Example 4.10
clc;
clear;
close;
// Given data
V_CC= 10;// in V
V_BE= 0.7;// in V
V_CE= 5;// in V
bita= 100;
I_C= 5;// in mA
// Applying KVL to collector circuit , V_CC-V_CE-I_C*R_C =0
R_C= (V_CC-V_CE)/I_C;// in k
disp(R_C,"The value of R_C in k  is : ")
I_B= I_C/bita;// in mA
disp(I_B*10^3,"The value of I_B in  A is : ")
// Applying KVL to base circuit , V_CC-I_B*R_B-V_BE=0
R_B= (V_CC-V_BE)/I_B;// in k
disp(R_B,"The value of R_B in k  is :")
// Note: In the book, there is an error in calculating the value of I_B, but they putted the correct value of I_B to evaluate the value of R_B
```

Scilab code Exa 4.11 DC load line and operating point

```
// Example 4.11
clc;
clear;
close;
// Given data
V_CC= 6;// in V
```

```
V_BE= 0.7;// in V
bita= 100;
R_C= 2;// in k
R_C= R_C*10^3;// in
R_B= 530;// in k
R_B= R_B*10^3;// in
R1= 10;// in k
R1= R1*10^3;// in
R2= 5;// in k
R2= R2*10^3;// in
V_CE= 0:0.1:V_CC;// in V
I_C= (V_CC-V_CE)/(R_C)*10^3;// in mA
plot(V_CE,I_C);
xlabel("V_CE in volts");
ylabel("I_C in mA");
title("DC load line");
I_B= (V_CC-V_BE)/R_B;// in A
I_CQ= I_B*bita;// in A
V_CE= V_CC-I_CQ*R_C;// in V
disp("Q-point is : "+string(V_CE)+" V, "+string(I_CQ
    *10^3)+" mA")
disp("DC load line shown in figure")
```

Scilab code Exa 4.12 Operating point

```
// Example 4.12
clc;
clear;
close;
// Given data
V_CC= 12;// in V
V_BE= 0.7;// in V
bita= 100;
R_C= 10;// in k
R_C=R_C*10^3;// in
```

```
R_B= 100;// in
R_B=R_B*10^3;// in
I_BQ= (V_CC-V_BE)/((1+bita)*R_C+R_B);// in A
I_CQ= bita*I_BQ;// in A
V_CEQ= V_CC-(I_CQ+I_BQ)*R_C;// in volts
disp("Q-Point value for the circuit is "+string(V_CEQ)+" V and "+string(I_CQ*10^3)+" mA")
// For dc load line when
I_C=0;
V_CE= V_CC-(I_C+I_BQ)*R_C;// in V
disp(V_CE,"At I_C=0, the value of V_CE in volts is : ")
// When
V_CE= 0;
I_C= (V_CC-I_BQ*R_C)/R_C;// in A
disp(I_C*10^3,"At V_CE=0, the value of I_C in mA is : ")
```

Scilab code Exa 4.13 Collector to base bias circuit

```
// Example 4.13
clc;
clear;
close;
// Given data
V_BE= 0.7;// in V
V_CC= 15;// in V
V_CE= 5;// in V
I_C= 5;// in mA
I_C=I_C*10^-3;// in A
bita= 100;
I_B= I_C/bita;// in A
// Applying KVL to collector circuit, V_CC= (I_C+I_B)*R_C+V_CE
R_C= (V_CC-V_CE)/(I_C+I_B);// in
```

```
// Applying KVL to base circuit , V_CC= (I_C+I_B)*R_C
   +I_B*R_B+V_BE
R_B= (V_CC-V_BE-R_C*(I_C+I_B))/I_B;// in
disp(R_C*10^-3,"The value of R_C in k  is : ")
disp(R_B*10^-3,"The value of R_B in k  is : ")
```

Scilab code Exa 4.14 The value bita VCC and RB

```
// Example 4.14
clc;
clear;
close;
// Given data
I_B= 20*10^-6;// in A
V_CE= 7.3;// in V
V_BE= 0.6;// in V
V_E= 2.1;// in V
R_E= 0.68*10^3;// in
R_C= 2.7*10^3;// in
I_E= V_E/R_E;// in A
I_C= I_E;// in A (approx)
bita= round(I_C/I_B);
V_CC= V_CE+I_C*R_C+I_E*R_E;// in V
// From V_CC= I_B*R_B+V_BE+V_E
R_B= (V_CC-(V_BE+V_E))/I_B;// in
disp(bita,"The value of bita is : ")
disp(V_CC,"The value of V_CC in volts is : ")
disp(R_B*10^-3,"The value of R_B in k  is : ")

// Note: In  the book, there is an error to
   calculate the value of R_B, hence the value of
   R_B in the book is wrong.
```

Scilab code Exa 4.15 The value of IC and VCE

```
// Exa 4.15
clc;
clear;
close;
// Given data
V_CC = 18;// in V
bita = 90;
R_C = 2.2 * 10^3;// in ohm
R_E = 1.8*10^3;// in ohm
R_B = 510*10^3;// in ohm
I_B = V_CC/( (bita*(R_C+R_E))+R_B );// in A
I_C = bita*I_B;// in A
disp(I_C*10^3,"The value of I_C in mA is");
V_CE = I_B*R_B;// in V
disp(V_CE,"The value of V_CE in V is");
```

Scilab code Exa 4.16 Value of IBQ and ICQ

```
// Exa 4.16
clc;
clear;
close;
// Given data
bita = 50;
V_CC = 12;// in V
V_BE = 0.7;// in V
R_B = 240;// in kohm
R_B = R_B*10^3;// in ohm
I_C = 2.35 * 10^-3;// in A
R_C = 2.2;// in kohm
R_C = R_C * 10^3;// in ohm
I_BQ = (V_CC - V_BE)/R_B;// in A
disp(I_BQ*10^6,"The value of I_BQ in  A is");
```

```
I_CQ = bita*I_BQ;// in A
disp(I_CQ*10^3,"The value of I_CQ in mA is");
V_CEQ = V_CC - (I_C*R_C);// in V
disp(V_CEQ,"The value of V_CEQ in V is");
V_B = V_BE;// in V
disp(V_B,"The value of V_B in V is");
V_BC = V_B -V_CEQ;// in V
disp(V_BC,"The voltage in V is");

// Note: In the book, there is a calculation error
   to evaluating the value of V_CEQ. So the answer
   in the book is wrong
```

Scilab code Exa 4.17 Value of IB and IC

```
// Exa 4.17
clc;
clear;
close;
// Given data
V_CC = 18;// in V
V_BE = 0.7;// in V
R_C = 3.3;// in kohm
R_C = R_C * 10^3;// in ohm
R_B = 210;// in kohm
R_B  = R_B * 10^3;// in ohm
bita = 75;
R_C = 3.3;// in kohm
R_C = R_C * 10^3;// in ohm
R_E = 510;// in ohm
I_B = (V_CC-V_BE)/( R_C+R_B+bita*(R_C+R_E) );// A
disp(round(I_B*10^6),"The value of I_B in  A is");
I_C = bita*I_B;// in A
disp(I_C*10^3,"The value of I_C in mA is : ")
V_C = V_CC - (I_C*R_C);// in V
```

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

Scilab code Exa 4.18 Value of VCC RB and RC

```
// Exa 4.18
clc;
clear;
close;
// Given data
V_BE = 0.7;// in V
I_B = 40 * 10^-6;// in A
V_CC = 20;// in V (From the load line)
disp(V_CC,"The voltage in V is");
I_C = 8;// in mA
R_C = V_CC/I_C;// in kohm
disp(R_C,"The resistance in kohm is");
R_B = (V_CC - V_BE)/I_B;// in ohm
disp(R_B*10^-3,"The resistance in kohm is");
```

Scilab code Exa 4.19 VCE for the voltage divider bias configuration

```
// Exa 4.19
clc;
clear;
close;
// Given data
R1 = 47;// in kohm
R1=  R1*10^3;// in ohm
R2 = 10;// in kohm
R2= R2*10^3;// in ohm
R_E = 1.1;// in kohm
R_E = R_E * 10^3;// in ohm
R_C = 2.4;// in kohm
```

```
R_C = R_C * 10^3;// in ohm
V_CC = -18;// in V
V_B = (R2*V_CC)/(R1+R2);// in V
V_BE = -0.7;// in V
V_E = V_B - V_BE;// in V
I_E = abs(V_E)/R_E;// in A
V_CE = V_CC + (I_E)*(R_C+R_E);// in V
disp(V_B,"The value of V_B in volts is : ");
disp(I_E*10^3,"The value of I_E in mA is : ")
disp(V_CE,"The value of V_CE in V is");
```

Scilab code Exa 4.20 Value of IB and IC

```
// Exa 4.20
clc;
clear;
close;
// Given data
V_BE = 0.8;// in V
V_CE = 0.2;// in V
V1 = 5;// in V
R_B = 50;// in kohm
R_B= R_B*10^3;// in ohm
R_C = 3;// in K ohm
R_C = R_C * 10^3;// in ohm
bita = 100;
R_E = 2;// in kohm
R_E= R_E*10^3;// in ohm
I_B = (V1-V_BE)/(R_B+(1+bita)*R_E);// in A
disp(I_B*10^6,"The value of I_B in  A is");
V_CC = 10;// in V
I_Csat = (V_CC - V_CE - (I_B*R_E))/(R_C+R_E);//in A
disp(I_Csat*10^3,"The value of I_C(sat) in mA is");
I_Bmin = I_Csat /bita;// in A
disp(I_Bmin*10^6,"The minimum value of I_B in  A is
```

```
: ");

// Note: There is calculation error to evaluate the value of I_Csat in the book, so the answer in the book is wrong
```

Scilab code Exa 4.21 Operating point

```
// Exa 4.21
clc;
clear;
close;
// Given data
R1 = 5;// in kohm
R1= R1*10^3;// in ohm
R2 = 5;// in kohm
R2= R2*10^3;// in ohm
R_B = R1*R2/(R1+R2);// in ohm
R_E = 1;// in kohm
R_E = R_E * 10^3;// in ohm
V_EE = 3;// in V
V_Th = (R2*V_EE)/(R1+R2);// in V
V_BE = 0.7;// in V
bita = 44;
I_B = (V_EE - V_BE - V_Th)/( ((1+bita)*R_E)+R_B);// in A
I_BQ = I_B;// in A
disp(I_BQ*10^6,"The value of I_BQ in   A is");
I_C = bita*I_BQ;// in A
disp(I_C*10^3,"The value of I_C in mA is");
I_E = (1+bita)*I_B;// in A
disp(I_E*10^3,"The value of I_E in mA is");
V_EC = (I_E*R_E)-V_EE;// in V
disp(V_EC,"The value of V_EC in V is");
disp("Q-point is "+string(V_EC)+" V, "+string(I_C
```

```
*10^3)+" mA")
```

Scilab code Exa 4.22 The region of operation

```
// Exa 4.22
clc;
clear;
close;
// Given data
V_BE = 0.7;// in V
V_BB = 5;// in V
R_B = 100;// in kohm
R_B = R_B * 10^3;// in ohm
R_E = 2;// in kohm
R_E = R_E * 10^3;// in ohm
bita = 100;
I_B = (V_BB-V_BE)/( R_B+((1+bita)*R_E) );// in A
disp(I_B*10^3,"The value of I_B in mA is");
V_B = V_BB-(I_B*10^-3*R_B);// in V
I_C = bita*I_B;// in A
disp(I_C*10^3,"The value of I_C in mA is");
V_CC = 10;// in V
V_C = V_CC-(I_C*R_E);// in V
disp(V_C,"The voltage in V is");
disp("Transistor is in active region is valid")
```

Scilab code Exa 4.23 Value of IB IC VCE VC VE VB and VBC

```
// Exa 4.23
clc;
clear;
close;
// Given data
```

```
V_CC = 20;// in V
V_BE = 0.7;// in V
R_B = 430;// in kohm
R_B = 430 * 10^3;// in ohm
bita = 50;
R_E = 1;// in kohm
R_E = R_E * 10^3;// in ohm
R_C = 2;// in kohm
R_C = R_C * 10^3;// in ohm
I_B = (V_CC - V_BE)/(R_B +(1+bita)*R_E);// in A
disp(I_B*10^6,"The base current in  A is");
I_C = bita*I_B;// in A
disp(I_C*10^3,"The collector current in mA is");
V_CE = V_CC - I_C*(R_C+R_E);// in V
disp(V_CE,"The value of V_CE in V is");
V_C = V_CC - (I_C*R_C);// in V
disp(V_C,"The value of V_C in V is");
V_E = V_C - V_CE;// in V
disp(V_E,"The value of V_E in V is");
V_B = V_BE+V_E;// in V
disp(V_B,"The value of V_B in V is : ")
V_BC = V_B-V_C;// in V
disp(V_BC,"The value of V_BC in V is");
```

Scilab code Exa 4.24 Value of ICQ and VCEQ

```
// Exa 4.24
clc;
clear;
close;
// Given data
V_CC = 20;// in V
V_BE = 0.7;// in V
R_B = 680;// in kohm
R_B = R_B * 10^3;// in ohm
```

```
R_C = 4.7;// in kohm
R_C = R_C * 10^3;// in ohm
bita = 120;
I_B = (V_CC - V_BE)/(R_B+bita*R_C);// in A
I_CQ = bita*I_B;// in A
disp(I_CQ*10^3,"The value of I_CQ in mA is");
V_CEQ = V_CC - (I_CQ*R_C);// in V
disp(V_CEQ,"The value of V_CEQ in V is");
V_B = V_BE;// in V
V_C = 11.26;// in V
V_E = 0;// in V
disp(V_E,"The value of V_E in V is");
V_BC = V_B - V_C;// in V
disp(V_BC,"The value of V_BC in V is");
```

Scilab code Exa 4.25 IB IC and VC

```
// Exa 4.25
clc;
clear;
close;
// Given data
V_CC = 16;// in V
V_BE = 0.7;// in V
R_B = 470;// in kohm
R_B= R_B*10^3;// in ohm
bita = 120;
R_C = 3.6;// in kohm
R_C= R_C*10^3;// in ohm
R_E = 0.51;// in kohm
R_E= R_E*10^3;// in ohm
I_B = (V_CC - V_BE)/(R_B+bita*(R_C+R_E));// in A
disp(I_B*10^6,"The base current in  A is");
I_C  = bita*I_B;// in A
disp(I_C*10^3,"The collector current in mA is");
```

```
V_C = V_CC - I_C*R_C;// in V
disp(V_C,"The collector voltage in V is");
```

Scilab code Exa 4.26 ICQ and VCEQ

```
// Exa 4.26
clc;
clear;
close;
// Given data
V_CC = 10;// in V
V_BE = 0.7;// in V
R_B = 250;// in kohm
R_B= R_B*10^3;// in ohm
bita = 90;
R_C = 4.7;// in kohm
R_C= R_C*10^3;// in ohm
R_E = 1.2;// in kohm
R_E= R_E*10^3;// in ohm
I_BQ = (V_CC - V_BE)/(R_B + bita*(R_C+R_E));// in A
disp(I_BQ*10^6,"The base current at Q-point in  A
   is");
I_CQ = bita*I_BQ;// in A
disp(I_CQ*10^3,"The collector current at Q-point in
   mA is");
V_CEQ = V_CC - (I_CQ*(R_C+R_E));// in V
disp(V_CEQ,"Collector emitter voltage at Q point in
   V is");
```

Scilab code Exa 4.27 Range of possible value for VC

```
// Exa 4.27
clc;
```

```
clear;
close;
// Given data
V_CC = 12;// in V
V_BE = 0.7;// in V
R_B = 150;// in kohm
R_B= R_B*10^3;// in ohm
bita = 180;
R_C = 4.7;// in kohm
R_C= R_C*10^3;// in ohm
R_E = 3.3;// in kohm
R_E= R_E*10^3;// in ohm
I_B = (V_CC-V_BE)/(R_B + bita*(R_C+R_E));// in A
disp(I_B*10^6,"The base current in  A is");
```

Scilab code Exa 4.28 Value of VE IC VC and IB

```
// Exa 4.28
clc;
clear;
close;
// Given data
V_B = 4;// in V
V_BE = 0.7;// in V
R_E = 1.2;// in kohm
R_E= R_E*10^3;// in ohm
V_E = V_B-V_BE;// in V
R_C = 2.2;// in kohm
R_C= R_C*10^3;// in ohm
R_B= 330;// in kohm
R_B= R_B*10^3;// in ohm
bita = 180;
I_B = 7.11 * 10^-6;// in A
V_CC = 18;// in V
disp("Part (a)")
```

```
disp(V_E,"The value of V_E in V is");
I_C = V_E/R_E;// in A
disp("Part (b)")
disp(I_C*10^3,"The value of I_C in mA is : ")
V_C =V_CC - (I_C*R_C);// in V
disp("Part (c)")
disp(V_C,"The value of V_C in V is");
V_CE = V_C-V_E;// in V
disp("Part (d)")
disp(V_CE,"The value of V_CE in V is : ")
//I_C = bita*I_B;// in A
//disp(I_C*10^3,"The value of I_C in mA is : ")
//V_CC= 12;// in V
//R_C = 4.7;// in kohm
//R_C= R_C*10^3;// ohm
//V_C = V_CC - (I_C*R_C);// in V
//disp(V_C,"The value of V_C in V is");
//R_B = 1.15*10^6;// in ohm
//R_E = 3.3*10^3;// in ohm
//I_B = (V_CC - V_BE)/(R_B + bita*(R_C+R_E));// in A
//disp(I_B*10^6,"The value of I_B in  A is : ")
//I_C = bita*I_B;// in A
//disp(I_C*10^3,"The value of I_C in mA is : ")
//V_C = V_CC - (I_C * R_C);// in V
//disp(V_C,"The value of V_C in V is : ")
//disp("We conclude that collector voltage V_C
    varies from 5.98 V to 8.30 V");
//disp("Part (e)")
I_B = (V_CC - (I_C*R_C) - V_BE - V_E)/R_B;// in A
disp(I_B*10^6,"Base current in  A is");
bita = I_C/I_B;
disp(bita,"Current gain is");
```

Scilab code Exa 4.29 Base current

```
// Exa 4.29
clc;
clear;
close;
// Given data
I_E = 10;// in mA
I_C = 9.95;// in mA
I_B = I_E-I_C;// in mA
disp(I_B,"The base current in mA is");
```

Scilab code Exa 4.30 Current gain

```
// Exa 4.30
clc;
clear;
close;
// Given data
I_C = 10;// in mA
I_B = 0.1;// in mA
bita = I_C/I_B;
disp(bita,"The current gain is");
```

Scilab code Exa 4.31 Base current

```
// Exa 4.31
clc;
clear;
close;
// Given data
V_BE = 0.7;// in V
V_BB = 10;// in V
R_B = 470;// in kohm
R_B = R_B * 10^3;// in ohm
```

```
I_B = (V_BB-V_BE)/R_B;// in A
disp(I_B*10^6,"The base current in  A is");
```

Scilab code Exa 4.32 Collector emitter voltage

```
// Exa 4.32
clc;
clear;
close;
// Given data
V_BB = 10;// in V
V_BE = 0;// in V
R_B = 470;// in kohm
R_B = R_B * 10^3;// in ohm
I_B = (V_BB - V_BE)/R_B;// in A
bita = 200;
I_C = bita*I_B;// in A
V_CC = 10;// in V
R_C = 820;// in ohm
V_CE = V_CC  - (I_C*R_C);// in V
disp("Part (a) : For ideal approximation")
disp(V_CE,"The collector emitter voltage in V is");
P_D = V_CE * I_C;// in W
disp(P_D*10^3,"Power dissipation in mW is");
disp("Part (b) : For second approximation")
V_BE = 0.7;// in V
I_B = (V_BB-V_BE)/R_B;// in A
I_C = bita*I_B;// in A
V_CE = V_CC - (I_C*R_C);// in V
disp(V_CE,"The collector emitter voltage in V is");
P_D = V_CE * I_C;// in W
disp(P_D*10^3,"Power dissipation in mW is");
```

Scilab code Exa 4.33 Collector emitter voltage

```
// Exa 4.33
clc;
clear;
close;
// Given data
V_BE = 0;// in V
V_BB = 12;// in V
R_B = 680;// in kohm
R_B = R_B * 10^3;// in ohm
I_B = (V_BB-V_BE)/R_B;// in A
beta_dc = 175;
I_C = beta_dc*I_B;// in A
V_CC = 12;// in V
R_C = 1.5;// in kohm
R_C = R_C * 10^3;// in ohm
V_CE = V_CC - (I_C*R_C);// in V
disp("Part (a) For ideal approximation")
disp(V_CE,"The collector emitter voltage in V is");
P_D = V_CE * I_C;// in mW
disp(P_D*10^3,"Transistor power in mW is");
disp("Part (b) For second approximation")
V_BE1 = 0.7;// in V
I_B = (V_BB-V_BE1)/R_B;// in A
I_C = beta_dc * I_B;// in A
V_CE = V_CC - (I_C*R_C);// in V
disp(V_CE,"Collector emitter voltage in V is");
P_D = V_CE * I_C;// in W
disp(P_D*10^3,"Power dissipation in mW is");
```

Scilab code Exa 4.34 Load line

```
// Exa 4.34
clc;
```

```
clear;
close;
// Given data
V_CC = 20;// in V
R_C = 3.3;// in kohm
R_C = R_C * 10^3;// in ohm
I_C = V_CC/R_C;// in A
disp(I_C*10^3,"Collector current in mA is");
V_CE = V_CC;// in V
disp(V_CE,"Collector emitter voltage in V is");
V_CE=0:0.1:20 ;// in V
I_C= (V_CC-V_CE)/(R_C*10^-3);// in mA
plot(V_CE,I_C);
xlabel("V_CE in volts")
ylabel("I_C in mA")
title("DC load line")
disp("DC load line shown in figure")
```

Scilab code Exa 4.35 Voltage between collector and ground

```
// Exa 4.35
clc;
clear;
close;
// Given data
V_BB = 10;// in V
V_BE = 0.7;// in V
R_B = 1;// in kohm
R_B = 1 * 10^6;// in ohm
I_B = (V_BB-V_BE)/R_B;// in A
disp(I_B*10^6,"The base current in  A is");
beta_dc = 200;
I_C = beta_dc * I_B;// in A
disp(I_C*10^3,"The collector current in mA is");
V_CC = 20;// in V
```

```
R_C = 3.3;// in kohm
R_C = R_C * 10^3;// in ohm
V_CE = V_CC - I_C*R_C;// in V
disp(V_CE,"The collector voltage in V is");
```

Scilab code Exa 4.36 Voltage between collector and ground

```
// Exa 4.36
clc;
clear;
close;
// Given data
V_BB = 5;// in V
V_BE = 0.7;// in V
R_B = 680;// in kohm
R_B = 680*10^3;// in ohm
I_B = (V_BB-V_BE)/R_B;// in A
disp(I_B*10^6,"The base current in  A is : ")
beta_dc= 150;
I_C = beta_dc * I_B;// in A
disp(I_C*10^3,"The collector current in mA is");
V_CC = 5;// in V
R_C = 470;// in ohm
V_CE = V_CC-(I_C*R_C);// in V
disp(V_CE,"Voltage between collector and ground in V is ");
```

Scilab code Exa 4.37 Collector voltage

```
// Exa 4.37
clc;
clear;
close;
```

```
// Given data
V_BB = 2.5;// in V
V_BE = 0.7;// in V
V_E = V_BB-V_BE;// in V
disp(V_E,"The emitter voltage in V is");
R_E = 1.8;// in kohm
R_E = R_E * 10^3;// in ohm
I_E = V_E/R_E;// in A
I_C= I_E;// in A
V_CC = 20;// in V
R_C = 10;// in kohm
R_C = R_C * 10^3;// in ohm
V_C = V_CC-(I_C*R_C);// in V
disp(V_C,"The collector voltage in V is");
```

Scilab code Exa 4.38 Emitter voltage

```
// Exa 4.38
clc;
clear;
close;
// Given data
V_CC = 25;// in V
R2 = 2.2;// in kohm
R1 = 10;// in kohm
V_BB = (V_CC * R2)/(R1+R2);// in V
V_BE = 0.7;// in V
V_E = V_BB - V_BE;// in V
disp(V_E,"The emitter voltage in V is");
R_E = 1;// in kohm
R_E = R_E * 10^3;// in ohm
I_E = V_E/R_E;// in A
I_C= I_E;// in A
V_CC = 25;// in V
R_C = 3.6;// in kohm
```

```
R_C = R_C * 10^3;// in ohm
V_C = V_CC - (I_C*R_C);// in V
disp(V_C,"Collector voltage in V is");
```

Scilab code Exa 4.39 Q point

```
// Exa 4.39
clc;
clear;
close;
// Given data
V_BB = 4.50;// in V
V_E = 3.8;// in V
V_C = 11.32;// in V
I_C = 3.8;// in mA
I_C=I_C*10^-3;// in A
V_BE = 0.7;// in V
R1 = 10;// in kohm
R2 = 2.2;// in kohm
R_B = (R1*R2)/(R1+R2);// in kohm
R_B = R_B * 10^3;// in ohm
I_B = (V_BB-V_BE)/R_B;// in A
disp(I_B*10^3,"The base current in mA is");
V_CE = V_C-V_E;// in V
disp(V_CE,"Collector emitter voltage in V is");
disp("Thus the Q-point is : "+string(V_CE)+" V, "+
   string(I_B*10^3)+" mA") ;

// Note: There is calculation error to evaluate the
   value of I_B. So the answer in the book is wrong.
```

Chapter 5

Transistor Circuits

Scilab code Exa 5.1 Value of C

```
// exa 5.1
clc;
clear;
close;
// Given data
R1 = 600;// in ohm
R2 = 1000;// in ohm
R_TH = (R1*R2)/(R1+R2);// in ohm
X_C = 37.5;// in ohm
f = 1;// in kHz
f= f*10^3;// in Hz
C = 1/(2*%pi * f*X_C);// in F
disp(C*10^6,"Value of C in  F is");
```

Scilab code Exa 5.2 Voltage gain

```
// Exa 5.2
clc;
```

```
clear;
close;
// Given data
R_C= 3.6*10^3;// in ohm
R_L= 10*10^3;// in ohm
r_c = (R_C*R_L)/(R_C+R_L);// in ohm
V_CC = 10;// in V
V_BE = 0.7;// in V
R_E = 1;// in kohm
R_E = R_E * 10^3;// in ohm
R1 = 10;// in kohm
R1= R1*10^3;// in ohm
R2 = 2.2;// in  kohm
R2= R2*10^3;// in ohm
V_B = (V_CC*R2)/(R1+R2);// in V
I_E = (V_B-V_BE)/R_E;// in A
V = 25*10^-3;// in V   // only value is given in the
    book
r_e = V/I_E;// in ohm
A_V = round(r_c/r_e);
disp(A_V,"The voltage gain is");
V_in = 2;//in mV
V_out = A_V*V_in;// in mV
disp(V_out,"The output voltage in mV is");
```

Scilab code Exa 5.3 Output voltage

```
// Exa 5.3
clc;
clear;
close;
// Given data
A_V = 117;
r_e = 22.7;// in ohm
bita = 300;
```

```
Zin_base = bita*r_e;// in ohm
R1 = 2.2*10^3;// in  ohm
R2 = 10*10^3;// in ohm
Zin_stage = (Zin_base*R1*R2)/(Zin_base*R1+R1*R2+R2*
    Zin_base);// in ohm
R = 600;// in ohm
V = 2;// in mV
V_in = (Zin_stage/(R+Zin_stage))*V;// in mV
V_out = A_V * V_in;// in mV
disp(round(V_out),"The output voltage in mV is");
```

Scilab code Exa 5.4 Input impedance

```
// Exa 5.4
clc;
clear;
close;
// Given data
R1 = 4.3;// in K ohm
R1= R1*10^3;// in ohm
R2 = 10;// in K ohm
R2= R2*10^3;// in ohm
r_e = (R1*R2)/(R1+R2);// in ohm
bita = 200;
V=25;// in mV
I= 1;// in mA
r_e_desh= V/I;// in ohm
Zin_base = bita*(r_e + r_e_desh);// in ohm
disp(Zin_base*10^-3,"The input impedence of the base
     in k  is : ")
R3 = 10*10^3;// in ohm
Zin_stage = (R2*R3*Zin_base)/(R2*Zin_base+R3*
    Zin_base+R2*R3);// in ohm
disp(Zin_stage*10^-3,"The input impedance of the
    stage in k  is");
```

```
disp("Because the input impedence of base is much
   larger than the input impedence")
disp(" of the stage, usually approximate the input
   impedence of the stage as the parallel")
Zin_stage= R2*R3/(R2+R3);// in ohm
disp(" of the biasing resistor only ")
disp(string(Zin_stage*10^-3)+" k ")
```

Scilab code Exa 5.5 Value of RB

```
// Exa 5.5
clc;
clear;
close;
// Given data
V_CE = 0.2;// in V
V_BE= 0.7;// in V
R = 1;// in kohm
R = R * 10^3;// in ohm
V = 10;// in V
I_C = (V-V_CE)/R;// in A
beta_min = 50;
I_B = I_C/beta_min;// in A
I_B1 = V*I_B;// in A
V1 = 5;// in V
R_B = (V1-V_BE)/I_B1;// in ohm
disp(R_B*10^-3,"The base resistance in k is");
```

Scilab code Exa 5.6 Lowest frequency

```
// Exa 5.6
clc;
clear;
```

```
close;
// Given data
R = 10;// in K ohm
R = R * 10^3;// in ohm
X_C = 0.1 * R;
C = 47;// in   F
C = C * 10^-6;// in F
f = 1/(2*%pi * X_C *C) ;// in Hz
disp(f,"Lowest frequency in Hz is");
```

Scilab code Exa 5.7 Lowest frequency

```
// Exa 5.7
clc;
clear;
close;
// Given data
C = 220;// in   F
C = C * 10^-6;// in F
R1 = 10;// in kohm
R1 = R1 * 10^3;// in ohm
R2 = 2.2;// in kohm
R2 = R2 * 10^3;// in ohm
R_TH = (R1*R2)/(R1+R2);// in ohm
X_C = 0.1*R_TH;// in ohm
f = 1/(2*%pi*C*X_C);// in Hz
disp(f,"The lowest frequency in Hz is");
```

Scilab code Exa 5.8 AC beta

```
// Exa 5.8
clc;
clear;
```

```
close;
// Given data
i_c = 15;// in mA
i_c = i_c * 10^-3;// in A
i_b = 100;// in   A
i_b = i_b * 10^-6;// in A
bita = i_c/i_b;
disp(bita,"The value of ac bita is");
```

Scilab code Exa 5.9 Output voltage

```
// Exa 5.9
clc;
clear;
close;
// Given data
R_C = 3.6;// in kohm
R_C= R_C*10^3;// in ohm
R_L = 10;// in kohm
R_L=R_L*10^3;// in ohm
R_TH = (R_C*R_L)/(R_C+R_L);// in ohm
V_CC = 10;// in V
R2 = 2.2;// in kohm
R2 = R2 * 10^3;// in ohm
R1 = 10;// in kohm
R1 = R1 * 10^3;// in ohm
V_BE = 0.7;// in V
V_B = (V_CC*R2)/(R1+R2);// in V
R_E = 1;// in kohm
R_E = R_E *10^3;// in ohm
I_E = (V_B-V_BE)/R_E;// in A
V1 = 25;// in mV
V1 = V1*10^-3;// in V
r_e = V1/(I_E);// in ohm
A_v = (R_TH)/r_e;
```

```
V_in = 2;// in mV
V_in = V_in * 10^-3;// in V
V_out = A_v*V_in;// in V
disp(V_out,"The output voltage in V is");
```

Scilab code Exa 5.10 Voltage gain

```
// Exa 5.10
clc;
clear;
close;
// Given data
R_L = 10;// in kohm
R_L= R_L*10^3;// in ohm
R_C = 3.6;// in kohm
R_C= R_C*10^3;// in ohm
r_e_desh = 22.73;// in ohm
R_L_desh = R_L/2;// in ohm
A_v = ( (R_C*R_L_desh)/(R_C+R_L_desh))/r_e_desh;
disp(A_v,"The voltage gain is");
```

Scilab code Exa 5.11 Input impedance

```
// Exa 5.11
clc;
clear;
close;
// Given data
R_E = 1;// in kohm
R_E = R_E * 10^3;// in ohm
R_L = 3.3;// in kohm
R_L = R_L * 10^3;// in ohm
r_e = (R_E*R_L)/(R_E+R_L);// in ohm
```

```
V_CC = 15;// in V
R2 = 2.2;// in K ohm
R2 = R2 * 10^3;// in ohm
R1 = R2;// in ohm
V_B = (V_CC*R2)/(R1+R2);// in V
V_BE = 0.7;// in V
R_E = 1;// in K ohm
R_E = R_E * 10^3;// in ohm
I_E = (V_B-V_BE)/R_E;// in A
V1 = 25*10^-3;// in V
r_e1 = V1/I_E;
bita = 200;
Zin_base = bita*(r_e+r_e1);// in ohm
disp(Zin_base*10^-3,"The input impedence of the base
    in k  is : ")
Zin_stage = (R1*R2*Zin_base)/(R1*R2+R2*Zin_base+R1*
   Zin_base);// in ohm
disp(Zin_stage*10^-3,"The input impedance of the
   stage in k  is");
```

Scilab code Exa 5.12 Voltage gain and ac load voltage

```
// Exa 5.12
clc;
clear;
close;
// Given data
r_e = 767.44;
r_e1 = 3.68;
V_in = 1;// in V
A_v = round(r_e/(r_e+r_e1));
disp(A_v,"The voltage gain is : ")
V_o = A_v*V_in;// in V
disp(V_o,"The load voltage in V is");
```

Chapter 6

Field Effect Devices

Scilab code Exa 6.1 Drain voltage

```
// Exa 6.1
clc;
clear;
close;
// Given data
V_D = 10;// in V
R = 10*10^3;// in ohm
I_D = V_D/R;// in A
V_P = 4;// in V
I_DSS = 10;// in mA
I_DSS = I_DSS * 10^-3;// in A
R_DS  = V_P/I_DSS;// in ohm
V_D = (R_DS/(R+R_DS))*V_D;// in V
disp(V_D,"The drain voltage in V is");
```

Scilab code Exa 6.2 Drain voltage

```
// Exa 6.2
```

```
clc;
clear;
close;
// Given data
V_P = 4;// in V
I_DSS = 10;// in mA
I_DSS  =I_DSS  *10^-3;// in A
R_DS = V_P/I_DSS;// in ohm
V_DD = 30;// in V
I_D = 2.5;// in mA
R_D = 2;// in kohm
V_D = V_DD - (I_D*R_D);// in V
disp(V_D,"The drain voltage in V is");
```

Scilab code Exa 6.3 DC load line and operating point

```
// Exa 6.3
clc;
clear;
close;
// Given data
R2 = 1;// in M ohm
R2 = R2*10^6;// in ohm
R1 = 2;// in M ohm
R1 = R1*10^6;// in ohm
V_DD = 30;// in V
R_D= 1*10^3;// in ohm
V_G = (R2/(R1+R2))*V_DD;// in V
R_S= 2*10^3;// in ohm
I_D= V_G/R_S;// in A
V_D= V_DD-I_D*R_D;// in V
V_DS= V_D-V_G;// in V
R_D= R_D+R_S;// in ohm
I_Dsat=V_DD/R_D*10^3;// in mA
disp(I_D*10^3,"The value of I_D in mA is : ")
```

```
disp(V_DS,"The value of V_DS in volts is : ")
disp("Thus the Q-point is "+string(V_DS)+" V, "+
    string(I_D*10^3)+" mA")
disp("DC load line shown in figure")
V_D= 0:0.1:V_DD;// in V
I_D= (V_DD-V_D)/R_D*10^3;// in mV
plot(V_D,I_D);
ylabel("I_D in mA");
xlabel("V_DS in volts");
title("DC load line")
```

Scilab code Exa 6.4 Drain current

```
// Exa 6.4
clc;
clear;
close;
// Given data
V_DD = 15;// in V
R = 3;// in kohm
I_D = V_DD/R;// in mA
R_D = 1;// in kohm
V_D = V_DD - (I_D*R_D);// in V
disp(V_D,"The drain voltage in V is");
```

Scilab code Exa 6.5 Output voltage

```
// Exa 6.5
clc;
clear;
close;
// Given data
R_D = 3.6;// in K ohm
```

```
R_L = 10;// in K ohm
r_d = (R_D*R_L)/(R_D+R_L);// in K ohm
g_m = 5000;// in  S
g_m= g_m*10^-6;// in S
A_v = g_m *r_d;
V_out = A_v;// in V
disp(V_out*10^3,"The output volatge in mV is ");
```

Scilab code Exa 6.6 Minimum value of VDS

```
// Exa 6.6
clc;
clear;
close;
// Given data
V_GS = -2;// in V
V_P = -5;// in V
V_DS = V_GS-V_P;// in V
I_DSS = 8;// in mA
I_DS = I_DSS*( 1-(V_GS/V_P) )^2;// in mA
disp(I_DS,"The drain current in mA is");
```

Scilab code Exa 6.7 Drain current

```
// Exa 6.7
clc;
clear;
close;
// Given data
I_DSS = 8.4;// in mA
I_DSS= I_DSS*10^-3;// in A
V_P = -3;// in V
V_GS = -1.5;// in V
```

```
I_D = I_DSS*( 1-(V_GS/V_P) )^2;// in A
disp(I_D*10^3,"The drain current in mA is");
V_GS1 = 0;// in V
g_mo = -( (2*I_DSS)/V_P );// in A/V
g_m = g_mo*(1-(V_GS/V_P));// in A/V
disp(g_m*10^3,"Transconductacne at V_G=-1.5 V,  in
   mA/V is");
```

Scilab code Exa 6.8 Minimum value of VDS

```
// Exa 6.8
clc;
clear;
close;
// Given data
V_P = -4;// in V
V_GS = -2;// in V
I_DSS = 10;// in mA
I_DSS= I_DSS*10^-3;// in A
I_D = I_DSS*(1-(V_GS/V_P))^2;// in A
disp(I_D*10^3,"The drain current in  mA is");
V_DS = V_P;// in V
disp(V_DS,"The minimum value of V_DS in V is ");
```

Scilab code Exa 6.9 Gate source voltage

```
// Exa 6.9
clc;
clear;
close;
// Given data
I_DSS = -40;// in mA
V_P = 5;// in V
```

```
I_D = -15;// in mA
V_GS = V_P*(1-sqrt(I_D/I_DSS));// in V
disp(V_GS,"The gate source voltage in V is");
```

Scilab code Exa 6.10 Value of ID and VGS

```
// Exa 6.10
clc;
clear;
close;
// Given data
I_DSS = 4;// in mA
I_DSS= I_DSS*10^-3;// in A
V_P = -4;// in V
V_GG = -2;// in V
V_GS = V_GG;// in V
disp(V_GS,"The value of V_GS in V is");
I_D = I_DSS*(1-(V_GS/V_P))^2;// in A
disp(I_D*10^3,"The value of I_D in mA is");
V_DD = 10;// in V
R_D = 5;// in kohm
R_D = R_D * 10^3;// in ohm
V_DS = V_DD - (I_D*R_D);// in V
disp(V_DS,"The value of V_DS in V is");
```

Scilab code Exa 6.11 Value of IDQ VD VS and VDS

```
// Exa 6.11
clc;
clear;
close;
// Given data
V_DD= 20;// in V
```

```
R1= 2.1*10^6;// in
R2= 270*10^3;// in
R_D= 4.7;// in  k
R_S= 1.5;// in  k
I_DSS= 8;// in mA
V_P= -4;// in V
V_G= V_DD*R2/(R1+R2);// in V
// V_GS= V_G-R_S*I_D     (as Vs= I_D*R_S) and
// I_D= I_DSS*(1-V_GS/V_P)^2;// in A
// I_D= I_DSS*(1-(V_G-R_S*I_D)/V_P)^2;// in mA  or
// I_D= I_D^2*I_DSS*R_S^2/V_P^2  + I_D*(2*R_S*I_DSS/V_P-2*V_G*R_S*I_DSS/V_P^2-1) + I_DSS*(1+V_G^2/V_P^2-2*V_G/V_P)
a= I_DSS*R_S^2/V_P^2;// assumed
b= 2*R_S*I_DSS/V_P-2*V_G*R_S*I_DSS/V_P^2-1;// assumed
c= I_DSS*(1+V_G^2/V_P^2-2*V_G/V_P);// assumed
root= [a b c];
I_D= roots(root);// in mA
I_D= I_D(2);// discarding maximum value as it will be less than I_DSS
I_DQ= I_D;// in mA
disp(I_DQ,"The value of I_DQ in mA is : ")
V_GSQ= V_G-R_S*I_D;// in V
disp(V_GSQ,"The value of V_GSQ in V is : ")
V_DSQ= V_DD-I_DQ*(R_D+R_S);// in V
disp(V_DSQ,"The value of V_DSQ in V is : ")
V_S= I_D*R_S;// in V
V_D= V_S+V_DSQ;//in V
V_DS= V_D-V_G;// in V
disp(V_S,"The value of V_S in V is : ")
disp(V_D,"The value of V_D in V is : ")
disp(V_DS,"The value of V_DS in V is : ")
```

Scilab code Exa 6.12 Value of IDQ VGSQ VDS VD and VS

```
// Exa 6.12
clc;
clear;
close;
// Given data
V_DD= 20;// in V
I_DSS= 9;// in mA
V_BB= -10;// in V
R_S= 1.5;// in  k
R_D= 1.8;// in  k
V_P= -3;// in V
V_G=0;
// V_S= I_D*R_S+V_BB;
// V_GS= V_G-V_S or
// V_GS= V_G-(I_D*R_S+V_BB)
// I_D= I_DSS*(1-V_GS/V_P)^2 or
// I_D^2*R_S^2 + I_D*[2*R_S*V_BB+2*V_P*R_S-V_P^2/I_DSS]+[V_P^2+V_BB^2+2*V_BB*V_P]
root= [R_S^2 2*R_S*V_BB+2*V_P*R_S-V_P^2/I_DSS V_P^2+V_BB^2+2*V_BB*V_P]
I_D= roots(root);// in mA
I_D= I_D(2);// discarding maximum value as it will be less than I_DSS
I_DQ= I_D;// in mA
disp(I_DQ,"The value of I_DQ in mA is : ")
V_GS= V_G-(I_D*R_S+V_BB);// in V
V_GSQ= V_GS;// in V
disp(V_GSQ,"The value of V_GSQ in volts is : ")
V_DS= V_DD-I_D*(R_D+R_S)-V_BB;// in V
disp(V_DS,"The value of V_DS in volts is : ")
V_S= I_D*R_S+V_BB;// in V
disp(V_S,"The value of V_S in volts is : ");
V_D= V_S+V_DS;// in V
disp(V_D,"The value of V_D in volts is : ")
```

Scilab code Exa 6.13 Value of IDQ VGSQ and IDSS

```
// Exa 6.13
clc;
clear;
close;
// Given data
V_S = 1.7;// in V
R_S = 0.51;// in kohm
R_S= R_S*10^3;// in ohm
V_DD = 18;// in V
R_D = 2*10^3;// in ohm
V_GS = -1.7;// in V
V_P = - 4.5;// in V
I_DQ = V_S/R_S;//in A
disp(I_DQ*10^3,"The value of I_DQ in mA is");
V_GSQ = -V_S;// in V
disp(V_GSQ,"The value of V_GSQ in V is");
I_DSS = I_DQ/( (1-(V_GS/V_P))^2 );// in A
disp(I_DSS*10^3,"The value of I_DSS in mA is");
V_D = V_DD - (I_DQ*R_D);// in V
disp(V_D,"The value of V_D in V is");
V_DS = V_D-V_S;// in V
disp(V_DS,"The value of V_DS in V is");
```

Scilab code Exa 6.14 Transfer curve

```
// Exa 6.14
clc;
clear;
close;
// Given data
I_DSS = 12;// in mA
V_GS = 0;// in V
I_D = 0;// in mA
```

```
V_P = -6;// in V
V_GS= 0:-0.1:V_P;// in V
I_D = I_DSS*(1-(V_GS/V_P))^2;// mA
subplot(1,2,1)
plot(V_GS,I_D);
xlabel("V_GS in volts")
ylabel("I_D in mA")
title("n-channel device")
V_P = 6;// in V
V_GS= 0:0.1:V_P;// in V
I_D = I_DSS*(1-(V_GS/V_P))^2;// mA
subplot(1,2,2)
plot(V_GS,I_D);
xlabel("V_GS in volts")
ylabel("I_D in mA")
title("p-channel device")
```

Scilab code Exa 6.15 Drain current

```
// Exa 6.15
clc;
clear;
close;
// Given data
I_DSS = 30;// in mA
V_GS = -5;// in V
V_GS_off = -8;// in V
I_D = I_DSS*(1-(V_GS/V_GS_off))^2;// in mA
disp(I_D,"The drain current in mA is");
```

Scilab code Exa 6.16 Value of RS and RD

```
// Exa 6.16
```

```
clc;
clear;
close;
// Given data
I_D = 1.5;// in mA
I_DSS = 5;// in mA
V_P = -2;// in V
V_GS = V_P*(1-sqrt(I_D/I_DSS));// in V
V_G = 0;// in V
V_S = V_G-V_GS;// in V
R_S = V_S/I_D;// in kohm
disp(R_S*10^3,"The source resistance in ohm is");
V_DD = 20;// in V
V_DS= 10;// in V
R_D = (V_DD-(V_DS+(I_D*R_S)))/(I_D);// in kohm
disp(R_D,"The diode resistance in K ohm is");
```

Scilab code Exa 6.17 Value of VGS gm RS and RD

```
// Exa 6.17
clc;
clear;
close;
// Given data
I_D = 0.8;// in mA
I_D= I_D*10^-3;// in A
I_DSS = 1.645;// in mA
I_DSS= I_DSS*10^-3;// in A
V_P = -2;// in V
V_GS = V_P * (1-sqrt(I_D/I_DSS));// in V
disp(V_GS,"The gate source voltage in V is");
g_mo = -((2*I_DSS)/V_P);// in A/V
g_m = g_mo*(1-(V_GS/V_P));// in A/V
disp(g_m*10^3,"The transconductance in mA/V is");
R_S = -(V_GS/I_D);// in ohm
```

```
disp(R_S,"The source resistance in ohm is");
AdB= 20;// in dB
A= 10^(AdB/20);
R_D= A/g_m;// in ohm
disp(R_D*10^-3,"The value of R_D in k  is : ")

// Note: There is calculation error to find the value of R_S in the book . So the answer in the book is wrong
```

Scilab code Exa 6.18 Value of VGS IDQ VDS VD VG and VS

```
// Exa 6.18
clc;
clear;
close;
// Given data
V_GG = 2;// in V
V_GS = -V_GG;// in V
disp(V_GS,"The value of V_GS in V is");
I_DSS = 10;// in mA
V_P = -8;// in V
I_D = I_DSS*(1-(V_GS/V_P))^2;// in mA
I_DQ= I_D;// in mA
disp(I_DQ,"The value of I_DQ in mA is");
R_D = 2;// in K ohm
V_DD = 16;// in V
V_DS = V_DD - (I_D*R_D);// in V
disp(V_DS,"The value of V_DS in V is");
V_D = V_DS;// in V
disp(V_D,"The value of V_D in V is");
V_G = V_GS;// in V
disp(V_G,"The value of V_G in V is");
V_S = 0;// in V
disp(V_S,"The value of V_S in V is");
```

Scilab code Exa 6.19 Resistance between gate and source

```
// Exa 6.19
clc;
clear;
close;
// Given data
V_GS = 10;// in V
I_G = 0.001;// in  A
R_GS = V_GS/I_G;// in  M
disp(R_GS,"The gate source resistance in M  is");
```

Scilab code Exa 6.20 AC drain resistance

```
// Exa 6.20
clc;
clear;
close;
// Given data
del_VDS = 1.5;// in V
del_ID = 120 * 10^-6;// in A
r_d = del_VDS/del_ID;// in ohm
r_d = r_d * 10^-3;// in kohm
disp(r_d,"The drain resistance of the JFET in K ohm is");
```

Scilab code Exa 6.21 Value of ID and gm

```
// Exa 6.21
```

```
clc;
clear;
close;
// Given data
I_DSS  = 8.4;// in mA
V_P = -3;// in V
V_GS = -1.5;// in V
I_D = I_DSS*(1-(V_GS/V_P))^2;// in mA
g_mo = -( (2*I_DSS)/V_P );// in mA/V
g_m = g_mo*(1-(V_GS/V_P));// in mA/V
disp(g_m,"The value of g_m in mA/V is");
```

Scilab code Exa 6.22 Value of gm ID and VDS

```
// Exa 6.22
clc;
clear;
close;
// Given data
V_DD= 20;// in V
I_DSS= 9;// in mA
V_P= -3;// in V
R1= 0.3*10^3;// in k
R2= 1.7*10^3;//in k
R_D= 3.2;// in k
R=1;// in k
V_G= V_DD*R1/(R1+R2);// in V
//I_D= I_DSS*[1-V_GS/V_P]^2
                                          (i)
// V_G= V_GS+I_D*R or I_D= (V_G-V_GS)/R       (ii)
// From (i) and (ii)
//V_GS*1/V_P^2+V_GS*[1/(R*I_DSS)-2/V_P]+[1-V_G/(R*
    I_DSS)]=0
V_GS= [1/V_P^2 1/(R*I_DSS)-2/V_P 1-V_G/(R*I_DSS)];
V_GS= roots(V_GS);
```

```
V_GS= V_GS(2);// in V (selecting lower value)
I_D= I_DSS*[1-V_GS/V_P]^2;// in mA
disp(I_D,"The value of I_D in mA is : ")
V_S= I_D*R;//in V
V_D= V_DD-I_D*R_D;// in V
V_DS= V_D-V_S;// in V
gm= -2*I_DSS/V_P*(1-V_GS/V_P);// in mA/V
disp(V_DS,"The value of V_DS in volts is : ")
disp(gm,"The transconductance in mA/V is : ")
```

Scilab code Exa 6.23 Voltage gain

```
// Exa 6.23
clc;
clear;
close;
// Given data
r_d = 25;// in  k
R1 = r_d;// in  k
R2 = r_d;// in  k
g_m = 2;//mA/V
g_m= g_m*10^-3;// in A/V
R_L = (r_d*R1*R2)/(r_d*R1+R1*R2+R2*r_d);// in  k
R_L= R_L*10^3;// in
A_v = -g_m*R_L;
disp(A_v,"The voltage gain is ");
```

Scilab code Exa 6.24 Input resistance of the gate

```
// Exa 6.24
clc;
clear;
close;
```

```
// Given data
V_GS = 15;// in V
I_G = 1;// in nA
I_G =I_G * 10^-9;// in A
R_in = V_GS/I_G;// in
disp(R_in*10^-9,"Input resistance in G  is");
```

Scilab code Exa 6.25 Maximum drain current

```
// Exa 6.25
clc;
clear;
close;
// Given data
I_DSS = 20;// in mA
V_P = 4;// in V
I_D = I_DSS;// in mA
disp(I_D,"The maximum drain current in mA is");
V_GS = -V_P;// in V
disp(V_GS,"The gate source cut off voltage in volts is");
R_DS = V_P/I_DSS;// in k
disp(R_DS*10^3,"The value of ohmic resistance in  is");
```

Scilab code Exa 6.26 Gate voltage and drain current

```
// Exa 6.26
clc;
clear;
close;
// Given data
I_DSS= 16*10^-3;// in A
```

```
V_GSoff= -6;//in V
V_GS= V_GSoff/2;// in V
I_D= I_DSS*(1-V_GS/V_GSoff)^2;// in A
disp(I_D*10^3,"The drain current in mA is : ")
V_GS= abs(V_GSoff)/2;// in V
disp(V_GS,"The gate voltage in volts is : ")
```

Scilab code Exa 6.27 Drain saturation current

```
// Exa 6.27
clc;
clear;
close;
// Given data
V_DD = 15;// in V
R_D = 10;// in kohm
R_D = R_D * 10^3;// in ohm
I_D = V_DD/R_D;// in A
disp(I_D*10^3,"The drain current in mA is");
V_D = V_DD - I_D*R_D;// in V
disp(V_D,"The drain voltage in V is");
```

Scilab code Exa 6.28 DC load line and operating point

```
// Exa 6.28
clc;
clear;
close;
// Given data
R2 = 1;// in M ohm
R2 = R2 * 10^6;// in ohm
R1 = 1.5;// in M ohm
R1 = R1 * 10^6;// in ohm
```

```
V_DD = 25;// in V
V_G = (R2*V_DD)/(R1+R2);// in V
R_S = 22;// in kohm
R_S = R_S * 10^3;// in ohm
I_D = V_G/R_S;// in A
disp(I_D*10^3,"The drain current in mA is ");
R_D = 10;// in  kohm
R_D = R_D * 10^3;// in ohm
V_D = V_DD - (I_D*R_D);//in V
V_S = 10;// in V
V_DS = V_D - V_S;// in V
disp(V_DS,"The Drain source voltage in V is");
disp("Thus the Q-point is : "+string(V_DS)+" V, "+
   string(I_D*10^3)+" mA")
I_Dsat = V_DD/R_D;// in A
V_DS = V_DD;// in V
V_D= 0:0.1:25;// in V
I_D= (V_DD-V_D)/R_D*10^3;// in mA
plot(V_D,I_D);
xlabel("V_DS in volts");
ylabel("I_D in mA");
title("DC load line");
disp("DC load line shown in figure")
```

Scilab code Exa 6.29 Drain current

```
// Exa 6.29
clc;
clear;
close;
// Given data
V_SS = 25;// in V
V_GS = 0;// in V
R_S = 18;// in kohm
R_S = R_S * 10^3;// in ohm
```

```
I_D = (V_SS-V_GS)/R_S;// in A
disp(I_D*10^3,"The drain current in mA is");
V_DD = 25;// in V
R_D = 7.5;// in kohm
R_D = R_D * 10^3;// in ohm
V_D = V_DD - (I_D*R_D);// in V
disp(V_D,"The drain voltage in V is");
```

Scilab code Exa 6.30 AC output voltage

```
// Exa 6.30
clc;
clear;
close;
// Given data
R_D = 1;// in kohm
R_D = R_D * 10^3;// in ohm
V_in = 2;// in mV
V_in = V_in * 10^-3;// in V
R_L = 10;// in kohm
R_L = R_L * 10^3;// in ohm
r_d = (R_D*R_L)/(R_D+R_L);// in ohm
g_m = 3000;//in   S
g_m = g_m * 10^-6;// in S
A_v = g_m*r_d;
V_out = A_v*V_in;// in V
V_out = V_out * 10^3;// in mV
disp(V_out,"The output Voltage in mV is");
```

Chapter 7

MOSFET

Scilab code Exa 7.1 Output voltage

```
// Exa 7.1
clc;
clear;
close;
// Given data
V_GS = 0;// in V
I_D = 4;// in mA
R = 2;// in kohm
V_DD = 15;// in V
V_DS = V_DD - (I_D*R);// in V
g_m = 2000;// in  S
g_m= g_m*10^-6;// in S
g_mo = g_m;// in S
R_D = 2;// in kohm
R_D = R_D * 10^3;// in ohm
R_L = 10;// in  kohm
R_L = R_L * 10^3;// in ohm
r_d = (R_D*R_L)/(R_D+R_L);// in ohm
A_v = g_m*r_d;
V_in = 20;// in mV
V_out = A_v * V_in;// in mV
```

```
disp(V_out,"The output voltage in mV is");
```

Scilab code Exa 7.2 LED current

```
//Exa 7.2
clc;
clear;
close;
// Given data
V1 = 20;// in V
V2 = 2;// in V
V = V1-V2;// in V
R = 1;// in kohm
R = R * 10^3;// in ohm
I_D = V/R;// in A
I_D = I_D * 10^3;// in mA
disp(I_D,"The drain current in mA is");
```

Scilab code Exa 7.3 Transfer characteristics

```
// Exa 7.3
clc;
clear;
close;
// Given data
I_DSS = 10;// in mA
V_GS = 0;// in V
I_D = 0;// in mA
V_P = -4;// in V
V_GS= 0:-0.1:V_P;// in V
I_D = I_DSS*(1-(V_GS/V_P))^2;// mA
plot(V_GS,I_D);
xlabel("V_gs in volts");
```

```
ylabel("I_D in mA");
title("Transfer characteristics for an n-channel
   depletion type MOSFET")
```

Scilab code Exa 7.4 Value of VDS

```
// Exa 7.4
clc;
clear;
close;
// Given data
V_GS = 0;// in V
I_DSS = 10;// in mA
I_D = I_DSS;// in mA
R_D = 1.5;// in kohm
V_DD = 20;// in V
V_DS = V_DD - (I_D*R_D);// in V
disp(V_DS,"The value of V_DS in V is");
```

Scilab code Exa 7.5 Drain current

```
// Exa 7.5
clc;
clear;
close;
// Given data
I_D = 5;// in mA
V_GS1 = 8;// in V
V_GS2 = 4;// in V
V_GS = 6;// in V
K = I_D/(V_GS1-V_GS2)^2;// in mA/V^2
I_D = K*(V_GS-V_GS2)^2;// in mA
disp(I_D,"The drain current in mA is");
```

Scilab code Exa 7.6 Value of K

```
// Exa 7.6
clc;
clear;
close;
// Given data
V_T = 1;// in V
I_D = 4;// in mA
V_GS = 5;// in V
V_GSth = 1;// in V
K = I_D/(V_GS-V_GSth)^2;// in mA/V^2
disp(K,"The value of K in mA/V^2 is");
```

Scilab code Exa 7.7 Region of operation

```
// Exa 7.7
clc;
clear;
close;
// Given data
V_GS = 3;// in V
V_GSth=2;// inV
// Part (a)
V_DS= 0.5;// in V
if V_DS<(V_GS-V_GSth) then
    disp("Transistor is in ohmic region")
else
    disp("Transistor is in saturation region")
end

```

```
// Part (b)
V_DS= 1;// in V
if V_DS<(V_GS-V_GSth) then
    disp("Transistor is in ohmic region")
else
    disp("Transistor is in saturation region")
end

// Part (c)
V_DS= 5;// in V
if V_DS<(V_GS-V_GSth) then
    disp("Transistor is in ohmic region")
else
    disp("Transistor is in saturation region")
end
```

Scilab code Exa 7.8 Value of ID

```
// Exa 7.8
clc;
clear;
close;
// Given data
I_DSS = 4;// in mA
V_GSoff = -2;// in V
V_GS = -0.5;// in V
I_D = I_DSS*(1-(V_GS/V_GSoff))^2;// in mA
disp(I_D,"At V_GS=-0.5 V, the drain current in mA is
   ");
V_GS = -1;//in V
I_D = I_DSS*(1-(V_GS/V_GSoff))^2;// in mA
disp(I_D,"At V_GS=-1.0 V, the drain current in mA is
   ");
V_GS = -1.5;// in V
I_D = I_DSS*(1-(V_GS/V_GSoff))^2;// in mA
```

```
disp(I_D,"At V_GS=-1.5 V, the drain current in mA is
   ");
```

Scilab code Exa 7.9 Drain current and the value of VDS

```
// Exa 7.9
clc;
clear;
close;
// Given data
I_DSS = 12;// in mA
I_DSS= I_DSS*10^-3;// in A
I_D = I_DSS;// in A
V_DD = 12;// in V
R_D = 470;// in ohm
V_DS = V_DD - (I_D*R_D);// in V
disp(I_D*10^3,"The circuit drain current in mA is :
   ")
disp(V_DS,"The drain source voltage in V is");
```

Scilab code Exa 7.10 Value of rd Av and Vout

```
// Exa 7.10
clc;
clear;
close;
// Given data
I_D = 12;// in mA
I_D= I_D*10^-3;// in A
I_DSS = I_D;// in A
V_DS = 6.36;// in V
g_mo = 4000;// in  S
g_mo=g_mo*10^-6;// in S
```

```
g_m = g_mo;// in S
R_D = 470;// in ohm
R_L = 2;// in kohm
R_L = R_L * 10^3;// in ohm
r_d = (R_D*R_L)/(R_D+R_L);// in ohm
disp(r_d,"The value of r_d in    is : ")
A_v = g_m*r_d;
disp(A_v,"The value of A_v is : ")
V_in = 100;// in mV
V_in = V_in *10^-3;// in V
V_out = A_v*V_in;// in V
disp(V_out,"The value of Vout in V is");
```

Scilab code Exa 7.11 Value of RDS

```
// Exa 7.11
clc;
clear;
close;
// Given data
V_DS = 0.1;// in V
I_D = 10;// in mA
I_D= I_D*10^-3;// in A
R_DS = V_DS/I_D;// in ohm
disp(R_DS,"Part (a) The value of R_DS(on) in ohm is"
   );
V_DS = 0.75;// in V
I_D = 100;// in mA
I_D= I_D*10^-3;// in A
R_DS = V_DS/I_D;// in ohm
disp(R_DS,"Part (b) The value of R_DS(on) in ohm is"
   );
```

Scilab code Exa 7.12 Voltage across EMOSFET

```
// Exa 7.12
clc;
clear;
close;
// Given data
I_D = 500;// in mA
V_GS = 3;// in V
R_DS = 2;// in ohm
V_DD = 20;// in V
R1 = 1;// in kohm
R1 = R1 * 10^3;// in ohm
V_out = (R_DS/(R1+R_DS))*V_DD;// in V
disp(V_out,"The output voltage in V is");
```

Chapter 8

Operational Amplifiers

Scilab code Exa 8.1 Value of Rf

```
// Exa 8.1
clc;
clear;
close;
// Given data
A_V = -100;
R1 = 2.2;// in kohm
R1 = R1*10^3;// in ohm
R_f =-( A_V*R1);// in ohm
R_f = R_f * 10^-3;// in kohm
disp(R_f,"The resistance value in k  is");
```

Scilab code Exa 8.2 Output voltage

```
// Exa 8.2
clc;
clear;
close;
```

```
// Given data
R_f = 200;// in kohm
R1 = 2;// in kohm
A_V = - (R_f/R1);
V_in = 2.5;// in mV
V_in= V_in*10^-3;// in V
V_o = (A_V * V_in);// in V
disp(V_o,"The output voltage in V is");
```

Scilab code Exa 8.3 Output voltage

```
// Exa 8.3
clc;
clear;
close;
// Given data
V1 = 2;// in V
R_f = 500;// in kohm
R_f = R_f*10^3;// in ohm
R1 = 100;// in kohm
R1 = R1 * 10^3;// in ohm
V_o = (1+(R_f/R1))*V1;// in V
disp(V_o,"The output voltage in V is");
```

Scilab code Exa 8.4 Output voltage

```
// Exa 8.4
clc;
clear;
close;
// Given data
R_f = 1;// in Mohm
R_f = R_f * 10^6;// in ohm
```

```
disp("Part (a)")
V1 = 1;// in V
V2 = 2;// in V
V3 = 3;// in V
R1 = 500;// in kohm
R1 = R1 * 10^3;// in ohm
R2 = 1;// in Mohm
R2 = R2 * 10^6;// in ohm
R3 = 1;// in Mohm
R3 = R3 * 10^6;// in ohm
V_o = -(R_f) * ( (V1/R1)+(V2/R2)+(V3/R3) );// in V
disp(V_o,"The output voltage in V is");

disp("Part (b)")
V1 = -2;// in V
V2 = 3;// in V
V3 = 1;// in V
R1 = 200;// in kohm
R1 = R1 * 10^3;// in ohm
R2 = 500;// in kohm
R2 = R2 * 10^3;// in ohm
R3 = 1;// in Mohm
R3 = R3 * 10^6;// in ohm
V_o = -(R_f) * ( (V1/R1)+(V2/R2)+(V3/R3) );// in V
disp(V_o,"The output voltage in V is");
```

Scilab code Exa 8.6 Output voltage

```
// Exa 8.6
clc;
clear;
close;
// Given data
R_f = 0;// in V
R1 = 2;// in kohm
```

```
R1 = R1 * 10^3;// in ohm
A_vmin = (1+(R_f/R1));
disp(A_vmin,"The minimum closed loop voltage gain is
   ");
R_f1 = 100;// in kohm
R_f1 = R_f1 * 10^3;// in ohm
A_vmax = (1+(R_f1/R1));
disp(A_vmax,"The maximum closed loop voltage gain is
   ");
```

Scilab code Exa 8.7 Output voltage

```
// Exa 8.7
clc;
clear;
close;
// Given data
V1 = 745;// in  V
V1 = V1 * 10^-6;// in V
V2 = 740;// in  V
V2 = V2 * 10^-6;// in V
Av = 5*10^5;
CMRR = 80;// in dB
// Formula CMRR in dB= 20*log(Av/Ac)
Ac= Av/(10^(CMRR/20));
disp(Ac,"The common mode gain is");
V_o = Av*(V1-V2)+Ac*((V1+V2)/2);// in V
disp(V_o,"The output voltage in V is");

// Note: In the book the calculation of finding the
   value of common mode gain  (i.e. Ac) is wrong, so
    the answer in the book is wrong
```

Scilab code Exa 8.8 Voltage gain of the amplifier

```
// Exa 8.8
clc;
clear;
close;
// Given data
R_f = 1;// in Mohm
R_f = R_f * 10^6;// in ohm
Ri= 1*10^6;// in ohm
R1 = Ri;// in ohm
A_VF = -(R_f/R1);
disp(A_VF,"The Voltage gain is");
```

Scilab code Exa 8.10 Output voltage

```
// Exa 8.10
clc;
clear;
close;
// Given data
R_F = 3;// in kohm
R1 = 1;// in  kohm
V1 = 2;// in V
V2 = 3;// in V
V_o1 = (1+(R_F/R1))*V1;// in V
V_o2 = (1+(R_F/R1))*V2;// in V
V_o = V_o1+V_o2;// in V
disp(V_o,"The output voltage in V is");
```

Scilab code Exa 8.11 Range of voltage gain

```
// exa 8.11
```

```
clc;
clear;
close;
// Given data
R_i = 10;// in k
R_im = 20;// in k
R_f = 500;// in k
A_vmin = -(R_f/R_i);
disp(A_vmin,"Closed loop voltage gain corresponding to minimum resistance is");
A_vmax = -(R_f/R_im);
disp(A_vmax,"Closed loop voltage gain corresponding to maximum resistance is");
```

Scilab code Exa 8.12 Range of output voltage

```
// Exa 8.12
clc;
clear;
close;
// Given data
R_f = 200;// in kohm
R1 = 20;// in kohm
A_v = -(R_f/R1);
V_i = 0.1;// in V
V_im = 0.5;// in V
V_omin = -10*V_i;// in V
disp(V_omin,"The minimum output voltage in V is");
V_omax = -10*V_im;// in V
disp(V_omax,"The maximum output voltage in V is");
disp("Output voltage ranges from "+string(V_omin)+" to "+string(V_omax))
```

Scilab code Exa 8.13 Output waveform

```
// exa 8.13
clc;
clear;
close;
// Given data
R = 133;// in kohm
R = R *10^3;// in ohm
C = 0.1;// in   F
C = 0.1 * 10^-6;// in F
Vi= 1.5;// in V
t=0:0.1:1;
subplot(2,1,1)
plot(t,Vi);
ylabel("Vi in volts")
xlabel("t")
title("Input voltage");
t= 0:0.1:1;
Vo= -1/(R*C)*t;
subplot(2,1,2)
plot(t,Vo)
xlabel("t");
ylabel("Vo in volts");
title("Output voltage")
```

Scilab code Exa 8.14 Value of R1 and R2

```
// Exa 8.14
clc;
clear;
close;
// Given data
Rf = 250;// in kohm
Vo= '-5*Va+3*Vb';// given expression
```

```
// But output voltage of difference amplifier is
// Vo= -Rf/R1*Va+(R2/(R1+R2))*(1+Rf/R1)*Vb      (i)
// By comparing (i) with given expression
R1 = Rf/5;// in kohm
disp(R1,"The value of R1 in k  is : ");
// (R2/(R1+R2))*(1+Rf/R1)= 3
R2= 3*R1^2/(R1+Rf-3*R1);// in k
disp(R2,"The value of R2 in k  is : ")

// Note: There is calculation error to find the
   value of R2 in the book.
```

Scilab code Exa 8.15 Output voltage

```
// Exa 8.15
clc;
clear;
close;
// Given data
V_i1 = 150;// in  V
V_i2 = 140;// in  V
V_d = V_i1-V_i2;// in  V
V_C = (1/2)*(V_i1+V_i2);// in  V
disp("Part (i)")
CMRR = 100;
A_d = 4000;
V_o = (A_d * V_d)*(1+(1/CMRR)*(V_C/V_d));// in  V
V_o = V_o * 10^-3;// in mV
disp(V_o,"The output voltage in mV is");
disp("Part(ii)")
CMRR = 10^5;
V_o = (A_d * V_d)*(1+(1/CMRR)*(V_C/V_d));// in  V
V_o = V_o * 10^-3;// in mV
disp(V_o,"The output voltage in mV is");
```

Scilab code Exa 8.16 Output voltage

```
// Exa 8.16
clc;
clear;
close;
// Given data
R_f = 470;// in k
R1 = 4.3;// in k
R2 = 33;// in k
R3 = R2;// in k
A1 = (1+R_f/R1);
A2 = -(R_f/R2);
A3 = -(R_f/R3);
A = A1*A2*A3;
V_i = 80;// in  V
V_i= 80*10^-6;// in V
V_o = A*V_i;
disp(V_o,"The output voltage in V is")
```

Scilab code Exa 8.18 Output voltage

```
// Exa 8.18
clc;
clear;
close;
// Given data
R4 = 300;// in k
R2 = 150;// in k
R3 = 10;// in k
R1 = 10;// in k
V1 = 1;// in V
```

```
V2 = 2;// in V
V_o = ( (1+(R4/R2))*((R3/(R1+R3))*V1)-((R4/R2)*V2) );// in V
disp(V_o,"The output voltage in V is");
```

Scilab code Exa 8.19 Input voltage

```
// Exa 8.19
clc;
clear;
close;
// Given data
V_o = 2;// in V
R_i = 20;// in k
R_f = 1;// in M
V_i = -((V_o*R_i)/R_f);// in mV
disp(V_i,"The input volatge in mV is");
```

Scilab code Exa 8.20 Range of output voltage

```
// Exa 8.20
clc;
clear;
close;
// Given data
R_f = 200;// in k
R_i = 30;// in k
V_i = 0.1;// in V
V_im = 0.5;// in V
Vo_min = -((R_f/R_i)*V_i);// in V
disp(Vo_min,"The minimum output voltage in V is");
Vo_max = -((R_f/R_i)*V_im);// in V
disp(Vo_max,"The minimum output voltage in V is");
```

```
disp("The output voltage range is : "+string(Vo_min)
   +" V to "+string(Vo_max)+" V")
```

Scilab code Exa 8.21 Output voltage

```
// Exa 8.21
clc;
clear;
close;
// Given data
R_f = 360;// in kohm
R_i = 12;// in kohm
V1 = - 0.3;// in V
V_o = (1+(R_f/R_i))*V1;// in V
disp(V_o,"The output voltage in V is");
V_o1 = 2.4;// in V
V_i = V_o1/(1+(R_f/R_i));// in V
disp(V_i*10^3,"The input voltage in mV is");
```

Scilab code Exa 8.22 Output voltage

```
// Exa 8.22
clc;
clear;
close;
// Given data
R_f = -68;// in kohm
R1 = 33;// in kohm
R2 = 22;// in kohm
R3 = 12;// in kohm
V1 = 0.2;// in V
V2 = - 0.5;// in V
V3 = 0.8;// in V
```

```
V_o = ((R_f/R1)*V1) + ((R_f/R2)*V2) + ((R_f/R3)*V3);
    // in V
disp(V_o,"The output voltage in V is");
```

Scilab code Exa 8.23 Closed loop voltage gain and bandwidth

```
// Exa 8.23
clc;
clear;
close;
// Given data
R_f = 1.8;// in kohm
R_f = R_f * 10^3;// in ohm
R1 = 180;// in ohm
A_v = (R_f/R1);
disp(A_v,"Closed loop gain is");
F = 1;// in MHz
F = F * 10^6;// in Hz
f2 = F/A_v;// in Hz
disp(f2,"Closed loop bandwidth in Hz is");
V_in = 25;// in mV
V_in = V_in * 10^-3;// in V
V_o = A_v*V_in;// in V
disp(V_o,"The output voltage in V is");
```

Scilab code Exa 8.24 Closed loop voltage gain and bandwidth and output voltage

```
// Exa 8.24
clc;
clear;
close;
// Given data
```

```
R_f = 3;// in K ohm
R_f = R_f * 10^3;// in ohm
R1 = 150;// in ohm
A_v = (R_f/R1) + 1;
disp(A_v,"Close loop gain for inverting amplifier is
    ");
f = 1;// in MHz
f = f * 10^6;// in Hz
f2 = f/A_v;// in Hz
f2 = f2 * 10^-3;// in KHz
disp(f2,"The closed loop bandwidth in KHz is");
```

Chapter 9

Electronic Instrumentation and Measurements

Scilab code Exa 9.1 Peak to peak amplitude

```
// Exa 9.1
clc;
clear;
close;
// Given data
scale= 5;// in mV/cm
gh= 5.2;//amplitude of the graph in cm
PtoPamplitude= gh*scale;// in mV
disp(PtoPamplitude,"Peak-to-peak amplitude in mV is
    : ")
```

Scilab code Exa 9.2 Amplitude of the pulse signal

```
// Exa 9.2
clc;
clear;
```

```
close;
// Given data
scale= 100;// in mV/cm
gh= 5.2;//amplitude of the graph in cm
PtoPamplitude= gh*scale;// in mV
disp(PtoPamplitude*10^-3,"Peak-to-peak amplitude in
    V is : ")
```

Scilab code Exa 9.3 Period of the waveform

```
// Exa 9.3
clc;
clear;
close;
// Given data
scale= 20;// in  S /cm
gh= 3.2;//amplitude of the graph in cm
T= gh*scale;// in mV
disp(T,"The period of the waveform in  S is : ")
```

Scilab code Exa 9.4 Pulse delay

```
// Exa 9.4
clc;
clear;
close;
// Given data
scale= 50;// in  S /cm
gh= 2;//amplitude of the graph in cm
T_PD= gh*scale;// in mV
disp(T_PD,"The pulse delay for the waveform in  s
    is : ")
```

Scilab code Exa 9.5 Pulse width of the waveform

```
// Exa 9.5
clc;
clear;
close;
// Given data
scale= 2;// in  S /cm
gh= 4.6;//amplitude of the graph in cm
T_PQ= gh*scale;// in mV
disp(T_PQ,"The pulse width of the waveform in  s is
    : ")
```