

Scilab Textbook Companion for
Electronics Engineering
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Scilab numbering policy used in this document and the relation to the above book.

Exa Example (Solved example)

Eqn Equation (Particular equation of the above book)

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

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

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Chapter 1

Impact Load And Stresses

Scilab code Exa 1.1 Barrier potential

```
1 // Exa 1.1
2 clc;
3 clear;
4 close;
5 // Given data
6 T1 = 25; // in degree C
7 T2 = 100; // in degree C
8 del_T = T2-T1; // in degree C
9 V= 0.7; // barrier potential t 25 C in V
10 del_V = -(2)*del_T; // in mV
11 del_V= del_V*10^-3; // in V
12 V_B = V- abs(del_V); // in V
13 disp(V_B,"(i) When the junction temperature is 100
    C , the barrier potential of a silicon diode in
    V is");
14 T2 = 0; // in degree C
15 del_T = T2-T1; // in degree C
16 del_V = -(2)*del_T; // in mV
17 del_V= del_V*10^-3; //in V
18 V_B = V+del_V; // in V
19 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

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

Scilab code Exa 1.3 Load voltage and current

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

Scilab code Exa 1.4 Load voltage and current

```
1 // Exa 1.4
2 clc;
3 clear;
4 close;
5 // Given data
6 v1 = 10; // in V
7 v2 = 0.7; // in V
8 V_L = v1-v2; // in V
9 disp(V_L,"The load voltage in V is");
10 R_L = 1*10^3; // in
11 I_L = V_L/R_L; // in A
12 disp(I_L*10^3,"The load current in mA is");
13 P_D = v2*I_L; // in watt
14 disp(P_D*10^3,"The diode Power in mW is");
```

Scilab code Exa 1.5 Load voltage and current

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

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

Scilab code Exa 1.6 Value of Vo I1 ID1 and ID2

```
1 // Exa 1.6
2 clc;
3 clear;
4 close;
5 // Given data
6 V_o = 0.7; // in V
7 disp(V_o,"The value of V_o in V is");
8 E = 10; // in V
9 V_D = V_o; // in V
10 R = 330; // in ohm
11 I1 = (E - V_D)/R; // in A
12 I1 = I1*10^3; // in mA
13 disp(I1,"The value of I1 in mA is");
14 I_D1 = I1/2; // in mA
15 disp(I_D1,"The value of I_D1 in mA is");
16 I_D2 = I_D1; // in mA
17 disp(I_D2,"The value of I_D2 in mA is");
```

Scilab code Exa 1.7 Value of Vo and ID

```
1 // Exa 1.7
2 clc;
3 clear;
4 close;
5 // Given data
6 V_i = 12; // in V
7 V_D1 = 0.7; // in V
8 V_D2 = 0.3; // in V
```

```

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

```

Scilab code Exa 1.8 Value of current

```

1 // Exa 1.8
2 clc;
3 clear;
4 close;
5 // Given data
6 V1 = 24; // in V
7 V2 = 6; // in V
8 V_D1 = 0.7; // in V
9 R = 3*10^3; // in ohm
10 I = (V1 - V2 - V_D1)/R; // in A
11 I = I * 10^3; // in mA
12 disp(I,"The current in mA is");

```

Scilab code Exa 1.9 Diode current

```

1 // Exa 1.9
2 clc;
3 clear;
4 close;
5 // Given data
6 r= 20; // in
7 R_B= 15; // in
8 V_K1= 0.2; // in V
9 V_K2= 0.6; // in V

```

```

10 V= 100; // in V
11 R1= 10*10^3; // in
12 // Vo= V_K1+r*I1 = V_K2+R_B*I2
13 // Resulting current I= I1+I2 or
14 // (V-Vo)/(R1) = (Vo-V_K1)/r + (Vo-V_K2)/R_B
15 Vo= (r*R_B*V+R1*R_B*V_K1+R1*r*V_K2)/(R1*R_B+R1*r+r*
    R_B); // in V
16 I1= (Vo-V_K1)/r; // in A
17 I2= (V_K2-Vo)/R_B; // in A
18 disp(I1*10^3, "The value of I1 in mA is : ")
19 disp(I2*10^3, "The value of I2 in mA is : ")

```

Scilab code Exa 1.10 DC resistance levels

```

1 // Exa 1.10
2 clc;
3 clear;
4 close;
5 // Given data
6 I_D = 10; // in mA
7 I_D = I_D * 10^-3; // in A
8 V_D = 0.5; // in V
9 r_F1 = V_D/I_D; // in ohm
10 disp(r_F1, "The value of r_F1 in ohm is");
11 I_D = 20; // in mA
12 I_D = I_D * 10^-3; // in A
13 V_D = 0.8; // in V
14 r_F2 = V_D/I_D; // in ohm
15 disp(r_F2, "The value of r_F2 in ohm is");
16 I_D = -1; // in A
17 I_D = I_D * 10^-6; // in A
18 V_D = -10; // in V
19 r_R = V_D/I_D; // in ohm
20 disp(r_R*10^-6, "The value of r_R in Mohm is");
21

```



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

Scilab code Exa 1.11 Value of ID VD2 and Vo

```
1 // Exa 1.11
2 clc;
3 clear;
4 close;
5 // Given data
6 R= 5.6*10^3; // in
7 I_D = 0; // in A
8 V_D = 0; // in V
9 E= 12; // in V
10 Vo= I_D*R; // in V
11 disp(I_D,"The value of I_D in A is :");
12 disp(Vo,"The value of Vo in V is");
13 V_D1 = 0; // in V
14 V_D2 = E -V_D1 - Vo; // in V
15 disp(V_D2,"The value of V_D2 in V is");
```

Scilab code Exa 1.12 Value of I1 I2 and ID2

```
1 // Exa 1.12
2 clc;
3 clear;
4 close;
5 // Given data
6 E = 20; // in V
7 V_D1 = 0.7; // in V
8 V_D2 = 0.7; // in V
9 V2 = E - V_D1 - V_D2; // in V
```

```

10 R1 = 3.3*10^3; // in ohm
11 R2 = 5.6*10^3; // in ohm
12 I2 = V2/R2; // in A
13 I2 = I2*10^3; // in mA
14 disp(I2,"The current through resistor R2 in mA is ")
    ;
15 I1 = V_D2/R1;
16 I1 = I1 * 10^3; // in mA
17 disp(I1,"The current through resistor R1 in mA is");
18 I_D2 = I2-I1; // in mA
19 disp(I_D2,"The current through diode D2 in mA is");

```

Scilab code Exa 1.13 Output voltage

```

1 // Exa 1.13
2 clc;
3 clear;
4 close;
5 // Given data
6 V1 = 12; // in V
7 V2 = 0.3; // in V
8 V_o = V1-V2; // in V
9 disp(V_o,"The output voltage in V is");

```

Scilab code Exa 1.14 Value of ID

```

1 // Exa 1.14
2 clc;
3 clear;
4 close;
5 // Given data
6 disp("Part (a) Analysis using approximate diode
    model")

```

```

7 V_D = 0.7; // in V
8 disp(V_D,"The value of V_D in V is");
9 E = 30; // in V
10 V_R = E-V_D; // in V
11 disp(V_R,"The value of V_R in V is");
12 R = 2.2 * 10^3; // in ohm
13 I_D = V_R/R;
14 I_D = I_D * 10^3; // in mA
15 disp(I_D,"The value of I_D in mA is");
16 disp("Part (b) Analysis using ideal diode model")
17 V_D = 0; // in V
18 disp(V_D,"The value of V_D in V is");
19 V_R = E; // in V
20 disp(V_R,"The value of V_R in V is");
21 I_D = V_R/R;
22 I_D = I_D * 10^3; // in mA
23 disp(I_D,"The value of I_D in mA is");

```

Scilab code Exa 1.15 Value of current

```

1 // Exa 1.15
2 clc;
3 clear;
4 close;
5 // Given data
6 V1 = 20; // in V
7 V2 = 0.7; // in V
8 V = V1-V2; // in V
9 R = 20; // in ohm
10 I = V/R; // in A
11 disp(I,"The current through resistance in A is");

```

Scilab code Exa 1.16 Output voltage

```

1 // Exa 1.16
2 clc;
3 clear;
4 close;
5 // Given data
6 R1= 2; // in k
7 R2= 2; // in k
8 V=19; // in V
9 V_o = (V*R1)/(R1+R2); // in V
10 disp(V_o,"The output voltage in V is");

```

Scilab code Exa 1.17 Value of Vo and ID

```

1 // Exa 1.17
2 clc;
3 clear;
4 close;
5 // Given data
6 V1 = 0.7; // in V
7 V2 = 5; // in V
8 V_o = V1-V2; // in V
9 R = 2.2*10^3; // in ohm
10 I_D = -V_o/R;
11 I_D = I_D * 10^3; // in mA
12 disp(V_o,"The output voltage in volts is : ")
13 disp(I_D,"The current through diode in mA is");

```

Scilab code Exa 1.18 Output voltage and diode current

```

1 // Exa 1.18
2 clc;
3 clear;
4 close;

```

```

5 // Given data
6 V_gamma = 0.7; // in V
7 R1 = 5*10^3; // in ohm
8 R2 = 10*10^3; // in ohm
9 V=5; // in V
10 disp("Part (a)")
11 I_R2 = (V-V_gamma-(-V))/(R1+R2); // in A
12 I_D2 = I_R2; // in A
13 disp(I_D2*10^3,"The value of I-D1 and I-D2 in mA is"
);
14 V_o = V - (I_D2 * R1); // in V
15 disp(V_o,"The value of Vo in V is");
16 V_A = V_o - V_gamma; // in V
17 disp(V_A,"The value of V_A in V is");
18 disp("Part (b)")
19 V_I = 4; // in V
20 V_A= V_I-V_gamma; // in V
21 Vo= V_A+V_gamma; // in V
22 I_R1= (V-Vo)/R1; // in A
23 I_D2= I_R1; // in A
24 disp(I_D2*10^3,"The value of I-D2 in mA is : ")
25 I_R2= (V_A-(-V))/R2; // in A
26 I_D1= I_R2-I_R1; // in A
27 disp(I_D1*10^3,"The value of I-D1 in mA is : ")
28 disp(Vo,"The value of Vo in volts is : ")

```

Scilab code Exa 1.19 Total current

```

1 // Exa 1.19
2 clc;
3 clear;
4 close;
5 // Given data
6 V_S = 6; // in V
7 V_D = 0.7; // in V

```

```

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

```

Scilab code Exa 1.20 Total current

```

1 // Exa 1.20
2 clc;
3 clear;
4 close;
5 // Given data
6 V_S = 5; // in V
7 V_D = 0.7; // in V
8 R1 = 1.2 * 10^3; // in ohm
9 R2 = 2.2 * 10^3; // in ohm
10 I_T = (V_S-V_D)/(R1+R2);
11 I_T = I_T * 10^3; // in mA
12 disp(I_T,"The total circuit current in mA is");

```

Scilab code Exa 1.21 Total current

```

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

```

Scilab code Exa 1.22 Total current

```
1 // Exa 1.22
2 clc;
3 clear;
4 close;
5 // Given data
6 V_S = 10; // in V
7 R1 = 1.5*10^3; // in ohm
8 R2 = 1.8*10^3; // in ohm
9 I_T = V_S/(R1+R2); // in A
10 disp(I_T*10^3,"Using the ideal diode , the total
    current in mA is ");
11 V_D1 = 0.7; // in V
12 V_D2 = 0.7; // in V
13 I_T = (V_S-V_D1-V_D2)/(R1+R2); // in A
14 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

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

Scilab code Exa 1.24 Diode current

```
1 // Exa 1.24
2 clc;
3 clear;
4 close;
5 // Given data
6 V_S = 2; // in V
7 R = 100; // in ohm
8 I_D = V_S/R;
9 I_D = I_D * 10^3; // in mA
10 disp("Part (a)")
11 disp(I_D,"The diode current in mA is");
12 V_K = 0.7; // in V
13 I_D1 = (V_S-V_K)/R;
14 I_D1 = I_D1*10^3; // in mA
15 disp("Part (b)")
16 disp(I_D1,"The diode current in mA is");
17 R_f = 30; // in ohm
18 I_D2 = (V_S - V_K)/(R+R_f);
19 I_D2 = I_D2 * 10^3; // in mA
20 disp("Part (c)")
21 disp(I_D2,"The diode current in mA is");
```

Scilab code Exa 1.25 Value of Vo1 and Vo2

```
1 // Exa 1.25
2 clc;
3 clear;
4 close;
5 // Given data
```



```

6 R1= 1; // in k
7 R2= 0.47; // in k
8 V_o1 = 0.7; // in V
9 disp(V_o1,"The value of Vo1 in V is");
10 V_o2 = 0.3; // in V
11 disp(V_o2,"The value of Vo2 in V is");
12 I1 = (20-V_o1)/R1; // in mA
13 I2 = (V_o2-V_o1)/R2; // in mA
14 I = I1 + I2; // in mA
15 disp(I,"The current in mA is");

```

Scilab code Exa 1.26 Output voltage and diode current

```

1 // Exa 1.26
2 clc;
3 clear;
4 close;
5 // Given data
6 V1 = 10; // in V
7 V2 = 0.7; // in V
8 R1 = 1*10^3; // in ohm
9 R2 = 2*10^3; // in ohm
10 I = (V1-V2)/(R1+R2); // in A
11 V_o = I * R2; // in V
12 disp(V_o,"The output voltage in V is");
13 I_D = I/2; // in A
14 disp(I_D*10^3,"The diode current in mA is");

```

Scilab code Exa 1.27 Output voltage and diode current

```

1 // Exa 1.27
2 clc;
3 clear;

```

```

4 close;
5 // Given data
6 V1 = 20; // in V
7 V2 = 0.7; // in V
8 R = 4.7*10^3; // in ohm
9 I = (V1-V2)/R; // in A
10 I_D = I/2; // in A
11 disp(I_D*10^3,"The diode current in mA is");
12 V_o = I_D*R; // in V
13 disp(V_o,"The output voltage in V is");

```

Scilab code Exa 1.28 Output voltage and diode current

```

1 // Exa 1.28
2 clc;
3 clear;
4 close;
5 // Given data
6 V1 = 15; // in V
7 V2 = 0.7; // in V
8 V3 = 5; // in V
9 R = 2.2; // in K ohm
10 I_D = (V1-V2+V3)/R; // in mA
11 disp(I_D,"The diode current in mA is");
12 V_o = (R * I_D) - V3; // in V
13 disp(V_o,"The output voltage in V");

```

Scilab code Exa 1.29 Current and output voltage

```

1 // Exa 1.29
2 clc;
3 clear;
4 close;

```

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

Chapter 2

Diode Applications

Scilab code Exa 2.1 Average current and load voltage

```
1 // Exa 2.1
2 clc;
3 clear;
4 close;
5 // Given data
6 R_L = 1000; // in ohm
7 N2byN1= 4;
8 Vi= '10*sin(omega*t)';
9 // V2= N2byN1*V1
10 // V2= 40*sin(omega*t)
11 Vm= N2byN1*10; // in V
12 V_Lav= Vm/%pi; // in V
13 disp(V_Lav,"The average load voltage in volts is : "
    )
14 Im= Vm/R_L; // in A
15 I_dc= Im/%pi; // in A
16 I_av = I_dc; // in A
17 I_av= I_av*10^3; // in mA
18 disp(I_av,"Average load current in mA is");
19 V_Lrms = Vm/2; // in V
20 disp(V_Lrms,"RMS load voltage in V is");
```

```

21 I_rms = V_Lrms/R_L; // in A
22 I_rms= I_rms*10^3; // in mA
23 disp(I_rms,"RMS load current in mA is");
24 Eta = I_av^2/I_rms^2*100; // in %
25 disp(Eta,"Efficiency in % is");
26 V2rms= Vm/sqrt(2); // in V
27 TUF = ((I_av )^2)/(V2rms*I_rms)*100; // in %
28 disp(TUF,"Transformer utilization factor in % is");
29 Gamma= sqrt(V_Lrms^2-I_av^2)/V_Lav*100;
30 disp(round(Gamma),"Ripple factor in % is");

```

Scilab code Exa 2.2 Average RMS and peak value of current

```

1 // Exa 2.2
2 clc;
3 clear;
4 close;
5 // Given data
6 R_L = 1; // in K ohm
7 R_L = R_L * 10^3; // in ohm
8 V_m = 15; // in V
9 V_i = '15*sin(314*t)';
10 I_m= V_m/R_L; // in A
11 I_dc = I_m/%pi; // in A
12 I_dc = I_dc * 10^3; // in mA
13 disp(I_dc,"Average current through the diode in mA
    is");
14 I_drms = V_m/(2*R_L);
15 I_drms = I_drms * 10^3; // in mA
16 disp(I_drms,"RMS current in mA is");
17 I_m = V_m/R_L;
18 I_m = I_m*10^3; // in mA
19 disp(I_m,"Peak diode current in mA is");
20 PIV = 2*V_m; // in V
21 disp(PIV,"Peak inverse voltage in V is");

```

Scilab code Exa 2.3 Required PIV

```
1 // Exa 2.3
2 clc;
3 clear;
4 close;
5 // Given data
6 R1 = 2.2*10^3; // in ohm
7 R2 = 4.7*10^3; // in ohm
8 R_AB = (R1*R2)/(R1+R2); // in ohm
9 Vi = 20; // in V
10 V_o = (Vi * R_AB)/(R_AB+R1); // in V
11 PIV= Vi; // in volts
12 disp(V_o,"The output voltage in V is");
13 disp(PIV,"Peak inverse voltage in volts is : ")
```

Scilab code Exa 2.4 Required PIV

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

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

Scilab code Exa 2.4.2 Peak magnitude of output waveform

```
1 // Exa 2.4.2 (again 2.4)
2 clc;
3 clear;
4 close;
5 // Given data
6 V_in = 10; // in V
7 R_L = 2000; // in ohm
8 R1 = 100; // in ohm
9 V_R= 0.7; // in V
10 V_o = V_in * ( (R_L)/(R1+R_L) ); // in V
11 disp(V_o,"The peak magnitude of the positive output
    voltage in V is");
12 Vo=-V_R; // in V
13 disp(Vo,"The peak magnitude of the negative output
    voltage in V is : ")
```

Scilab code Exa 2.7 Average load voltage

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

```

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

```

Scilab code Exa 2.8 DC output voltage

```

1 // Exa 2.8
2 clc;
3 clear;
4 close;
5 // Given data
6 V = 220;// in V
7 f=50;// in Hz
8 N2byN1=1/4;
9 R_L = 1;// in kohm
10 R_L= R_L*10^3;// in ohm
11 V_o = 220;// in V
12 V_s = N2byN1*V_o;// in V
13 V_m = sqrt(2) * V_s;// in V
14 V_Ldc = (2*V_m)/%pi;// in V
15 disp(V_Ldc,"Average load output voltage in V is");
16 P_dc = (V_Ldc)^2/R_L;// in W
17 disp(P_dc,"DC power delivered to load in watt is");
18 PIV = V_m;// in V
19 disp(PIV,"Peak inverse Voltage in V is");
20 f_o = 2*f;// in Hz
21 disp(f_o,"Output frequency in Hz is");

```

Scilab code Exa 2.10 RMS value of signal voltage

```

1 // Exa 2.10
2 clc;
3 clear;

```



```

4 close;
5 // Given data
6 R_L = 20; // in ohm
7 I_Ldc = 100; // in mA
8 R2 = 1; // in ohm
9 R_F = 0.5; // in ohm
10 I_m = (%pi * I_Ldc)/2; // in mA
11 V_m = I_m*10^-3*(R2+R_F+R_L); // in V
12 V_srms = V_m/sqrt(2); // in V
13 disp(V_srms,"RMS value of secondary signal voltage
    in V is");
14 P_Ldc = (I_Ldc*10^-3)^2*R_L; // in Watt
15 disp(P_Ldc,"power delivered to load in Watt is");
16 PIV = 2*V_m; // in V
17 disp(PIV,"Peak inverse voltage in V is");
18 P_ac = (V_m)^2/(2*(R2+R_F+R_L)); // in Watt
19 disp(P_ac,"Input power in Watt is");
20 Eta = P_Ldc/P_ac*100; // in %
21 disp(Eta,"Conversion efficiency in % is");

```

Scilab code Exa 2.16 AC voltage

```

1 // Exa 2.16
2 clc;
3 clear;
4 close;
5 // Given data
6 V_dc = 12; // in V
7 R_L = 500; // in ohm
8 R_F = 25; // in ohm
9 I_dc = V_dc/R_L; // in A
10 V_m = I_dc * %pi * (R_L+R_F); // in V
11 V_rms = V_m/sqrt(2); // in V
12 V = V_rms; // in V
13 disp(round(V),"The voltage in V is");

```

Scilab code Exa 2.17 PIV

```
1 // Exa 2.17
2 clc;
3 clear;
4 close;
5 // Given data
6 V_dc = 100; // in V
7 V_m = (V_dc*%pi)/2; // in V
8 PIV = 2*V_m; // in V
9 disp(PIV,"Peak inverse voltage for center tapped FWR
    in V is");
10 PIV1 = V_m; // in V
11 disp(PIV1,"Peak inverse voltage for bridge type FWR
    in V is");
```

Scilab code Exa 2.19 Required PIV rating

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

```

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

```

Scilab code Exa 2.20 Value of current

```

1 // Exa 2.20
2 clc;
3 clear;
4 close;
5 // Given data
6 V1 = 10; // in V
7 V2 = 0.7; // in V
8 V3 = V2; // in V
9 V = V1-V2-V3; // in V
10 R1 = 1; // in ohm
11 R2 = 48; // in ohm
12 R3 = 1; // in ohm
13 R = R1+R2+R3; // in ohm
14 I = V/R; // in A
15 I = I * 10^3; // in mA
16 disp(I,"Current in mA is");

```

Scilab code Exa 2.21 AC and DC power output

```

1 // Exa 2.21
2 clc;

```

```

3 clear;
4 close;
5 // Given data
6 V_m = 50; // in V
7 r_f = 20; // in ohm
8 R_L = 800; // in ohm
9 I_m = V_m/(R_L+r_f); // in A
10 I_m = I_m * 10^3; // in mA
11 disp(round(I_m),"The value of Im in mA is");
12 I_dc = I_m/%pi; // in mA
13 disp(I_dc,"The value of I_dc in mA is");
14 I_rms = I_m/2; // in mA
15 disp(I_rms,"The value of Irms in mA is");
16 P_ac = (I_rms * 10^-3)^2 * (r_f + R_L); // in Watt
17 disp(P_ac,"AC power input in Watt is");
18 V_dc = I_dc * 10^-3*R_L; // in V
19 disp(V_dc,"DC output voltage in V is");
20 P_dc = (I_dc * 10^-3)^2 * (r_f + R_L); // in Watt
21 Eta = (P_dc/P_ac)*100; // in %
22 disp(Eta,"The efficiency of rectification in % is");
23
24 // 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

```

1 // Exa 2.22
2 clc;
3 clear;
4 close;
5 // Given data
6 R_L = 1; // in K ohm
7 R_L = R_L * 10^3; // in ohm
8 r_d = 10; // in ohm

```

```

9 V_m = 220; // in V
10 I_m = V_m/(r_d+R_L); // in A
11 disp(I_m,"Peak value of current in A is");
12 I_dc = (2*I_m)/%pi; // in A
13 disp(I_dc,"DC value of current in A is");
14 Irms= I_m/sqrt(2); // in A
15 r_f = sqrt((Irms/I_dc)^2-1)*100; // in %
16 disp(r_f,"Ripple factor in % is");
17 Eta = (I_dc)^2 * R_L/((Irms)^2*(R_L+r_d))*100; // in
    %
18 disp(Eta,"Rectification efficiency in % is");

```

Scilab code Exa 2.23 Peak load voltage

```

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

```

Scilab code Exa 2.24 Load current

```

1 // Exa 2.24
2 clc;
3 clear;
4 close;

```

```

5 // Given data
6 V_s = 10; // in V
7 R_L = 100; // in ohm
8 I_L = V_s/R_L; // in A
9 disp(I_L,"The load current during positive half
    cycle in A is");
10 I_D2 = 0; // in A
11 R2 = R_L; // in ohm
12 I_L1 = -(V_s)/(R2+R_L); // in A
13 disp(I_L1,"The load current during negative half
    cycle in A is");

```

Scilab code Exa 2.25 Value of Vdc

```

1 // Exa 2.25
2 clc;
3 clear;
4 close;
5 // Given data
6 V_m = 50; // in V
7 V_dc = (2*V_m)/%pi; // in V
8 disp(V_dc,"The dc voltage in V is");

```

Scilab code Exa 2.26 DC voltage

```

1 // Exa 2.26
2 clc;
3 clear;
4 close;
5 // Given data
6 R1 = 1.1; // in K ohm
7 R2 = 2.2; // in K ohm
8 Vi= 170; // in V

```

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

Chapter 3

Special Purpose Diodes

Scilab code Exa 3.1 Zener current

```
1 // Exa 3.1
2 clc;
3 clear;
4 close;
5 // given data
6 V1 = 18; // in V
7 V2 = 10; // in V
8 R = 270; // in ohm
9 I_S = (V1-V2)/R; // in A
10 V_L = 10; // in V
11 R_L = 1; // in K ohm
12 R_L = R_L*1000; // in ohm
13 I_L = V_L/R_L; // in A
14 I_Z = I_S-I_L; // in A
15 disp(I_Z*10^3, "The zener current in mA is");
```

Scilab code Exa 3.5 Load voltage


```

1 // Exa 3.5
2 clc;
3 clear;
4 close;
5 // Given data
6 I_Z = 2*10^-3; // in A
7 R_Z = 8.5; // in V
8 del_VL = I_Z*R_Z; // in V
9 V1 = 10; // in V
10 disp(del_VL,"Change in load voltage in V is");
11 V_L = V1 + del_VL; // in V
12 disp(V_L,"The load voltage in V is");
13
14 // 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

```

1 // Exa 3.6
2 clc;
3 clear;
4 close;
5 // Given data
6 R_L = 1.2; // in K ohm
7 R_L = R_L * 10^3; // in ohm
8 V_i = 16; // in V
9 R_i = 1; // in K ohm
10 R_i = R_i * 10^3; // in ohm
11 V = (R_L * V_i)/(R_L + R_i); // in V
12 V_L = V; // in V
13 disp(V_L,"The load voltage in V is");
14 V_R = V_i - V_L; // in V
15 disp(V_R,"The voltage in V is");
16 I_Z = 0; // A

```

```

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

```

Scilab code Exa 3.7 Resistance of device

```

1 // Exa 3.7
2 clc;
3 clear;
4 close;
5 // Given data
6 I_Z1 = 20; // in mA
7 I_Z1= I_Z1*10^-3; // in A
8 I_Z2 = 30; // in mA
9 I_Z2= I_Z2*10^-3; // in A
10 V_Z1 = 5.6; // in V
11 V_Z2 = 5.75; // in V
12 del_Iz = I_Z2-I_Z1; // in A
13 del_VZ = V_Z2-V_Z1; // in V
14 r_Z = del_VZ/del_Iz; // in ohm
15 disp(r_Z,"Resistance of zener diode in ohm is");

```

Scilab code Exa 3.8 Range of RL and IL

```

1 // Exa 3.8
2 clc;
3 clear;
4 close;
5 // Given data
6 R = 1; // in K ohm
7 R = R * 10^3; // in ohm
8 V_Z = 10; // in V

```

```

 9 V_i = 50; // in V
10 I_ZM = 32; // in mA
11 I_ZM= I_ZM*10^-3; // in A
12 R_Lmin = (R*V_Z)/(V_i-V_Z); // in ohm
13 disp(R_Lmin,"The minimum value of R_L in ohm is : ")
14 V_R = V_i-V_Z; // in V
15 I_R = V_R/R; // in A
16 I_Lmin = I_R-I_ZM; // in A
17 disp(I_Lmin*10^3,"The minimum value of I_L in mA is
   : ");
18 R_Lmax = V_Z/I_Lmin; // in ohm
19 disp(R_Lmax*10^-3,"The maximum value of R_L in kohm
   is");

```

Scilab code Exa 3.9 Range of value of Vi

```

1 // Exa 3.9
2 clc;
3 clear;
4 close;
5 // Given data
6 V_Z = 20; // in V
7 R_L = 1.2; // in K ohm
8 R_L = R_L * 10^3; // in ohm
9 R = 220; // in ohm
10 I_ZM = 60; // in mA
11 I_ZM= I_ZM*10^-3; // in A
12 Vi_min = (R_L + R)/R_L*V_Z; // in V
13 disp(Vi_min,"The minimum value of Vi in V is");
14 V_L= V_Z; // in V
15 I_L= V_L/R_L; // in A
16 Vi_max= (I_ZM+I_L)*R+V_Z; // in V
17 disp(Vi_max,"The maximum value of Vi in V is");

```

Scilab code Exa 3.10 Zener diode operation

```
1 // Exa 3.10
2 clc;
3 clear;
4 close;
5 // Given data
6 V1 = 18; // in V
7 V2 = 270; // in V
8 R = 1; // in K ohm
9 R = R*1000; // in ohm
10 V = (V1*R)/(V2+R); // in V
11 disp(V,"The open circuit voltage in volts is");
12 if V>=10 then
13     disp("The zener diode is operating in the
14         breakdown region.")
15 end
```

Scilab code Exa 3.11 Value of VL IL IZ and IR

```
1 // Exa 3.11
2 clc;
3 clear;
4 close;
5 // Given data
6 R_L = 300; // in ohm
7 R = 200; // in ohm
8 V_i = 20; // in V
9 V = (R_L/(R_L+R))*V_i; // in V
10 disp(V,"The value of V_L in Volts is");
11 V_L = 10; // in V
12 V_Z= V_L; // in V
```

```

13 I_L = V_L/R_L; // A
14 disp(I_L*10^3,"The value of I_L in mA is");
15 I_R = (V_i-V_L)/R; // in A
16 disp(I_R*10^3,"The value of I_R in mA is");
17 I_Z = I_R-I_L; // in A
18 disp(I_Z*10^3,"The value of I_Z in mA is");
19 // Formula V_Z= R_L*V_i/(R_L+R)
20 R_L= R*V_Z/(V_i-V_Z); // in ohm
21 disp(R_L,"The value of R_L in ohm is : ")

```

Scilab code Exa 3.12 Range of input voltage

```

1 // Exa 3.12
2 clc;
3 clear;
4 close;
5 // Given data
6 V_Z = 5; // in V
7 I_Zmin = 2; // in mA
8 I_Zmin= I_Zmin*10^-3; // in A
9 I_Zmax = 20; // in mA
10 I_Zmax=I_Zmax*10^-3; // in A
11 R_L = 1; // in kohm
12 R_L = R_L * 10^3; // in ohm
13 I_L = V_Z/R_L; // in A
14 I = I_L + I_Zmin; // in A
15 Vin_min = V_Z + (I*R_L); // in V
16 disp(Vin_min,"The minimum input voltage in V is");
17 I = I_L + I_Zmax; // in A
18 Vin_max = V_Z + I* R_L; // in V
19 disp(Vin_max,"The maximum input voltage in V is");

```

Scilab code Exa 3.13 Design a zener voltage regulator

```

1 // Exa 3.13
2 clc;
3 clear;
4 close;
5 // Given data
6 V_in1 = 18; // in V
7 V_in2 = 22; // in V
8 V_o = 6; // in V
9 I_L = 50; // in mA
10 I_L = I_L * 10^-3; // in A
11 I_Zmin = 5; // in mA
12 I_Zmin = I_Zmin * 10^-3; // in A
13 P_Z = 0.5; // in Watt
14 V_Z = 6; // in V
15 I_Zmax = P_Z / V_Z; // in A
16 disp(I_Zmax * 10^3, "Zener diode current in mA is");
17 R_S1 = (V_in2 - V_Z) / (I_L + I_Zmax); // in ohm
18 disp(R_S1, "The minimum value of Rs in ohm is");
19 R_S2 = (V_in1 - V_Z) / (I_L + I_Zmin); // in ohm
20 disp(R_S2, "The maximum value of Rs in ohm is");

```

Scilab code Exa 3.14 Range of Vi

```

1 // Exa 3.14
2 clc;
3 clear;
4 close;
5 // Given data
6 R_S = 91; // in ohm
7 V_Z = 8; // in V
8 P_Z = 400; // in mW
9 P_Z = P_Z * 10^-3; // in W
10 R_L = 0.22; // in K ohm
11 R_L = R_L * 10^3; // in ohm
12 I_L = V_Z / R_L; // in A

```

```

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

```

Scilab code Exa 3.15 The value of RS and RL

```

1 // Exa 3.15
2 clc;
3 clear;
4 close;
5 // Given data
6 V_L = 12; // in V
7 I_Lmin = 0; // in mA
8 I_Lmin = I_Lmin *10^-3; // in A
9 I_Lmax = 200; // in mA
10 I_Lmax = I_Lmax *10^-3; // in A
11 I_Zmin = 5; // in mA
12 I_Zmin = I_Zmin*10^-3; // in A
13 I_Zmax = 200; // in mA
14 I_Zmax = I_Zmax*10^-3; // in A
15 V_i = 16; // in V
16 V_Z = V_L; // in V
17 disp(V_Z,"The value of V_Z in V is");
18 R_Lmin = V_L/I_Lmax; // in ohm
19 disp(R_Lmin,"The minimum value of R_L in ohm is");
20 // R_L2 = V_L/I_Lmin; // in ohm
21 disp("The maximum value of R_L in ohm is");
22 disp("infinite")
23 I_Z = I_Zmin+I_Zmax; // in A
24 disp(I_Z*10^3,"The zener current in mA is");
25 P_Zmax = V_Z*I_Z; // in Watt

```

```

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

```

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

```

1 // Exa 3.16
2 clc;
3 clear;
4 close;
5 // Given data
6 V_in = 20; // in V
7 R_S = 220; // in ohm
8 V_Z = 10; // in V
9 P_Z = 400; // in mW
10 // Part (I)
11 R_L = 200; // in ohm
12 disp("Part (I) For R_L= 200 ")
13 V_L = V_Z; // in V
14 disp(V_L,"Load voltage in V is");
15 I_L = V_L/R_L; // in A
16 disp(I_L,"Load current in A is");
17 I_R = (V_in-V_Z)/R_S; // in A
18 disp(I_R,"The current through resistor in A is");
19 I_Z = I_R-I_L; // in A
20 disp(I_Z,"The value of I_Z in A is");
21 // Part (II)
22 R_L = 50; // in ohm
23 disp("Part (II) For R_L= 50 ")
24 V_L = V_Z; //
25 disp(V_L,"Load voltage in V is");
26 I_L = V_L/R_L; // in A
27 disp(I_L,"Load current in A is");
28 I_R = (V_in-V_Z)/R_S; // in A
29 disp(I_R,"The current through resistor in A is");

```



```

30 I_Z = I_R-I_L; // in A
31 disp(I_Z,"Zener current in A is");
32 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

```

1 // Exa 3.17
2 clc;
3 clear;
4 close;
5 // Given data
6 I_Zmin = 1; // in mA
7 I_Zmin=I_Zmin*10^-3; // in A
8 I_Zmax = 5; // in mA
9 I_Zmax=I_Zmax*10^-3; // in A
10 I_Lmin = 0; // in mA
11 I_Lmin=I_Lmin*10^-3; // in A
12 I_Lmax = 4; // in mA
13 I_Lmax=I_Lmax*10^-3; // in A
14 R = 5; // in kohm
15 R = R * 10^3; // in ohm
16 V_Z = 50; // in V
17 disp("Part (A)")
18 V_max = (I_Zmax+ I_Lmin)*R+V_Z; // in V
19 disp(V_max,"The maximum Voltage in V is");
20 V_min = (I_Zmin+I_Lmax)*R + V_Z; // in V
21 disp(V_min,"The minimum Voltage in V is");
22 disp("Part (B)")
23 V_L = 50; // in V
24 V_in = 75; // in V
25 R_L = 15; // in kohm
26 R_L= R_L*10^3; // in ohm

```

```

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

```

Scilab code Exa 3.18 Range of load currents

```

1 // Exa 3.18
2 clc;
3 clear;
4 close;
5 // Given data
6 V_S = 7.5; // in V
7 V_Z = 5; // in V
8 R_S = 4.75; // in ohm
9 I_Zmin= 0.05; // in A
10 I_Zmax=1.0; // in A
11 I_S = (V_S-V_Z)/R_S; // in A
12 I_Lmax= I_S-I_Zmin; // in A
13 disp(I_Lmax,"The maximum value of load current in A
    is : ")
14 // when
15 V_S= 10; // in V
16 I_S = (V_S-V_Z)/R_S; // in A
17 I_Lmin= I_S-I_Zmax; // in A
18 disp(I_Lmin,"The minimum value of load current in A
    is : ")
19 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

```
1 // Example 4.1
2 clc;
3 clear;
4 close;
5 // Given data
6 I_C= 0.9; // in mA
7 I_E=1; // in mA
8 alpha = I_C/I_E;
9 disp(alpha,"Current gain is : ")
10 // Formula I_E= I_B+I_C
11 I_B= I_E-I_C; // in mA
12 disp(I_B,"The base current in mA is : ")
```

Scilab code Exa 4.2 Base current

```
1 // Example 4.2
2 clc;
3 clear;
```

```

4 close;
5 // Given data
6 alpha= 0.97;
7 I_E=1;// in mA
8 // Formula alpha = I_C/I_E;
9 I_C= alpha*I_E;// in mA
10 // Formula I_E= I_B+I_C
11 I_B= I_E-I_C;// in mA
12 disp(I_B,"The base current in mA is : ")

```

Scilab code Exa 4.3 The value of bita

```

1 // Example 4.3
2 clc;
3 clear;
4 close;
5 // Given data
6 // Part (i)
7 a= 0.90;
8 B=a/(1-a);
9 disp(B,"At alpha= 0.90 , the value of Bita is : ")
10 // Part (ii)
11 a= 0.99;
12 B=a/(1-a);
13 disp(B,"At alpha= 0.99 , the value of Bita is : ")

```

Scilab code Exa 4.4 Alpha rating

```

1 // Example 4.4
2 clc;
3 clear;
4 close;
5 // Given data

```

```

6 bita= 50;
7 I_E= 10; // in mA
8 I_B= 200*10^-3; // in mA
9 alfa= bita/(1+bita)
10 disp(alfa,"The value of alfa is : ")
11 I_C= alfa*I_E; // in mA
12 disp(I_C,"The value of I_C in mA using the value of
    alpha is : ")
13 I_C= bita*I_B; // in mA
14 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

```

1 // Example 4.5
2 clc;
3 clear;
4 close;
5 // Given data
6 V_BB= 10; // in V
7 V_CC= 10; // in V
8 V_BE= 0.7; // in V
9 R_B= 1; // in M
10 R_B= R_B*10^6; // in
11 R_C= 2; // in k
12 R_C= R_C*10^3; // in
13 bita= 300;
14 I_B= (V_BB-V_BE)/R_B; // in A
15 I_C= bita*I_B; // in A
16 V_CE= V_CC-I_C*R_C; // in V
17 P_D= V_CE*I_C; // in W
18 disp(I_B*10^6,"The value of I_B in A is : ")
19 disp(I_C*10^3,"The value of I_C in mA is : ")
20 disp(V_CE,"The value of V_CE in volts is : ")
21 disp(P_D*10^3,"The value of P_D in mW is : ")

```

Scilab code Exa 4.6 Collector current

```
1 // Example 4.6
2 clc;
3 clear;
4 close;
5 // Given data
6 beta= 100;
7 V_BE= 0; // in V
8 V_BB= 15; // in V
9 R_B= 470; // in k
10 R_B= R_B*10^3; // in
11 V_CC= 15; // in V
12 R_C= 3.6; // in k
13 R_C= R_C*10^3; // in
14 I_B= (V_BB-V_BE)/R_B; // in A
15 I_C= beta*I_B; // in A
16 V_CE= V_CC-I_C*R_C; // in V
17 I_E= I_C+I_B; // in A
18 disp(I_B*10^6,"The base current in A is : ")
19 disp(I_C*10^3,"The collector current in mA is : ")
20 disp(V_CE,"The value of V_CE in volts is : ")
21 disp(I_E*10^3,"The emitter current in mA is ; ")
```

Scilab code Exa 4.7 Collector emitter voltage

```
1 // Example 4.7
2 clc;
3 clear;
4 close;
5 // Given data
```

```

6 bita= 100;
7 V_BE= 0.7; // in V
8 V_BB= 15; // in V
9 R_B= 470; // in k
10 R_B= R_B*10^3; // in
11 V_CC= 15; // in V
12 R_C= 3.6; // in k
13 R_C= R_C*10^3; // in
14 I_B= (V_BB-V_BE)/R_B; // in A
15 I_C= bita*I_B; // in A
16 V_CE= V_CC-I_C*R_C; // in V
17 disp(I_B*10^6,"The base current in A is : ")
18 disp(I_C*10^3,"The collector current in mA is : ")
19 disp(V_CE,"The value of V_CE in volts is : ")

```

Scilab code Exa 4.8 DC load line and operating point

```

1 // Example 4.8
2 clc;
3 clear;
4 close;
5 // Given data
6 V_CC= 15; // in V
7 V_BE= 0.7; // in V
8 R_C= 1; // in k
9 R_C= R_C*10^3; // in
10 R_E= 2; // in k
11 R_E= R_E*10^3; // in
12 R1= 10; // in k
13 R1= R1*10^3; // in
14 R2= 5; // in k
15 R2= R2*10^3; // in
16 V_CE= 0:0.1:V_CC
17 I_C= (V_CC-V_CE)/(R_C+R_E)*10^3; // in mA
18 plot(V_CE, I_C);

```

```

19 xlabel("V_CE in volts");
20 ylabel("I_C in mA");
21 title("DC load line");
22 V_B= V_CC*R2/(R1+R2); // in V
23 I_E= (V_B-V_BE)/R_E; // in A
24 I_C= I_E; // in A
25 I_CQ= I_C; // in A
26 V_CE= V_CC-I_C*(R_C+R_E); // in V
27 disp("Q-point is : "+string(V_CE)+" V, "+string(I_CQ
    *10^3)+" mA")
28 disp("DC load line shown in figure")

```

Scilab code Exa 4.9 Emitter current

```

1 // Example 4.9
2 clc;
3 clear;
4 close;
5 // Given data
6 V_BB= 1.8; // in V
7 V_BE= 0.7; // in V
8 R1= 10; // in k
9 R2= 2.2; // in k
10 R_E= 1; // in k
11 bita= 200;
12 R= R1*R2/(R1+R2); // in k
13 R=R*10^3; // in
14 R_E= R_E*10^3; // in
15 I_E= (V_BB-V_BE)/(R_E+R/bita); // in mA
16 disp(I_E*10^3,"The emitter current in mA is : ")
17 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

```
1 // Example 4.10
2 clc;
3 clear;
4 close;
5 // Given data
6 V_CC= 10; // in V
7 V_BE= 0.7; // in V
8 V_CE= 5; // in V
9 beta= 100;
10 I_C= 5; // in mA
11 // Applying KVL to collector circuit ,  $V_{CC}-V_{CE}-I_C \cdot R_C = 0$ 
12 R_C= (V_CC-V_CE)/I_C; // in k
13 disp(R_C,"The value of R_C in k is : ")
14 I_B= I_C/beta; // in mA
15 disp(I_B*10^3,"The value of I_B in A is : ")
16 // Applying KVL to base circuit ,  $V_{CC}-I_B \cdot R_B - V_{BE} = 0$ 
17 R_B= (V_CC-V_BE)/I_B; // in k
18 disp(R_B,"The value of R_B in k is : ")
19 // 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

```
1 // Example 4.11
2 clc;
3 clear;
4 close;
5 // Given data
6 V_CC= 6; // in V
```

```

7 V_BE= 0.7; // in V
8 bita= 100;
9 R_C= 2; // in k
10 R_C= R_C*10^3; // in
11 R_B= 530; // in k
12 R_B= R_B*10^3; // in
13 R1= 10; // in k
14 R1= R1*10^3; // in
15 R2= 5; // in k
16 R2= R2*10^3; // in
17 V_CE= 0:0.1:V_CC; // in V
18 I_C= (V_CC-V_CE)/(R_C)*10^3; // in mA
19 plot(V_CE,I_C);
20 xlabel("V_CE in volts");
21 ylabel("I_C in mA");
22 title("DC load line");
23 I_B= (V_CC-V_BE)/R_B; // in A
24 I_CQ= I_B*bita; // in A
25 V_CE= V_CC-I_CQ*R_C; // in V
26 disp("Q-point is : "+string(V_CE)+" V, "+string(I_CQ
    *10^3)+" mA")
27 disp("DC load line shown in figure")

```

Scilab code Exa 4.12 Operating point

```

1 // Example 4.12
2 clc;
3 clear;
4 close;
5 // Given data
6 V_CC= 12; // in V
7 V_BE= 0.7; // in V
8 bita= 100;
9 R_C= 10; // in k
10 R_C=R_C*10^3; // in

```

```

11 R_B= 100; // in
12 R_B=R_B*10^3; // in
13 I_BQ= (V_CC-V_BE)/((1+bita)*R_C+R_B); // in A
14 I_CQ= bita*I_BQ; // in A
15 V_CEQ= V_CC-(I_CQ+I_BQ)*R_C; // in volts
16 disp("Q-Point value for the circuit is "+string(
    V_CEQ)+" V and "+string(I_CQ*10^3)+" mA")
17 // For dc load line when
18 I_C=0;
19 V_CE= V_CC-(I_C+I_BQ)*R_C; // in V
20 disp(V_CE,"At I_C=0, the value of V_CE in volts is :
    ")
21 // When
22 V_CE= 0;
23 I_C= (V_CC-I_BQ*R_C)/R_C; // in A
24 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

```

1 // Example 4.13
2 clc;
3 clear;
4 close;
5 // Given data
6 V_BE= 0.7; // in V
7 V_CC= 15; // in V
8 V_CE= 5; // in V
9 I_C= 5; // in mA
10 I_C=I_C*10^-3; // in A
11 bita= 100;
12 I_B= I_C/bita; // in A
13 // Applying KVL to collector circuit , V_CC= (I_C+I_B
    )*R_C+V_CE
14 R_C= (V_CC-V_CE)/(I_C+I_B); // in

```

```

15 // Applying KVL to base circuit ,  $V_{CC} = (I_C + I_B) * R_C$ 
     $+ I_B * R_B + V_{BE}$ 
16  $R_B = (V_{CC} - V_{BE} - R_C * (I_C + I_B)) / I_B$ ; // in
17 disp( $R_C * 10^{-3}$ , "The value of  $R_C$  in k is : ")
18 disp( $R_B * 10^{-3}$ , "The value of  $R_B$  in k is : ")

```

Scilab code Exa 4.14 The value bita VCC and RB

```

1 // Example 4.14
2 clc;
3 clear;
4 close;
5 // Given data
6  $I_B = 20 * 10^{-6}$ ; // in A
7  $V_{CE} = 7.3$ ; // in V
8  $V_{BE} = 0.6$ ; // in V
9  $V_E = 2.1$ ; // in V
10  $R_E = 0.68 * 10^3$ ; // in
11  $R_C = 2.7 * 10^3$ ; // in
12  $I_E = V_E / R_E$ ; // in A
13  $I_C = I_E$ ; // in A (approx)
14 bita = round( $I_C / I_B$ );
15  $V_{CC} = V_{CE} + I_C * R_C + I_E * R_E$ ; // in V
16 // From  $V_{CC} = I_B * R_B + V_{BE} + V_E$ 
17  $R_B = (V_{CC} - (V_{BE} + V_E)) / I_B$ ; // in
18 disp(bita, "The value of bita is : ")
19 disp( $V_{CC}$ , "The value of  $V_{CC}$  in volts is : ")
20 disp( $R_B * 10^{-3}$ , "The value of  $R_B$  in k is : ")
21
22 // 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

```
1 // Exa 4.15
2 clc;
3 clear;
4 close;
5 // Given data
6 V_CC = 18; // in V
7 bita = 90;
8 R_C = 2.2 * 10^3; // in ohm
9 R_E = 1.8*10^3; // in ohm
10 R_B = 510*10^3; // in ohm
11 I_B = V_CC / ( (bita*(R_C+R_E))+R_B ); // in A
12 I_C = bita*I_B; // in A
13 disp(I_C*10^3, "The value of I_C in mA is");
14 V_CE = I_B*R_B; // in V
15 disp(V_CE, "The value of V_CE in V is");
```

Scilab code Exa 4.16 Value of IBQ and ICQ

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

```

16 I_CQ = beta*I_BQ; // in A
17 disp(I_CQ*10^3,"The value of I_CQ in mA is");
18 V_CEQ = V_CC - (I_C*R_C); // in V
19 disp(V_CEQ,"The value of V_CEQ in V is");
20 V_B = V_BE; // in V
21 disp(V_B,"The value of V_B in V is");
22 V_BC = V_B -V_CEQ; // in V
23 disp(V_BC,"The voltage in V is");
24
25 // 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

```

1 // Exa 4.17
2 clc;
3 clear;
4 close;
5 // Given data
6 V_CC = 18; // in V
7 V_BE = 0.7; // in V
8 R_C = 3.3; // in kohm
9 R_C = R_C * 10^3; // in ohm
10 R_B = 210; // in kohm
11 R_B = R_B * 10^3; // in ohm
12 beta = 75;
13 R_C = 3.3; // in kohm
14 R_C = R_C * 10^3; // in ohm
15 R_E = 510; // in ohm
16 I_B = (V_CC-V_BE)/( R_C+R_B+beta*(R_C+R_E) ); // A
17 disp(round(I_B*10^6),"The value of I_B in A is");
18 I_C = beta*I_B; // in A
19 disp(I_C*10^3,"The value of I_C in mA is : ")
20 V_C = V_CC - (I_C*R_C); // in V

```

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

Scilab code Exa 4.18 Value of VCC RB and RC

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

Scilab code Exa 4.19 VCE for the voltage divider bias configuration

```
1 // Exa 4.19
2 clc;
3 clear;
4 close;
5 // Given data
6 R1 = 47; // in kohm
7 R1= R1*10^3; // in ohm
8 R2 = 10; // in kohm
9 R2= R2*10^3; // in ohm
10 R_E = 1.1; // in kohm
11 R_E = R_E * 10^3; // in ohm
12 R_C = 2.4; // in kohm
```

```

13 R_C = R_C * 10^3; // in ohm
14 V_CC = -18; // in V
15 V_B = (R2*V_CC)/(R1+R2); // in V
16 V_BE = -0.7; // in V
17 V_E = V_B - V_BE; // in V
18 I_E = abs(V_E)/R_E; // in A
19 V_CE = V_CC + (I_E)*(R_C+R_E); // in V
20 disp(V_B,"The value of V_B in volts is : ");
21 disp(I_E*10^3,"The value of I_E in mA is : ");
22 disp(V_CE,"The value of V_CE in V is");

```

Scilab code Exa 4.20 Value of IB and IC

```

1 // Exa 4.20
2 clc;
3 clear;
4 close;
5 // Given data
6 V_BE = 0.8; // in V
7 V_CE = 0.2; // in V
8 V1 = 5; // in V
9 R_B = 50; // in kohm
10 R_B = R_B*10^3; // in ohm
11 R_C = 3; // in K ohm
12 R_C = R_C * 10^3; // in ohm
13 bita = 100;
14 R_E = 2; // in kohm
15 R_E = R_E*10^3; // in ohm
16 I_B = (V1-V_BE)/(R_B+(1+bita)*R_E); // in A
17 disp(I_B*10^6,"The value of I_B in A is");
18 V_CC = 10; // in V
19 I_Csat = (V_CC - V_CE - (I_B*R_E))/(R_C+R_E); // in A
20 disp(I_Csat*10^3,"The value of I_C(sat) in mA is");
21 I_Bmin = I_Csat /bita; // in A
22 disp(I_Bmin*10^6,"The minimum value of I_B in A is

```



```

        : ");
23
24 // 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

```

1 // Exa 4.21
2 clc;
3 clear;
4 close;
5 // Given data
6 R1 = 5; // in kohm
7 R1= R1*10^3; // in ohm
8 R2 = 5; // in kohm
9 R2= R2*10^3; // in ohm
10 R_B = R1*R2/(R1+R2); // in ohm
11 R_E = 1; // in kohm
12 R_E = R_E * 10^3; // in ohm
13 V_EE = 3; // in V
14 V_Th = (R2*V_EE)/(R1+R2); // in V
15 V_BE = 0.7; // in V
16 bita = 44;
17 I_B = (V_EE - V_BE - V_Th)/((1+bita)*R_E)+R_B); //
    in A
18 I_BQ = I_B; // in A
19 disp(I_BQ*10^6,"The value of I_BQ in A is");
20 I_C = bita*I_BQ; // in A
21 disp(I_C*10^3,"The value of I_C in mA is");
22 I_E = (1+bita)*I_B; // in A
23 disp(I_E*10^3,"The value of I_E in mA is");
24 V_EC = (I_E*R_E)-V_EE; // in V
25 disp(V_EC,"The value of V_EC in V is");
26 disp("Q-point is "+string(V_EC)+" V, "+string(I_C

```

*10³)+” mA”)

Scilab code Exa 4.22 The region of operation

```
1 // Exa 4.22
2 clc;
3 clear;
4 close;
5 // Given data
6 V_BE = 0.7; // in V
7 V_BB = 5; // in V
8 R_B = 100; // in kohm
9 R_B = R_B * 103; // in ohm
10 R_E = 2; // in kohm
11 R_E = R_E * 103; // in ohm
12 beta = 100;
13 I_B = (V_BB - V_BE) / ( R_B + ((1 + beta) * R_E) ); // in A
14 disp(I_B * 103, "The value of I_B in mA is");
15 V_B = V_BB - (I_B * 10-3 * R_B); // in V
16 I_C = beta * I_B; // in A
17 disp(I_C * 103, "The value of I_C in mA is");
18 V_CC = 10; // in V
19 V_C = V_CC - (I_C * R_E); // in V
20 disp(V_C, "The voltage in V is");
21 disp("Transistor is in active region is valid")
```

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

```
1 // Exa 4.23
2 clc;
3 clear;
4 close;
5 // Given data
```

```

6 V_CC = 20; // in V
7 V_BE = 0.7; // in V
8 R_B = 430; // in kohm
9 R_B = 430 * 10^3; // in ohm
10 bita = 50;
11 R_E = 1; // in kohm
12 R_E = R_E * 10^3; // in ohm
13 R_C = 2; // in kohm
14 R_C = R_C * 10^3; // in ohm
15 I_B = (V_CC - V_BE)/(R_B +(1+bita)*R_E); // in A
16 disp(I_B*10^6,"The base current in A is");
17 I_C = bita*I_B; // in A
18 disp(I_C*10^3,"The collector current in mA is");
19 V_CE = V_CC - I_C*(R_C+R_E); // in V
20 disp(V_CE,"The value of V_CE in V is");
21 V_C = V_CC - (I_C*R_C); // in V
22 disp(V_C,"The value of V_C in V is");
23 V_E = V_C - V_CE; // in V
24 disp(V_E,"The value of V_E in V is");
25 V_B = V_BE+V_E; // in V
26 disp(V_B,"The value of V_B in V is : ")
27 V_BC = V_B-V_C; // in V
28 disp(V_BC,"The value of V_BC in V is");

```

Scilab code Exa 4.24 Value of ICQ and VCEQ

```

1 // Exa 4.24
2 clc;
3 clear;
4 close;
5 // Given data
6 V_CC = 20; // in V
7 V_BE = 0.7; // in V
8 R_B = 680; // in kohm
9 R_B = R_B * 10^3; // in ohm

```

```

10 R_C = 4.7; // in kohm
11 R_C = R_C * 10^3; // in ohm
12 bita = 120;
13 I_B = (V_CC - V_BE)/(R_B+bita*R_C); // in A
14 I_CQ = bita*I_B; // in A
15 disp(I_CQ*10^3,"The value of I_CQ in mA is");
16 V_CEQ = V_CC - (I_CQ*R_C); // in V
17 disp(V_CEQ,"The value of V_CEQ in V is");
18 V_B = V_BE; // in V
19 V_C = 11.26; // in V
20 V_E = 0; // in V
21 disp(V_E,"The value of V_E in V is");
22 V_BC = V_B - V_C; // in V
23 disp(V_BC,"The value of V_BC in V is");

```

Scilab code Exa 4.25 IB IC and VC

```

1 // Exa 4.25
2 clc;
3 clear;
4 close;
5 // Given data
6 V_CC = 16; // in V
7 V_BE = 0.7; // in V
8 R_B = 470; // in kohm
9 R_B= R_B*10^3; // in ohm
10 bita = 120;
11 R_C = 3.6; // in kohm
12 R_C= R_C*10^3; // in ohm
13 R_E = 0.51; // in kohm
14 R_E= R_E*10^3; // in ohm
15 I_B = (V_CC - V_BE)/(R_B+bita*(R_C+R_E)); // in A
16 disp(I_B*10^6,"The base current in A is");
17 I_C = bita*I_B; // in A
18 disp(I_C*10^3,"The collector current in mA is");

```

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

Scilab code Exa 4.26 ICQ and VCEQ

```
1 // Exa 4.26
2 clc;
3 clear;
4 close;
5 // Given data
6 V_CC = 10; // in V
7 V_BE = 0.7; // in V
8 R_B = 250; // in kohm
9 R_B= R_B*10^3; // in ohm
10 bita = 90;
11 R_C = 4.7; // in kohm
12 R_C= R_C*10^3; // in ohm
13 R_E = 1.2; // in kohm
14 R_E= R_E*10^3; // in ohm
15 I_BQ = (V_CC - V_BE)/(R_B + bita*(R_C+R_E)); // in A
16 disp(I_BQ*10^6,"The base current at Q-point in A
    is");
17 I_CQ = bita*I_BQ; // in A
18 disp(I_CQ*10^3,"The collector current at Q-point in
    mA is");
19 V_CEQ = V_CC - (I_CQ*(R_C+R_E)); // in V
20 disp(V_CEQ,"Collector emitter voltage at Q point in
    V is");
```

Scilab code Exa 4.27 Range of possible value for VC

```
1 // Exa 4.27
2 clc;
```

```

3 clear;
4 close;
5 // Given data
6 V_CC = 12; // in V
7 V_BE = 0.7; // in V
8 R_B = 150; // in kohm
9 R_B= R_B*10^3; // in ohm
10 bita = 180;
11 R_C = 4.7; // in kohm
12 R_C= R_C*10^3; // in ohm
13 R_E = 3.3; // in kohm
14 R_E= R_E*10^3; // in ohm
15 I_B = (V_CC-V_BE)/(R_B + bita*(R_C+R_E)); // in A
16 disp(I_B*10^6,"The base current in A is");

```

Scilab code Exa 4.28 Value of V_E I_C V_C and I_B

```

1 // Exa 4.28
2 clc;
3 clear;
4 close;
5 // Given data
6 V_B = 4; // in V
7 V_BE = 0.7; // in V
8 R_E = 1.2; // in kohm
9 R_E= R_E*10^3; // in ohm
10 V_E = V_B-V_BE; // in V
11 R_C = 2.2; // in kohm
12 R_C= R_C*10^3; // in ohm
13 R_B= 330; // in kohm
14 R_B= R_B*10^3; // in ohm
15 bita = 180;
16 I_B = 7.11 * 10^-6; // in A
17 V_CC = 18; // in V
18 disp("Part (a)")

```

```

19 disp(V_E,"The value of V_E in V is");
20 I_C = V_E/R_E;// in A
21 disp("Part (b)")
22 disp(I_C*10^3,"The value of I_C in mA is : ")
23 V_C =V_CC - (I_C*R_C);// in V
24 disp("Part (c)")
25 disp(V_C,"The value of V_C in V is");
26 V_CE = V_C-V_E;// in V
27 disp("Part (d)")
28 disp(V_CE,"The value of V_CE in V is : ")
29 //I_C = beta*I_B;// in A
30 //disp(I_C*10^3,"The value of I_C in mA is : ")
31 //V_CC= 12;// in V
32 //R_C = 4.7;// in kohm
33 //R_C= R_C*10^3;// ohm
34 //V_C = V_CC - (I_C*R_C);// in V
35 //disp(V_C,"The value of V_C in V is");
36 //R_B = 1.15*10^6;// in ohm
37 //R_E = 3.3*10^3;// in ohm
38 //I_B = (V_CC - V_BE)/(R_B + beta*(R_C+R_E));// in A
39 //disp(I_B*10^6,"The value of I_B in A is : ")
40 //I_C = beta*I_B;// in A
41 //disp(I_C*10^3,"The value of I_C in mA is : ")
42 //V_C = V_CC - (I_C * R_C);// in V
43 //disp(V_C,"The value of V_C in V is : ")
44 //disp("We conclude that collector voltage V_C
    varies from 5.98 V to 8.30 V");
45 //disp("Part (e)")
46 I_B = (V_CC - (I_C*R_C) - V_BE - V_E)/R_B;// in A
47 disp(I_B*10^6,"Base current in A is");
48 beta = I_C/I_B;
49 disp(beta,"Current gain is");

```

Scilab code Exa 4.29 Base current

```
1 // Exa 4.29
2 clc;
3 clear;
4 close;
5 // Given data
6 I_E = 10; // in mA
7 I_C = 9.95; // in mA
8 I_B = I_E - I_C; // in mA
9 disp(I_B, "The base current in mA is");
```

Scilab code Exa 4.30 Current gain

```
1 // Exa 4.30
2 clc;
3 clear;
4 close;
5 // Given data
6 I_C = 10; // in mA
7 I_B = 0.1; // in mA
8 bita = I_C / I_B;
9 disp(bita, "The current gain is");
```

Scilab code Exa 4.31 Base current

```
1 // Exa 4.31
2 clc;
3 clear;
4 close;
5 // Given data
6 V_BE = 0.7; // in V
7 V_BB = 10; // in V
8 R_B = 470; // in kohm
9 R_B = R_B * 10^3; // in ohm
```



```

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

```

Scilab code Exa 4.32 Collector emitter voltage

```

1 // Exa 4.32
2 clc;
3 clear;
4 close;
5 // Given data
6 V_BB = 10; // in V
7 V_BE = 0; // in V
8 R_B = 470; // in kohm
9 R_B = R_B * 10^3; // in ohm
10 I_B = (V_BB - V_BE)/R_B; // in A
11 beta = 200;
12 I_C = beta*I_B; // in A
13 V_CC = 10; // in V
14 R_C = 820; // in ohm
15 V_CE = V_CC - (I_C*R_C); // in V
16 disp("Part (a) : For ideal approximation")
17 disp(V_CE,"The collector emitter voltage in V is");
18 P_D = V_CE * I_C; // in W
19 disp(P_D*10^3,"Power dissipation in mW is");
20 disp("Part (b) : For second approximation")
21 V_BE = 0.7; // in V
22 I_B = (V_BB-V_BE)/R_B; // in A
23 I_C = beta*I_B; // in A
24 V_CE = V_CC - (I_C*R_C); // in V
25 disp(V_CE,"The collector emitter voltage in V is");
26 P_D = V_CE * I_C; // in W
27 disp(P_D*10^3,"Power dissipation in mW is");

```

Scilab code Exa 4.33 Collector emitter voltage

```
1 // Exa 4.33
2 clc;
3 clear;
4 close;
5 // Given data
6 V_BE = 0; // in V
7 V_BB = 12; // in V
8 R_B = 680; // in kohm
9 R_B = R_B * 10^3; // in ohm
10 I_B = (V_BB - V_BE) / R_B; // in A
11 beta_dc = 175;
12 I_C = beta_dc * I_B; // in A
13 V_CC = 12; // in V
14 R_C = 1.5; // in kohm
15 R_C = R_C * 10^3; // in ohm
16 V_CE = V_CC - (I_C * R_C); // in V
17 disp("Part (a) For ideal approximation")
18 disp(V_CE, "The collector emitter voltage in V is");
19 P_D = V_CE * I_C; // in mW
20 disp(P_D * 10^3, "Transistor power in mW is");
21 disp("Part (b) For second approximation")
22 V_BE1 = 0.7; // in V
23 I_B = (V_BB - V_BE1) / R_B; // in A
24 I_C = beta_dc * I_B; // in A
25 V_CE = V_CC - (I_C * R_C); // in V
26 disp(V_CE, "Collector emitter voltage in V is");
27 P_D = V_CE * I_C; // in W
28 disp(P_D * 10^3, "Power dissipation in mW is");
```

Scilab code Exa 4.34 Load line

```
1 // Exa 4.34
2 clc;
```

```

3 clear;
4 close;
5 // Given data
6 V_CC = 20; // in V
7 R_C = 3.3; // in kohm
8 R_C = R_C * 10^3; // in ohm
9 I_C = V_CC/R_C; // in A
10 disp(I_C*10^3,"Collector current in mA is");
11 V_CE = V_CC; // in V
12 disp(V_CE,"Collector emitter voltage in V is");
13 V_CE=0:0.1:20 ; // in V
14 I_C= (V_CC-V_CE)/(R_C*10^-3); // in mA
15 plot(V_CE,I_C);
16 xlabel("V_CE in volts")
17 ylabel("I_C in mA")
18 title("DC load line")
19 disp("DC load line shown in figure")

```

Scilab code Exa 4.35 Voltage between collector and ground

```

1 // Exa 4.35
2 clc;
3 clear;
4 close;
5 // Given data
6 V_BB = 10; // in V
7 V_BE = 0.7; // in V
8 R_B = 1; // in kohm
9 R_B = 1 * 10^6; // in ohm
10 I_B = (V_BB-V_BE)/R_B; // in A
11 disp(I_B*10^6,"The base current in A is");
12 beta_dc = 200;
13 I_C = beta_dc * I_B; // in A
14 disp(I_C*10^3,"The collector current in mA is");
15 V_CC = 20; // in V

```

```

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

```

Scilab code Exa 4.36 Voltage between collector and ground

```

1 // Exa 4.36
2 clc;
3 clear;
4 close;
5 // Given data
6 V_BB = 5; // in V
7 V_BE = 0.7; // in V
8 R_B = 680; // in kohm
9 R_B = 680*10^3; // in ohm
10 I_B = (V_BB-V_BE)/R_B; // in A
11 disp(I_B*10^6,"The base current in A is : ")
12 beta_dc= 150;
13 I_C = beta_dc * I_B; // in A
14 disp(I_C*10^3,"The collector current in mA is");
15 V_CC = 5; // in V
16 R_C = 470; // in ohm
17 V_CE = V_CC-(I_C*R_C); // in V
18 disp(V_CE,"Voltage between collector and ground in V
    is ");

```

Scilab code Exa 4.37 Collector voltage

```

1 // Exa 4.37
2 clc;
3 clear;
4 close;

```

```

5 // Given data
6 V_BB = 2.5; // in V
7 V_BE = 0.7; // in V
8 V_E = V_BB - V_BE; // in V
9 disp(V_E, "The emitter voltage in V is");
10 R_E = 1.8; // in kohm
11 R_E = R_E * 10^3; // in ohm
12 I_E = V_E / R_E; // in A
13 I_C = I_E; // in A
14 V_CC = 20; // in V
15 R_C = 10; // in kohm
16 R_C = R_C * 10^3; // in ohm
17 V_C = V_CC - (I_C * R_C); // in V
18 disp(V_C, "The collector voltage in V is");

```

Scilab code Exa 4.38 Emitter voltage

```

1 // Exa 4.38
2 clc;
3 clear;
4 close;
5 // Given data
6 V_CC = 25; // in V
7 R2 = 2.2; // in kohm
8 R1 = 10; // in kohm
9 V_BB = (V_CC * R2) / (R1 + R2); // in V
10 V_BE = 0.7; // in V
11 V_E = V_BB - V_BE; // in V
12 disp(V_E, "The emitter voltage in V is");
13 R_E = 1; // in kohm
14 R_E = R_E * 10^3; // in ohm
15 I_E = V_E / R_E; // in A
16 I_C = I_E; // in A
17 V_CC = 25; // in V
18 R_C = 3.6; // in kohm

```

```

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

```

Scilab code Exa 4.39 Q point

```

1 // Exa 4.39
2 clc;
3 clear;
4 close;
5 // Given data
6 V_BB = 4.50; // in V
7 V_E = 3.8; // in V
8 V_C = 11.32; // in V
9 I_C = 3.8; // in mA
10 I_C=I_C*10^-3; // in A
11 V_BE = 0.7; // in V
12 R1 = 10; // in kohm
13 R2 = 2.2; // in kohm
14 R_B = (R1*R2)/(R1+R2); // in kohm
15 R_B = R_B * 10^3; // in ohm
16 I_B = (V_BB-V_BE)/R_B; // in A
17 disp(I_B*10^3,"The base current in mA is");
18 V_CE = V_C-V_E; // in V
19 disp(V_CE,"Collector emitter voltage in V is");
20 disp("Thus the Q-point is : "+string(V_CE)+" V, "+
      string(I_B*10^3)+" mA" ) ;
21
22 // 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

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

Scilab code Exa 5.2 Voltage gain

```
1 // Exa 5.2
2 clc;
```

```

3 clear;
4 close;
5 // Given data
6 R_C= 3.6*10^3; // in ohm
7 R_L= 10*10^3; // in ohm
8 r_c = (R_C*R_L)/(R_C+R_L); // in ohm
9 V_CC = 10; // in V
10 V_BE = 0.7; // in V
11 R_E = 1; // in kohm
12 R_E = R_E * 10^3; // in ohm
13 R1 = 10; // in kohm
14 R1= R1*10^3; // in ohm
15 R2 = 2.2; // in kohm
16 R2= R2*10^3; // in ohm
17 V_B = (V_CC*R2)/(R1+R2); // in V
18 I_E = (V_B-V_BE)/R_E; // in A
19 V = 25*10^-3; // in V // only value is given in the
    book
20 r_e = V/I_E; // in ohm
21 A_V = round(r_c/r_e);
22 disp(A_V,"The voltage gain is");
23 V_in = 2; //in mV
24 V_out = A_V*V_in; // in mV
25 disp(V_out,"The output voltage in mV is");

```

Scilab code Exa 5.3 Output voltage

```

1 // Exa 5.3
2 clc;
3 clear;
4 close;
5 // Given data
6 A_V = 117;
7 r_e = 22.7; // in ohm
8 bita = 300;

```



```

 9 Zin_base = beta*r_e;// in ohm
10 R1 = 2.2*10^3;// in ohm
11 R2 = 10*10^3;// in ohm
12 Zin_stage = (Zin_base*R1*R2)/(Zin_base*R1+R1*R2+R2*
    Zin_base);// in ohm
13 R = 600;// in ohm
14 V = 2;// in mV
15 V_in = (Zin_stage/(R+Zin_stage))*V;// in mV
16 V_out = A_V * V_in;// in mV
17 disp(round(V_out),"The output voltage in mV is");

```

Scilab code Exa 5.4 Input impedance

```

1 // Exa 5.4
2 clc;
3 clear;
4 close;
5 // Given data
6 R1 = 4.3;// in K ohm
7 R1= R1*10^3;// in ohm
8 R2 = 10;// in K ohm
9 R2= R2*10^3;// in ohm
10 r_e = (R1*R2)/(R1+R2);// in ohm
11 beta = 200;
12 V=25;// in mV
13 I= 1;// in mA
14 r_e_desh= V/I;// in ohm
15 Zin_base = beta*(r_e + r_e_desh);// in ohm
16 disp(Zin_base*10^-3,"The input impedance of the base
    in k is : ")
17 R3 = 10*10^3;// in ohm
18 Zin_stage = (R2*R3*Zin_base)/(R2*Zin_base+R3*
    Zin_base+R2*R3);// in ohm
19 disp(Zin_stage*10^-3,"The input impedance of the
    stage in k is");

```

```

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

```

Scilab code Exa 5.5 Value of RB

```

1 // Exa 5.5
2 clc;
3 clear;
4 close;
5 // Given data
6 V_CE = 0.2; // in V
7 V_BE= 0.7; // in V
8 R = 1; // in kohm
9 R = R * 10^3; // in ohm
10 V = 10; // in V
11 I_C = (V-V_CE)/R; // in A
12 beta_min = 50;
13 I_B = I_C/beta_min; // in A
14 I_B1 = V*I_B; // in A
15 V1 = 5; // in V
16 R_B = (V1-V_BE)/I_B1; // in ohm
17 disp(R_B*10^-3,"The base resistance in k is");

```

Scilab code Exa 5.6 Lowest frequency

```

1 // Exa 5.6
2 clc;
3 clear;

```

```

4 close;
5 // Given data
6 R = 10; // in K ohm
7 R = R * 10^3; // in ohm
8 X_C = 0.1 * R;
9 C = 47; // in F
10 C = C * 10^-6; // in F
11 f = 1/(2*pi * X_C * C) ; // in Hz
12 disp(f,"Lowest frequency in Hz is");

```

Scilab code Exa 5.7 Lowest frequency

```

1 // Exa 5.7
2 clc;
3 clear;
4 close;
5 // Given data
6 C = 220; // in F
7 C = C * 10^-6; // in F
8 R1 = 10; // in kohm
9 R1 = R1 * 10^3; // in ohm
10 R2 = 2.2; // in kohm
11 R2 = R2 * 10^3; // in ohm
12 R_TH = (R1*R2)/(R1+R2); // in ohm
13 X_C = 0.1*R_TH; // in ohm
14 f = 1/(2*pi*C*X_C); // in Hz
15 disp(f,"The lowest frequency in Hz is");

```

Scilab code Exa 5.8 AC beta

```

1 // Exa 5.8
2 clc;
3 clear;

```

```

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

```

Scilab code Exa 5.9 Output voltage

```

1 // Exa 5.9
2 clc;
3 clear;
4 close;
5 // Given data
6 R_C = 3.6; // in kohm
7 R_C = R_C * 10^3; // in ohm
8 R_L = 10; // in kohm
9 R_L = R_L * 10^3; // in ohm
10 R_TH = (R_C * R_L) / (R_C + R_L); // in ohm
11 V_CC = 10; // in V
12 R2 = 2.2; // in kohm
13 R2 = R2 * 10^3; // in ohm
14 R1 = 10; // in kohm
15 R1 = R1 * 10^3; // in ohm
16 V_BE = 0.7; // in V
17 V_B = (V_CC * R2) / (R1 + R2); // in V
18 R_E = 1; // in kohm
19 R_E = R_E * 10^3; // in ohm
20 I_E = (V_B - V_BE) / R_E; // in A
21 V1 = 25; // in mV
22 V1 = V1 * 10^-3; // in V
23 r_e = V1 / (I_E); // in ohm
24 A_v = (R_TH) / r_e;

```

```

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

```

Scilab code Exa 5.10 Voltage gain

```

1 // Exa 5.10
2 clc;
3 clear;
4 close;
5 // Given data
6 R_L = 10; // in kohm
7 R_L = R_L*10^3; // in ohm
8 R_C = 3.6; // in kohm
9 R_C = R_C*10^3; // in ohm
10 r_e_desh = 22.73; // in ohm
11 R_L_desh = R_L/2; // in ohm
12 A_v = ((R_C*R_L_desh)/(R_C+R_L_desh))/r_e_desh;
13 disp(A_v,"The voltage gain is");

```

Scilab code Exa 5.11 Input impedance

```

1 // Exa 5.11
2 clc;
3 clear;
4 close;
5 // Given data
6 R_E = 1; // in kohm
7 R_E = R_E * 10^3; // in ohm
8 R_L = 3.3; // in kohm
9 R_L = R_L * 10^3; // in ohm
10 r_e = (R_E*R_L)/(R_E+R_L); // in ohm

```

```

11 V_CC = 15; // in V
12 R2 = 2.2; // in K ohm
13 R2 = R2 * 10^3; // in ohm
14 R1 = R2; // in ohm
15 V_B = (V_CC*R2)/(R1+R2); // in V
16 V_BE = 0.7; // in V
17 R_E = 1; // in K ohm
18 R_E = R_E * 10^3; // in ohm
19 I_E = (V_B-V_BE)/R_E; // in A
20 V1 = 25*10^-3; // in V
21 r_e1 = V1/I_E;
22 bita = 200;
23 Zin_base = bita*(r_e+r_e1); // in ohm
24 disp(Zin_base*10^-3,"The input impedance of the base
    in k is : ")
25 Zin_stage = (R1*R2*Zin_base)/(R1*R2+R2*Zin_base+R1*
    Zin_base); // in ohm
26 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

```

1 // Exa 5.12
2 clc;
3 clear;
4 close;
5 // Given data
6 r_e = 767.44;
7 r_e1 = 3.68;
8 V_in = 1; // in V
9 A_v = round(r_e/(r_e+r_e1));
10 disp(A_v,"The voltage gain is : ")
11 V_o = A_v*V_in; // in V
12 disp(V_o,"The load voltage in V is");

```

Chapter 6

Field Effect Devices

Scilab code Exa 6.1 Drain voltage

```
1 // Exa 6.1
2 clc;
3 clear;
4 close;
5 // Given data
6 V_D = 10; // in V
7 R = 10*10^3; // in ohm
8 I_D = V_D/R; // in A
9 V_P = 4; // in V
10 I_DSS = 10; // in mA
11 I_DSS = I_DSS * 10^-3; // in A
12 R_DS = V_P/I_DSS; // in ohm
13 V_D = (R_DS/(R+R_DS))*V_D; // in V
14 disp(V_D,"The drain voltage in V is");
```

Scilab code Exa 6.2 Drain voltage

```
1 // Exa 6.2
```

```

2  clc;
3  clear;
4  close;
5  // Given data
6  V_P = 4; // in V
7  I_DSS = 10; // in mA
8  I_DSS = I_DSS * 10^-3; // in A
9  R_DS = V_P / I_DSS; // in ohm
10 V_DD = 30; // in V
11 I_D = 2.5; // in mA
12 R_D = 2; // in kohm
13 V_D = V_DD - (I_D * R_D); // in V
14 disp(V_D, "The drain voltage in V is");

```

Scilab code Exa 6.3 DC load line and operating point

```

1  // Exa 6.3
2  clc;
3  clear;
4  close;
5  // Given data
6  R2 = 1; // in M ohm
7  R2 = R2 * 10^6; // in ohm
8  R1 = 2; // in M ohm
9  R1 = R1 * 10^6; // in ohm
10 V_DD = 30; // in V
11 R_D = 1 * 10^3; // in ohm
12 V_G = (R2 / (R1 + R2)) * V_DD; // in V
13 R_S = 2 * 10^3; // in ohm
14 I_D = V_G / R_S; // in A
15 V_D = V_DD - I_D * R_D; // in V
16 V_DS = V_D - V_G; // in V
17 R_D = R_D + R_S; // in ohm
18 I_Dsat = V_DD / R_D * 10^3; // in mA
19 disp(I_D * 10^3, "The value of I_D in mA is : ")

```



```

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

```

Scilab code Exa 6.4 Drain current

```

1 // Exa 6.4
2 clc;
3 clear;
4 close;
5 // Given data
6 V_DD = 15;// in V
7 R = 3;// in kohm
8 I_D = V_DD/R;// in mA
9 R_D = 1;// in kohm
10 V_D = V_DD - (I_D*R_D);// in V
11 disp(V_D,"The drain voltage in V is");

```

Scilab code Exa 6.5 Output voltage

```

1 // Exa 6.5
2 clc;
3 clear;
4 close;
5 // Given data
6 R_D = 3.6;// in K ohm

```

```

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

```

Scilab code Exa 6.6 Minimum value of VDS

```

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

```

Scilab code Exa 6.7 Drain current

```

1 // Exa 6.7
2 clc;
3 clear;
4 close;
5 // Given data
6 I_DSS = 8.4; // in mA
7 I_DSS= I_DSS*10^-3; // in A
8 V_P = -3; // in V
9 V_GS = -1.5; // in V

```

```

10 I_D = I_DSS*( 1-(V_GS/V_P) )^2; // in A
11 disp(I_D*10^3,"The drain current in mA is");
12 V_GS1 = 0; // in V
13 g_mo = -( (2*I_DSS)/V_P ); // in A/V
14 g_m = g_mo*(1-(V_GS/V_P)); // in A/V
15 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

```

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

```

Scilab code Exa 6.9 Gate source voltage

```

1 // Exa 6.9
2 clc;
3 clear;
4 close;
5 // Given data
6 I_DSS = -40; // in mA
7 V_P = 5; // in V

```

```

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

```

Scilab code Exa 6.10 Value of ID and VGS

```

1 // Exa 6.10
2 clc;
3 clear;
4 close;
5 // Given data
6 I_DSS = 4; // in mA
7 I_DSS= I_DSS*10^-3; // in A
8 V_P = -4; // in V
9 V_GG = -2; // in V
10 V_GS = V_GG; // in V
11 disp(V_GS,"The value of V_GS in V is");
12 I_D = I_DSS*(1-(V_GS/V_P))^2; // in A
13 disp(I_D*10^3,"The value of I_D in mA is");
14 V_DD = 10; // in V
15 R_D = 5; // in kohm
16 R_D = R_D * 10^3; // in ohm
17 V_DS = V_DD - (I_D*R_D); // in V
18 disp(V_DS,"The value of V_DS in V is");

```

Scilab code Exa 6.11 Value of IDQ VD VS and VDS

```

1 // Exa 6.11
2 clc;
3 clear;
4 close;
5 // Given data
6 V_DD= 20; // in V

```

```

7 R1= 2.1*10^6; // in
8 R2= 270*10^3; // in
9 R_D= 4.7; // in k
10 R_S= 1.5; // in k
11 I_DSS= 8; // in mA
12 V_P= -4; // in V
13 V_G= V_DD*R2/(R1+R2); // in V
14 // V_GS= V_G-R_S*I_D (as V_S= I_D*R_S) and
15 // I_D= I_DSS*(1-V_GS/V_P)^2; // in A
16 // I_D= I_DSS*(1-(V_G-R_S*I_D)/V_P)^2; // in mA or
17 // 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)
18 a= I_DSS*R_S^2/V_P^2; // assumed
19 b= 2*R_S*I_DSS/V_P-2*V_G*R_S*I_DSS/V_P^2-1; //
    assumed
20 c= I_DSS*(1+V_G^2/V_P^2-2*V_G/V_P); // assumed
21 root= [a b c];
22 I_D= roots(root); // in mA
23 I_D= I_D(2); // discarding maximum value as it will
    be less than I_DSS
24 I_DQ= I_D; // in mA
25 disp(I_DQ,"The value of I_DQ in mA is : ")
26 V_GSQ= V_G-R_S*I_D; // in V
27 disp(V_GSQ,"The value of V_GSQ in V is : ")
28 V_DSQ= V_DD-I_DQ*(R_D+R_S); // in V
29 disp(V_DSQ,"The value of V_DSQ in V is : ")
30 V_S= I_D*R_S; // in V
31 V_D= V_S+V_DSQ; // in V
32 V_DS= V_D-V_G; // in V
33 disp(V_S,"The value of V_S in V is : ")
34 disp(V_D,"The value of V_D in V is : ")
35 disp(V_DS,"The value of V_DS in V is : ")

```

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

```

1 // Exa 6.12
2 clc;
3 clear;
4 close;
5 // Given data
6 V_DD= 20; // in V
7 I_DSS= 9; // in mA
8 V_BB= -10; // in V
9 R_S= 1.5; // in k
10 R_D= 1.8; // in k
11 V_P= -3; // in V
12 V_G=0;
13 // V_S= I_D*R_S+V_BB;
14 // V_GS= V_G-V_S or
15 // V_GS= V_G-(I_D*R_S+V_BB)
16 // I_D= I_DSS*(1-V_GS/V_P)^2 or
17 // 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]
18 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]
19 I_D= roots(root); // in mA
20 I_D= I_D(2); // discarding maximum value as it will
    be less than I_DSS
21 I_DQ= I_D; // in mA
22 disp(I_DQ,"The value of I_DQ in mA is : ")
23 V_GS= V_G-(I_D*R_S+V_BB); // in V
24 V_GSQ= V_GS; // in V
25 disp(V_GSQ,"The value of V_GSQ in volts is : ")
26 V_DS= V_DD-I_D*(R_D+R_S)-V_BB; // in V
27 disp(V_DS,"The value of V_DS in volts is : ")
28 V_S= I_D*R_S+V_BB; // in V
29 disp(V_S,"The value of V_S in volts is : ");
30 V_D= V_S+V_DS; // in V
31 disp(V_D,"The value of V_D in volts is : ")

```

Scilab code Exa 6.13 Value of IDQ VGSQ and IDSS

```
1 // Exa 6.13
2 clc;
3 clear;
4 close;
5 // Given data
6 V_S = 1.7; // in V
7 R_S = 0.51; // in kohm
8 R_S = R_S*10^3; // in ohm
9 V_DD = 18; // in V
10 R_D = 2*10^3; // in ohm
11 V_GS = -1.7; // in V
12 V_P = -4.5; // in V
13 I_DQ = V_S/R_S; // in A
14 disp(I_DQ*10^3, "The value of I_DQ in mA is");
15 V_GSQ = -V_S; // in V
16 disp(V_GSQ, "The value of V_GSQ in V is");
17 I_DSS = I_DQ / (1 - (V_GS/V_P)^2); // in A
18 disp(I_DSS*10^3, "The value of I_DSS in mA is");
19 V_D = V_DD - (I_DQ*R_D); // in V
20 disp(V_D, "The value of V_D in V is");
21 V_DS = V_D - V_S; // in V
22 disp(V_DS, "The value of V_DS in V is");
```

Scilab code Exa 6.14 Transfer curve

```
1 // Exa 6.14
2 clc;
3 clear;
4 close;
5 // Given data
6 I_DSS = 12; // in mA
7 V_GS = 0; // in V
8 I_D = 0; // in mA
```

```

 9 V_P = -6; // in V
10 V_GS= 0:-0.1:V_P; // in V
11 I_D = I_DSS*(1-(V_GS/V_P))^2; // mA
12 subplot(1,2,1)
13 plot(V_GS,I_D);
14 xlabel("V_GS in volts")
15 ylabel("I_D in mA")
16 title("n-channel device")
17 V_P = 6; // in V
18 V_GS= 0:0.1:V_P; // in V
19 I_D = I_DSS*(1-(V_GS/V_P))^2; // mA
20 subplot(1,2,2)
21 plot(V_GS,I_D);
22 xlabel("V_GS in volts")
23 ylabel("I_D in mA")
24 title("p-channel device")

```

Scilab code Exa 6.15 Drain current

```

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

```

Scilab code Exa 6.16 Value of RS and RD

```

1 // Exa 6.16

```



```

2  clc;
3  clear;
4  close;
5  // Given data
6  I_D = 1.5; // in mA
7  I_DSS = 5; // in mA
8  V_P = -2; // in V
9  V_GS = V_P*(1-sqrt(I_D/I_DSS)); // in V
10 V_G = 0; // in V
11 V_S = V_G-V_GS; // in V
12 R_S = V_S/I_D; // in kohm
13 disp(R_S*10^3,"The source resistance in ohm is");
14 V_DD = 20; // in V
15 V_DS= 10; // in V
16 R_D = (V_DD-(V_DS+(I_D*R_S)))/(I_D); // in kohm
17 disp(R_D,"The diode resistance in K ohm is");

```

Scilab code Exa 6.17 Value of VGS gm RS and RD

```

1  // Exa 6.17
2  clc;
3  clear;
4  close;
5  // Given data
6  I_D = 0.8; // in mA
7  I_D= I_D*10^-3; // in A
8  I_DSS = 1.645; // in mA
9  I_DSS= I_DSS*10^-3; // in A
10 V_P = -2; // in V
11 V_GS = V_P * (1-sqrt(I_D/I_DSS)); // in V
12 disp(V_GS,"The gate source voltage in V is");
13 g_mo = -((2*I_DSS)/V_P); // in A/V
14 g_m = g_mo*(1-(V_GS/V_P)); // in A/V
15 disp(g_m*10^3,"The transconductance in mA/V is");
16 R_S = -(V_GS/I_D); // in ohm

```

```

17 disp(R_S,"The source resistance in ohm is");
18 AdB= 20;// in dB
19 A= 10^(AdB/20);
20 R_D= A/g_m;// in ohm
21 disp(R_D*10^-3,"The value of R_D in k  is : ")
22
23 // 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

```

1 // Exa 6.18
2 clc;
3 clear;
4 close;
5 // Given data
6 V_GG = 2;// in V
7 V_GS = -V_GG;// in V
8 disp(V_GS,"The value of V_GS in V is");
9 I_DSS = 10;// in mA
10 V_P = -8;// in V
11 I_D = I_DSS*(1-(V_GS/V_P))^2;// in mA
12 I_DQ= I_D;// in mA
13 disp(I_DQ,"The value of I_DQ in mA is");
14 R_D = 2;// in K ohm
15 V_DD = 16;// in V
16 V_DS = V_DD - (I_D*R_D);// in V
17 disp(V_DS,"The value of V_DS in V is");
18 V_D = V_DS;// in V
19 disp(V_D,"The value of V_D in V is");
20 V_G = V_GS;// in V
21 disp(V_G,"The value of V_G in V is");
22 V_S = 0;// in V
23 disp(V_S,"The value of V_S in V is");

```

Scilab code Exa 6.19 Resistance between gate and source

```
1 // Exa 6.19
2 clc;
3 clear;
4 close;
5 // Given data
6 V_GS = 10; // in V
7 I_G = 0.001; // in A
8 R_GS = V_GS/I_G; // in M
9 disp(R_GS, "The gate source resistance in M is");
```

Scilab code Exa 6.20 AC drain resistance

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

Scilab code Exa 6.21 Value of ID and gm

```
1 // Exa 6.21
```

```

2  clc;
3  clear;
4  close;
5  // Given data
6  I_DSS = 8.4; // in mA
7  V_P = -3; // in V
8  V_GS = -1.5; // in V
9  I_D = I_DSS*(1-(V_GS/V_P))^2; // in mA
10 g_mo = -( (2*I_DSS)/V_P ); // in mA/V
11 g_m = g_mo*(1-(V_GS/V_P)); // in mA/V
12 disp(g_m,"The value of g_m in mA/V is");

```

Scilab code Exa 6.22 Value of gm ID and VDS

```

1  // Exa 6.22
2  clc;
3  clear;
4  close;
5  // Given data
6  V_DD= 20; // in V
7  I_DSS= 9; // in mA
8  V_P= -3; // in V
9  R1= 0.3*10^3; // in k
10 R2= 1.7*10^3; //in k
11 R_D= 3.2; // in k
12 R=1; // in k
13 V_G= V_DD*R1/(R1+R2); // in V
14 //I_D= I_DSS*[1-V_GS/V_P]^2
15 // V_G= V_GS+I_D*R or I_D= (V_G-V_GS)/R (i)
16 // From (i) and (ii)
17 //V_GS*1/V_P^2+V_GS*[1/(R*I_DSS)-2/V_P]+[1-V_G/(R*
18 I_DSS)]=0
19 V_GS= [1/V_P^2 1/(R*I_DSS)-2/V_P 1-V_G/(R*I_DSS)];
20 V_GS= roots(V_GS);

```

```

20 V_GS= V_GS(2); // in V (selecting lower value)
21 I_D= I_DSS*[1-V_GS/V_P]^2; // in mA
22 disp(I_D,"The value of I_D in mA is : ")
23 V_S= I_D*R; //in V
24 V_D= V_DD-I_D*R_D; // in V
25 V_DS= V_D-V_S; // in V
26 gm= -2*I_DSS/V_P*(1-V_GS/V_P); // in mA/V
27 disp(V_DS,"The value of V_DS in volts is : ")
28 disp(gm,"The transconductance in mA/V is : ")

```

Scilab code Exa 6.23 Voltage gain

```

1 // Exa 6.23
2 clc;
3 clear;
4 close;
5 // Given data
6 r_d = 25; // in k
7 R1 = r_d; // in k
8 R2 = r_d; // in k
9 g_m = 2; //mA/V
10 g_m= g_m*10^-3; // in A/V
11 R_L = (r_d*R1*R2)/(r_d*R1+R1*R2+R2*r_d); // in k
12 R_L= R_L*10^3; // in
13 A_v = -g_m*R_L;
14 disp(A_v,"The voltage gain is ");

```

Scilab code Exa 6.24 Input resistance of the gate

```

1 // Exa 6.24
2 clc;
3 clear;
4 close;

```

```

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

```

Scilab code Exa 6.25 Maximum drain current

```

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

```

Scilab code Exa 6.26 Gate voltage and drain current

```

1 // Exa 6.26
2 clc;
3 clear;
4 close;
5 // Given data
6 I_DSS = 16*10^-3; // in A

```

```

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

```

Scilab code Exa 6.27 Drain saturation current

```

1 // Exa 6.27
2 clc;
3 clear;
4 close;
5 // Given data
6 V_DD = 15; // in V
7 R_D = 10; // in kohm
8 R_D = R_D * 10^3; // in ohm
9 I_D = V_DD/R_D; // in A
10 disp(I_D*10^3,"The drain current in mA is");
11 V_D = V_DD - I_D*R_D; // in V
12 disp(V_D,"The drain voltage in V is");

```

Scilab code Exa 6.28 DC load line and operating point

```

1 // Exa 6.28
2 clc;
3 clear;
4 close;
5 // Given data
6 R2 = 1; // in M ohm
7 R2 = R2 * 10^6; // in ohm
8 R1 = 1.5; // in M ohm
9 R1 = R1 * 10^6; // in ohm

```

```

10 V_DD = 25; // in V
11 V_G = (R2*V_DD)/(R1+R2); // in V
12 R_S = 22; // in kohm
13 R_S = R_S * 10^3; // in ohm
14 I_D = V_G/R_S; // in A
15 disp(I_D*10^3,"The drain current in mA is ");
16 R_D = 10; // in kohm
17 R_D = R_D * 10^3; // in ohm
18 V_D = V_DD - (I_D*R_D); //in V
19 V_S = 10; // in V
20 V_DS = V_D - V_S; // in V
21 disp(V_DS,"The Drain source voltage in V is");
22 disp("Thus the Q-point is : "+string(V_DS)+" V, "+
       string(I_D*10^3)+" mA")
23 I_Dsat = V_DD/R_D; // in A
24 V_DS = V_DD; // in V
25 V_D= 0:0.1:25; // in V
26 I_D= (V_DD-V_D)/R_D*10^3; // in mA
27 plot(V_D,I_D);
28 xlabel("V_DS in volts");
29 ylabel("I_D in mA");
30 title("DC load line");
31 disp("DC load line shown in figure")

```

Scilab code Exa 6.29 Drain current

```

1 // Exa 6.29
2 clc;
3 clear;
4 close;
5 // Given data
6 V_SS = 25; // in V
7 V_GS = 0; // in V
8 R_S = 18; // in kohm
9 R_S = R_S * 10^3; // in ohm

```



```

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

```

Scilab code Exa 6.30 AC output voltage

```

1 // Exa 6.30
2 clc;
3 clear;
4 close;
5 // Given data
6 R_D = 1; // in kohm
7 R_D = R_D * 10^3; // in ohm
8 V_in = 2; // in mV
9 V_in = V_in * 10^-3; // in V
10 R_L = 10; // in kohm
11 R_L = R_L * 10^3; // in ohm
12 r_d = (R_D*R_L)/(R_D+R_L); // in ohm
13 g_m = 3000; // in S
14 g_m = g_m * 10^-6; // in S
15 A_v = g_m*r_d;
16 V_out = A_v*V_in; // in V
17 V_out = V_out * 10^3; // in mV
18 disp(V_out,"The output Voltage in mV is");

```

Chapter 7

MOSFET

Scilab code Exa 7.1 Output voltage

```
1 // Exa 7.1
2 clc;
3 clear;
4 close;
5 // Given data
6 V_GS = 0; // in V
7 I_D = 4; // in mA
8 R = 2; // in kohm
9 V_DD = 15; // in V
10 V_DS = V_DD - (I_D*R); // in V
11 g_m = 2000; // in S
12 g_m = g_m*10^-6; // in S
13 g_mo = g_m; // in S
14 R_D = 2; // in kohm
15 R_D = R_D * 10^3; // in ohm
16 R_L = 10; // in kohm
17 R_L = R_L * 10^3; // in ohm
18 r_d = (R_D*R_L)/(R_D+R_L); // in ohm
19 A_v = g_m*r_d;
20 V_in = 20; // in mV
21 V_out = A_v * V_in; // in mV
```

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

Scilab code Exa 7.2 LED current

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

Scilab code Exa 7.3 Transfer characteristics

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

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

Scilab code Exa 7.4 Value of VDS

```
1 // Exa 7.4
2 clc;
3 clear;
4 close;
5 // Given data
6 V_GS = 0; // in V
7 I_DSS = 10; // in mA
8 I_D = I_DSS; // in mA
9 R_D = 1.5; // in kohm
10 V_DD = 20; // in V
11 V_DS = V_DD - (I_D*R_D); // in V
12 disp(V_DS, "The value of V_DS in V is");
```

Scilab code Exa 7.5 Drain current

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

Scilab code Exa 7.6 Value of K

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

Scilab code Exa 7.7 Region of operation

```
1 // Exa 7.7
2 clc;
3 clear;
4 close;
5 // Given data
6 V_GS = 3; // in V
7 V_GSth=2; // inV
8 // Part (a)
9 V_DS= 0.5; // in V
10 if V_DS<(V_GS-V_GSth) then
11     disp("Transistor is in ohmic region")
12 else
13     disp("Transistor is in saturation region")
14 end
15
```

```

16 // Part (b)
17 V_DS= 1; // in V
18 if V_DS<(V_GS-V_GSth) then
19     disp("Transistor is in ohmic region")
20 else
21     disp("Transistor is in saturation region")
22 end
23
24 // Part (c)
25 V_DS= 5; // in V
26 if V_DS<(V_GS-V_GSth) then
27     disp("Transistor is in ohmic region")
28 else
29     disp("Transistor is in saturation region")
30 end

```

Scilab code Exa 7.8 Value of ID

```

1 // Exa 7.8
2 clc;
3 clear;
4 close;
5 // Given data
6 I_DSS = 4; // in mA
7 V_GSoff = -2; // in V
8 V_GS = -0.5; // in V
9 I_D = I_DSS*(1-(V_GS/V_GSoff))^2; // in mA
10 disp(I_D,"At V_GS=-0.5 V, the drain current in mA is
    ");
11 V_GS = -1; //in V
12 I_D = I_DSS*(1-(V_GS/V_GSoff))^2; // in mA
13 disp(I_D,"At V_GS=-1.0 V, the drain current in mA is
    ");
14 V_GS = -1.5; // in V
15 I_D = I_DSS*(1-(V_GS/V_GSoff))^2; // in mA

```

```
16 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

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

Scilab code Exa 7.10 Value of r_d , A_v and V_{out}

```
1 // Exa 7.10  
2 clc;  
3 clear;  
4 close;  
5 // Given data  
6 I_D = 12; // in mA  
7 I_D= I_D*10^-3; // in A  
8 I_DSS = I_D; // in A  
9 V_DS = 6.36; // in V  
10 g_mo = 4000; // in S  
11 g_mo=g_mo*10^-6; // in S
```

```

12 g_m = g_mo; // in S
13 R_D = 470; // in ohm
14 R_L = 2; // in kohm
15 R_L = R_L * 10^3; // in ohm
16 r_d = (R_D*R_L)/(R_D+R_L); // in ohm
17 disp(r_d,"The value of r_d in      is : ")
18 A_v = g_m*r_d;
19 disp(A_v,"The value of A_v is : ")
20 V_in = 100; // in mV
21 V_in = V_in *10^-3; // in V
22 V_out = A_v*V_in; // in V
23 disp(V_out,"The value of Vout in V is");

```

Scilab code Exa 7.11 Value of RDS

```

1 // Exa 7.11
2 clc;
3 clear;
4 close;
5 // Given data
6 V_DS = 0.1; // in V
7 I_D = 10; // in mA
8 I_D= I_D*10^-3; // in A
9 R_DS = V_DS/I_D; // in ohm
10 disp(R_DS,"Part (a) The value of R_DS(on) in ohm is"
    );
11 V_DS = 0.75; // in V
12 I_D = 100; // in mA
13 I_D= I_D*10^-3; // in A
14 R_DS = V_DS/I_D; // in ohm
15 disp(R_DS,"Part (b) The value of R_DS(on) in ohm is"
    );

```

Scilab code Exa 7.12 Voltage across EMOSFET

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

Chapter 8

Operational Amplifiers

Scilab code Exa 8.1 Value of Rf

```
1 // Exa 8.1
2 clc;
3 clear;
4 close;
5 // Given data
6 A_V = -100;
7 R1 = 2.2; // in kohm
8 R1 = R1*10^3; // in ohm
9 R_f = -( A_V*R1); // in ohm
10 R_f = R_f * 10^-3; // in kohm
11 disp(R_f, "The resistance value in k is");
```

Scilab code Exa 8.2 Output voltage

```
1 // Exa 8.2
2 clc;
3 clear;
4 close;
```

```

5 // Given data
6 R_f = 200; // in kohm
7 R1 = 2; // in kohm
8 A_V = - (R_f/R1);
9 V_in = 2.5; // in mV
10 V_in= V_in*10^-3; // in V
11 V_o = (A_V * V_in); // in V
12 disp(V_o,"The output voltage in V is");

```

Scilab code Exa 8.3 Output voltage

```

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

```

Scilab code Exa 8.4 Output voltage

```

1 // Exa 8.4
2 clc;
3 clear;
4 close;
5 // Given data
6 R_f = 1; // in Mohm
7 R_f = R_f * 10^6; // in ohm

```

```

8 disp("Part (a)")
9 V1 = 1; // in V
10 V2 = 2; // in V
11 V3 = 3; // in V
12 R1 = 500; // in kohm
13 R1 = R1 * 10^3; // in ohm
14 R2 = 1; // in Mohm
15 R2 = R2 * 10^6; // in ohm
16 R3 = 1; // in Mohm
17 R3 = R3 * 10^6; // in ohm
18 V_o = -(R_f) * ( (V1/R1)+(V2/R2)+(V3/R3) ); // in V
19 disp(V_o,"The output voltage in V is");
20
21 disp("Part (b)")
22 V1 = -2; // in V
23 V2 = 3; // in V
24 V3 = 1; // in V
25 R1 = 200; // in kohm
26 R1 = R1 * 10^3; // in ohm
27 R2 = 500; // in kohm
28 R2 = R2 * 10^3; // in ohm
29 R3 = 1; // in Mohm
30 R3 = R3 * 10^6; // in ohm
31 V_o = -(R_f) * ( (V1/R1)+(V2/R2)+(V3/R3) ); // in V
32 disp(V_o,"The output voltage in V is");

```

Scilab code Exa 8.6 Output voltage

```

1 // Exa 8.6
2 clc;
3 clear;
4 close;
5 // Given data
6 R_f = 0; // in V
7 R1 = 2; // in kohm

```

```

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

```

Scilab code Exa 8.7 Output voltage

```

1 // Exa 8.7
2 clc;
3 clear;
4 close;
5 // Given data
6 V1 = 745; // in V
7 V1 = V1 * 10^-6; // in V
8 V2 = 740; // in V
9 V2 = V2 * 10^-6; // in V
10 Av = 5*10^5;
11 CMRR = 80; // in dB
12 // Formula CMRR in dB= 20*log(Av/Ac)
13 Ac= Av/(10^(CMRR/20));
14 disp(Ac, "The common mode gain is");
15 V_o = Av*(V1-V2)+Ac*((V1+V2)/2); // in V
16 disp(V_o, "The output voltage in V is");
17
18 // 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

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

Scilab code Exa 8.10 Output voltage

```
1 // Exa 8.10
2 clc;
3 clear;
4 close;
5 // Given data
6 R_F = 3; // in kohm
7 R1 = 1; // in kohm
8 V1 = 2; // in V
9 V2 = 3; // in V
10 V_o1 = (1+(R_F/R1))*V1; // in V
11 V_o2 = (1+(R_F/R1))*V2; // in V
12 V_o = V_o1+V_o2; // in V
13 disp(V_o, "The output voltage in V is");
```

Scilab code Exa 8.11 Range of voltage gain

```
1 // exa 8.11
```

```

2  clc;
3  clear;
4  close;
5  // Given data
6  R_i = 10; // in k
7  R_im = 20; // in k
8  R_f = 500; // in k
9  A_vmin = -(R_f/R_i);
10 disp(A_vmin,"Closed loop voltage gain corresponding
    to minimum resistance is");
11 A_vmax = -(R_f/R_im);
12 disp(A_vmax,"Closed loop voltage gain corresponding
    to maximum resistance is");

```

Scilab code Exa 8.12 Range of output voltage

```

1  // Exa 8.12
2  clc;
3  clear;
4  close;
5  // Given data
6  R_f = 200; // in kohm
7  R1 = 20; // in kohm
8  A_v = -(R_f/R1);
9  V_i = 0.1; // in V
10 V_im = 0.5; // in V
11 V_omin = -10*V_i; // in V
12 disp(V_omin,"The minimum output voltage in V is");
13 V_omax = -10*V_im; // in V
14 disp(V_omax,"The maximum output voltage in V is");
15 disp("Output voltage ranges from "+string(V_omin)+"
    to "+string(V_omax))

```

Scilab code Exa 8.13 Output waveform

```
1 // exa 8.13
2 clc;
3 clear;
4 close;
5 // Given data
6 R = 133; // in kohm
7 R = R *10^3; // in ohm
8 C = 0.1; // in F
9 C = 0.1 * 10^-6; // in F
10 Vi= 1.5; // in V
11 t=0:0.1:1;
12 subplot(2,1,1)
13 plot(t,Vi);
14 ylabel("Vi in volts")
15 xlabel("t")
16 title("Input voltage");
17 t= 0:0.1:1;
18 Vo= -1/(R*C)*t;
19 subplot(2,1,2)
20 plot(t,Vo)
21 xlabel("t");
22 ylabel("Vo in volts");
23 title("Output voltage")
```

Scilab code Exa 8.14 Value of R1 and R2

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



```

8 // But output voltage of difference amplifier is
9 //  $V_o = -R_f/R_1 * V_a + (R_2/(R_1+R_2)) * (1+R_f/R_1) * V_b$  (i)
10 // By comparing (i) with given expression
11 R1 = Rf/5; // in kohm
12 disp(R1, "The value of R1 in k is : ");
13 //  $(R_2/(R_1+R_2)) * (1+R_f/R_1) = 3$ 
14 R2 = 3*R1^2/(R1+Rf-3*R1); // in k
15 disp(R2, "The value of R2 in k is : ")
16
17 // Note: There is calculation error to find the
    value of R2 in the book.

```

Scilab code Exa 8.15 Output voltage

```

1 // Exa 8.15
2 clc;
3 clear;
4 close;
5 // Given data
6 V_i1 = 150; // in V
7 V_i2 = 140; // in V
8 V_d = V_i1 - V_i2; // in V
9 V_C = (1/2) * (V_i1 + V_i2); // in V
10 disp("Part (i)")
11 CMRR = 100;
12 A_d = 4000;
13 V_o = (A_d * V_d) * (1 + (1/CMRR) * (V_C/V_d)); // in V
14 V_o = V_o * 10^-3; // in mV
15 disp(V_o, "The output voltage in mV is");
16 disp("Part (ii)")
17 CMRR = 10^5;
18 V_o = (A_d * V_d) * (1 + (1/CMRR) * (V_C/V_d)); // in V
19 V_o = V_o * 10^-3; // in mV
20 disp(V_o, "The output voltage in mV is");

```

Scilab code Exa 8.16 Output voltage

```
1 // Exa 8.16
2 clc;
3 clear;
4 close;
5 // Given data
6 R_f = 470; // in k
7 R1 = 4.3; // in k
8 R2 = 33; // in k
9 R3 = R2; // in k
10 A1 = (1+R_f/R1);
11 A2 = -(R_f/R2);
12 A3 = -(R_f/R3);
13 A = A1*A2*A3;
14 V_i = 80; // in V
15 V_i = 80*10^-6; // in V
16 V_o = A*V_i;
17 disp(V_o, "The output voltage in V is")
```

Scilab code Exa 8.18 Output voltage

```
1 // Exa 8.18
2 clc;
3 clear;
4 close;
5 // Given data
6 R4 = 300; // in k
7 R2 = 150; // in k
8 R3 = 10; // in k
9 R1 = 10; // in k
10 V1 = 1; // in V
```

```

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

```

Scilab code Exa 8.19 Input voltage

```

1 // Exa 8.19
2 clc;
3 clear;
4 close;
5 // Given data
6 V_o = 2; // in V
7 R_i = 20; // in k
8 R_f = 1; // in M
9 V_i = -((V_o*R_i)/R_f); // in mV
10 disp(V_i,"The input volatge in mV is");

```

Scilab code Exa 8.20 Range of output voltage

```

1 // Exa 8.20
2 clc;
3 clear;
4 close;
5 // Given data
6 R_f = 200; // in k
7 R_i = 30; // in k
8 V_i = 0.1; // in V
9 V_im = 0.5; // in V
10 Vo_min = -((R_f/R_i)*V_i); // in V
11 disp(Vo_min,"The minimum output voltage in V is");
12 Vo_max = -((R_f/R_i)*V_im); // in V
13 disp(Vo_max,"The minimum output voltage in V is");

```

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

Scilab code Exa 8.21 Output voltage

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

Scilab code Exa 8.22 Output voltage

```
1 // Exa 8.22
2 clc;
3 clear;
4 close;
5 // Given data
6 R_f = -68; // in kohm
7 R1 = 33; // in kohm
8 R2 = 22; // in kohm
9 R3 = 12; // in kohm
10 V1 = 0.2; // in V
11 V2 = - 0.5; // in V
12 V3 = 0.8; // in V
```

```

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

```

Scilab code Exa 8.23 Closed loop voltage gain and bandwidth

```

1 // Exa 8.23
2 clc;
3 clear;
4 close;
5 // Given data
6 R_f = 1.8; // in kohm
7 R_f = R_f * 10^3; // in ohm
8 R1 = 180; // in ohm
9 A_v = (R_f/R1);
10 disp(A_v,"Closed loop gain is");
11 F = 1; // in MHz
12 F = F * 10^6; // in Hz
13 f2 = F/A_v; // in Hz
14 disp(f2,"Closed loop bandwidth in Hz is");
15 V_in = 25; // in mV
16 V_in = V_in * 10^-3; // in V
17 V_o = A_v*V_in; // in V
18 disp(V_o,"The output voltage in V is");

```

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

```

1 // Exa 8.24
2 clc;
3 clear;
4 close;
5 // Given data

```

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

Chapter 9

Electronic Instrumentation and Measurements

Scilab code Exa 9.1 Peak to peak amplitude

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

Scilab code Exa 9.2 Amplitude of the pulse signal

```
1 // Exa 9.2
2 clc;
3 clear;
```

```

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

```

Scilab code Exa 9.3 Period of the waveform

```

1 // Exa 9.3
2 clc;
3 clear;
4 close;
5 // Given data
6 scale= 20;// in S/cm
7 gh= 3.2;//amplitude of the graph in cm
8 T= gh*scale;// in mV
9 disp(T,"The period of the waveform in S is : ")

```

Scilab code Exa 9.4 Pulse delay

```

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

```

Scilab code Exa 9.5 Pulse width of the waveform

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