

Scilab Textbook Companion for  
Electronics Engineering  
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# Book Description

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

**Exa** Example (Solved example)

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

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

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

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# Chapter 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 beta= 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/beta); // 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 beta = 44;
17 I_B = (V_EE - V_BE - V_Th)/((1+beta)*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 = beta*I_BQ; // in A
21 disp(I_C*10^3,"The value of I_C in mA is");
22 I_E = (1+beta)*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

```

\*10<sup>3</sup>)+” 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 VE IC VC and IB

```

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
      : ")
```

---