

Scilab Textbook Companion for  
Semiconductor Circuit Approximations  
by Malvino<sup>1</sup>

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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 2

## Rectifier Diodes

Scilab code Exa 2.1 Output voltage

```
1 // Example 2.1
2 clc;
3 clear;
4 close;
5 format('v',6)
6 // given data
7 Vin= 15;// in V
8 R_L= 10;// in k
9 // The output voltage
10 Vout= Vin ;// in V
11 // The current
12 I= Vout/R_L;// in mA
13 disp(Vout,"The output voltage in volts is : ");
14 disp(I,"The current in mA is : ");
```

---

Scilab code Exa 2.2 Output voltage

```
1 // Example 2.2
```

```

2  clc;
3  clear;
4  close;
5  format('v',6)
6  // given data
7  Vin= 15;// in V
8  I=0;
9  R_L= 10;// in k
10 R_L= R_L*10^3;// in
11 // The output voltage
12 Vout= I*R_L;// in V
13 // The voltage across the diode
14 V_R= Vin-Vout;// in V
15 disp(Vout,"The output voltage in volts is : ");
16 disp(V_R,"The voltage across the diode in volts is :
    ");

```

---

#### Scilab code Exa 2.4 Maximum reverse voltage

```

1  // Example 2.4
2  format('v',6)
3  clc;
4  clear;
5  close;
6  // given data
7  Vin= 15;// in V
8  V_P= Vin;// in V
9  R_L= 10;// in k
10 R_L= R_L*10^3;// in
11 Vout=0;
12 // The peak current through the diode
13 I_P= V_P/R_L;// in A
14 // The maximum reverse voltage
15 V_R= Vin-Vout;// in V
16 I_P= I_P*10^3;// in mA

```

```

17 disp(I_P,"The peak current through the diode in mA
    is : ");
18 disp(V_R,"The maximum reverse voltage in volts is :
    ")

```

---

### Scilab code Exa 2.5 Power dissipation of the diode

```

1 // Example 2.5
2 format('v',6)
3 clc;
4 clear;
5 close;
6 // given data
7 Vin= 15;// in V
8 V_K= 0.7;// in V
9 R_L= 10;// in k
10 R_L= R_L*10^3;// in
11 // The output voltage
12 Vout= Vin-V_K;// in V
13 // The current
14 I= Vout/R_L;// in A
15 // The power dissipation of the diode
16 P= V_K*I;// in W
17 I=I*10^3;// in mA
18 P= round(P*10^3);// in mW
19 disp(Vout,"The output voltage in volts is : ");
20 disp(I,"The current in mA is : ");
21 disp(P,"The power dissipation of the diode in mW is
    : ")

```

---

### Scilab code Exa 2.6 Peak forward current and PIV

```

1 // Example 2.6

```

```

2 format('v',6)
3 clc;
4 clear;
5 close;
6 // given data
7 Vin= 15;// in V
8 V_K= 0.7;// in V
9 Vout=0;// in V
10 R_L= 10;// in k
11 R_L= R_L*10^3;// in
12 // The peak output voltage
13 V_P= Vin-V_K;// in V
14 // The maximum forward current
15 I_P= V_P/R_L;// in A
16 // The peak inverse voltage
17 PIV= Vin-Vout;// in V
18 I_P= I_P*10^3;// in mA
19 disp(V_P,"The peak output voltage in volts is : ");
20 disp(I_P,"The maximum forward current in mA is : ");
21 disp(PIV,"The peak inverse voltage in volts is : ")

```

---

Scilab code Exa 2.7 Peak load voltage and peak inverse voltage

```

1 // Example 2.7
2 clc;
3 clear;
4 close;
5 format('v',5)
6 // given data
7 Vin= 10;// in V
8 V_K= 0.7;// in V
9 Vout=0;// in V
10 R_L= 1000;// in k
11 r_B= 20;// in
12 // The peak forward current ,

```

```
13 I_P= (Vin-V_K)/(R_L+r_B);// in A
14 // The peak voltage
15 V_P= I_P*R_L;// in V
16 // The peak inverse voltage
17 PIV= Vin-Vout;// in V
18 disp(V_P,"The peak voltage in volts is : ");
19 disp(PIV,"The peak inverse voltage in volts is : ")
```

---

# Chapter 3

## Special Diodes

Scilab code Exa 3.1 LED current

```
1 // Exa 3.1
2 format('v',5)
3 clc;
4 clear;
5 close;
6 // given data
7 Vin= 12;// in V
8 V_LED= 2;// in V
9 Rs= 470;// in
10 Vs= Vin-V_LED;// in V
11 // The LED current
12 I= Vs/Rs;// in A
13 I= I*10^3;// in mA
14 disp(I,"The LED current in mA is : ")
```

---

Scilab code Exa 3.2 LED current

```
1 // Exa 3.2
```

```

2 format('v',5)
3 clc;
4 clear;
5 close;
6 // given data
7 Vin= 5;// in V
8 V_LED= 2;// in V
9 Rs= 470;// in
10 Vs= Vin-V_LED;// in V
11 // When supply voltage is 5 V, the LED current
12 I= Vs/Rs;// in A
13 I= I*10^3;// in mA
14 disp(I,"When supply voltage is 5 V, the LED current
    in mA is : ")
15 Vin= 10;// in V
16 Vs= Vin-V_LED;// in V
17 // When supply voltage is 10 V, the LED current
18 I= Vs/Rs;// in A
19 I= I*10^3;// in mA
20 disp(I,"When supply voltage is 10 V, the LED current
    in mA is : ")
21 Vin= 15;// in V
22 Vs= Vin-V_LED;// in V
23 // When supply voltage is 15 V, the LED current
24 I= Vs/Rs;// in A
25 I= I*10^3;// in mA
26 disp(I,"When supply voltage is 15 V, the LED current
    in mA is : ")
27 Vin= 20;// in V
28 Vs= Vin-V_LED;// in V
29 // When supply voltage is 20 V, the LED current
30 I= Vs/Rs;// in A
31 I= I*10^3;// in mA
32 disp(I,"When supply voltage is 20 V, the LED current
    in mA is : ")

```

---

### Scilab code Exa 3.4 Tuning range

```
1 // Exa 3.4
2 format('v',5)
3 clc;
4 clear;
5 close;
6 // given data
7 C1= 560;//transistor capacitance at 1V in pF
8 C2= 30;//transistor capacitance at 10V in pF
9 // The tuning range
10 tuningRange= C1/C2;
11 disp(tuningRange,"The tuning range is : ")
```

---

### Scilab code Exa 3.5 Minimum and maximum zener current

```
1 // Exa 3.5
2 format('v',5)
3 clc;
4 clear;
5 close;
6 // given data
7 Vin_min= 20;// in V
8 Vin_max= 40;// in V
9 Vz= 10;// in V
10 Rs= 820;// in
11 // The minimum zener current ,
12 Iz_min= (Vin_min-Vz)/Rs;// in A
13 // The maximum zener current ,
14 Iz_max= (Vin_max-Vz)/Rs;// in A
15 // The output voltage ,
16 Vout= Vz;// in V
```



```

17 Iz_min= Iz_min*10^3; // in mA
18 Iz_max= Iz_max*10^3; // in mA
19 disp(Iz_min,"The minimum zener current in mA is : ")
    ;
20 disp(Iz_max,"The maximum zener current in mA is : ")
    ;
21 disp(Vout,"The output voltage in V is : ")

```

---

### Scilab code Exa 3.6 Minimum and maximum output voltage

```

1 // Exa 3.6
2 format('v',5)
3 clc;
4 clear;
5 close;
6 // given data
7 Rs= 820; // in
8 Rz= 17; // in
9 R_T= Rs+Rz; // in
10 Vz= 10; // in V
11 Vin_min= 20; // in V
12 Vin_max= 40; // in V
13 // The minimum zener current
14 Iz_min= (Vin_min-Vz)/R_T; // in A
15 // The maximum zener current
16 Iz_max= (Vin_max-Vz)/R_T; // in A
17 // The minimum output voltage
18 Vout_min= Vz+Iz_min*Rz; // in V
19 // The maximum output voltage
20 Vout_max= Vz+Iz_max*Rz; // in V
21 Iz_min= Iz_min*10^3; // in mA
22 Iz_max= Iz_max*10^3; // in mA
23 disp(Iz_min,"The minimum zener current in mA is : ")
24 disp(Iz_max,"The maximum zener current in mA is : ")
25 disp(Vout_min,"The minimum output voltage in V is : ")

```

```
    ")
26 disp(Vout_max,"The maximum output voltage in V is :
    ")
```

---

#### Scilab code Exa 3.7 Maximum current

```
1 // Exa 3.7
2 format('v',5)
3 clc;
4 clear;
5 close;
6 // given data
7 P= 100; // power rating in mW
8 V= 6.2; // in V
9 // The maximum current rating
10 I_ZM= P/V; // in mA
11 disp(I_ZM,"The maximum current rating in mA is : ")
```

---

#### Scilab code Exa 3.8 Value of IS IL IZ

```
1 // Exa 3.8
2 format('v',5)
3 clc;
4 clear;
5 close;
6 // given data
7 Vz= 12; // in V
8 Vout= Vz; // in V
9 Vin= 25; // in V
10 R_S= 180; // in
11 R_L= 200; // in
12 // The value of I_S
13 I_S= (Vin-Vout)/R_S; // in A
```

```

14 // The value of I_L
15 I_L= Vout/R_L;// in A
16 // The value of I_Z
17 I_Z= I_S-I_L;// in A
18 I_S= I_S*10^3;// in mA
19 I_L= I_L*10^3;// in mA
20 I_Z= I_Z*10^3;// in mA
21 disp(I_S,"The value of I_S in mA is : ")
22 disp(I_L,"The value of I_L in mA is : ")
23 disp(I_Z,"The value of I_Z in mA is : ")

```

---

### Scilab code Exa 3.9 Values of all currents

```

1 // Exa 3.9
2 format('v',5)
3 clc;
4 clear;
5 close;
6 // given data
7 disp("(i) For 200      load resistance");
8 R_L= 200;// in
9 Vz= 12;// in V
10 Vout= Vz;// in V
11 Vin= 25;// in V
12 R_S= 180;// in
13 // The value of I_S
14 I_S= (Vin-Vout)/R_S;// in A
15 // The value of I_L
16 I_L= Vout/R_L;// in A
17 // The value of I_Z
18 I_Z= I_S-I_L;// in A
19 I_S= I_S*10^3;// in mA
20 I_L= I_L*10^3;// in mA
21 I_Z= I_Z*10^3;// in mA
22 disp(I_S,"The value of I_S in mA is : ")

```

```

23 disp(I_L,"The value of I_L in mA is : ")
24 disp(I_Z,"The value of I_Z in mA is : ")
25 disp("(ii) For 400    load resistance");
26 R_L= 400;// in
27 // The value of I_S
28 I_S= (Vin-Vout)/R_S;// in A
29 // The value of I_L
30 I_L= Vout/R_L;// in A
31 // The value of I_Z
32 I_Z= I_S-I_L;// in A
33 I_S= I_S*10^3;// in mA
34 I_L= I_L*10^3;// in mA
35 I_Z= I_Z*10^3;// in mA
36 disp(I_S,"The value of I_S in mA is : ")
37 disp(I_L,"The value of I_L in mA is : ")
38 disp(I_Z,"The value of I_Z in mA is : ")
39 disp("(iii) For 600    load resistance");
40 R_L= 600;// in
41 // The value of I_S
42 I_S= (Vin-Vout)/R_S;// in A
43 // The value of I_L
44 I_L= Vout/R_L;// in A
45 // The value of I_Z
46 I_Z= I_S-I_L;// in A
47 I_S= I_S*10^3;// in mA
48 I_L= I_L*10^3;// in mA
49 I_Z= I_Z*10^3;// in mA
50 disp(I_S,"The value of I_S in mA is : ")
51 disp(I_L,"The value of I_L in mA is : ")
52 disp(I_Z,"The value of I_Z in mA is : ")
53 disp("(iv) For 800    load resistance");
54 R_L= 800;// in
55 // The value of I_S
56 I_S= (Vin-Vout)/R_S;// in A
57 // The value of I_L
58 I_L= Vout/R_L;// in A
59 // The value of I_Z
60 I_Z= I_S-I_L;// in A

```

```

61 I_S= I_S*10^3; // in mA
62 I_L= I_L*10^3; // in mA
63 I_Z= I_Z*10^3; // in mA
64 disp(I_S,"The value of I_S in mA is : ")
65 disp(I_L,"The value of I_L in mA is : ")
66 disp(I_Z,"The value of I_Z in mA is : ")
67 disp("(v) For 1 k load resistance");
68 R_L= 1*10^3; // in
69 // The value of I_S
70 I_S= (Vin-Vout)/R_S; // in A
71 // The value of I_L
72 I_L= Vout/R_L; // in A
73 // The value of I_Z
74 I_Z= I_S-I_L; // in A
75 I_S= I_S*10^3; // in mA
76 I_L= I_L*10^3; // in mA
77 I_Z= I_Z*10^3; // in mA
78 disp(I_S,"The value of I_S in mA is : ")
79 disp(I_L,"The value of I_L in mA is : ")
80 disp(I_Z,"The value of I_Z in mA is : ")

```

---

### Scilab code Exa 3.10 Value of Change in output voltage

```

1 // Exa 3.10
2 format('v',7)
3 clc;
4 clear;
5 close;
6 // given data
7 R_Z= 7; // in
8 I_Z1=12.2; // in mA
9 I_Z2=60.2; // in mA
10 deltaV_Z=(I_Z2-I_Z1)*R_Z; // in mV
11 deltaV_Z= deltaV_Z*10^-3; // in V
12 Vz= 12; // in V

```

```
13 // The output voltage ,
14 Vout= Vz+deltaV_Z;// in V
15 disp(Vout,"The output voltage in V is : ");
```

---

#### Scilab code Exa 3.11 Value of IS IL IZ

```
1 // Exa 3.11
2 format('v',6)
3 clc;
4 clear;
5 close;
6 // given data
7 Vz= 12;// in V
8 Vin= 15;// in V
9 R_S= 200;// in
10 R_L= 1*10^3;// in
11 // The value of I_S
12 I_S= (Vin-Vz)/R_S;// in A
13 // The value of I_L
14 I_L= Vz/R_L;// in A
15 // The value of I_Z
16 I_Z= I_S-I_L;// in A
17 I_S= I_S*10^3;// in mA
18 I_L= I_L*10^3;// in mA
19 I_Z= I_Z*10^3;// in mA
20 disp(I_S,"The value of I_S in mA is : ")
21 disp(I_L,"The value of I_L in mA is : ")
22 disp(I_Z,"The value of I_Z in mA is : ")
```

---

#### Scilab code Exa 3.12 Value of IS IL IZ

```
1 // Exa 3.12
2 format('v',6)
```

```

3  clc;
4  clear;
5  close;
6  // given data
7  disp("(i) For 15 V input voltage");
8  Vin= 15;// in V
9  Vz= 12;// in V
10 R_S= 200;// in
11 R_L= 1*10^3;// in
12 // The value of I_S
13 I_S= (Vin-Vz)/R_S;// in A
14 // The value of I_L
15 I_L= Vz/R_L;// in A
16 // The value of I_Z
17 I_Z= I_S-I_L;// in A
18 I_S= I_S*10^3;// in mA
19 I_L= I_L*10^3;// in mA
20 I_Z= I_Z*10^3;// in mA
21 disp(I_S,"The value of I_S in mA is : ")
22 disp(I_L,"The value of I_L in mA is : ")
23 disp(I_Z,"The value of I_Z in mA is : ")
24 disp("(ii) For 20 V input voltage");
25 Vin= 20;// in V
26 // The value of I_S
27 I_S= (Vin-Vz)/R_S;// in A
28 // The value of I_L
29 I_L= Vz/R_L;// in A
30 // The value of I_Z
31 I_Z= I_S-I_L;// in A
32 I_S= I_S*10^3;// in mA
33 I_L= I_L*10^3;// in mA
34 I_Z= I_Z*10^3;// in mA
35 disp(I_S,"The value of I_S in mA is : ")
36 disp(I_L,"The value of I_L in mA is : ")
37 disp(I_Z,"The value of I_Z in mA is : ")
38 disp("(iii) For 25 V input voltage");
39 Vin= 25;// in V
40 // The value of I_S

```

```

41 I_S= (Vin-Vz)/R_S;// in A
42 // The value of I_L
43 I_L= Vz/R_L;// in A
44 // The value of I_Z
45 I_Z= I_S-I_L;// in A
46 I_S= I_S*10^3;// in mA
47 I_L= I_L*10^3;// in mA
48 I_Z= I_Z*10^3;// in mA
49 disp(I_S,"The value of I_S in mA is : ")
50 disp(I_L,"The value of I_L in mA is : ")
51 disp(I_Z,"The value of I_Z in mA is : ")
52 disp("(iv) For 30 V input voltage");
53 Vin= 30;// in V
54 // The value of I_S
55 I_S= (Vin-Vz)/R_S;// in A
56 // The value of I_L
57 I_L= Vz/R_L;// in A
58 // The value of I_Z
59 I_Z= I_S-I_L;// in A
60 I_S= I_S*10^3;// in mA
61 I_L= I_L*10^3;// in mA
62 I_Z= I_Z*10^3;// in mA
63 disp(I_S,"The value of I_S in mA is : ")
64 disp(I_L,"The value of I_L in mA is : ")
65 disp(I_Z,"The value of I_Z in mA is : ")
66 disp("(v) For 35 V input voltage");
67 Vin= 35;// in V
68 // The value of I_S
69 I_S= (Vin-Vz)/R_S;// in A
70 // The value of I_L
71 I_L= Vz/R_L;// in A
72 // The value of I_Z
73 I_Z= I_S-I_L;// in A
74 I_S= I_S*10^3;// in mA
75 I_L= I_L*10^3;// in mA
76 I_Z= I_Z*10^3;// in mA
77 disp(I_S,"The value of I_S in mA is : ")
78 disp(I_L,"The value of I_L in mA is : ")

```



```
79 disp(I_Z,"The value of I_Z in mA is : ")
```

---

# Chapter 4

## Diode Applications

Scilab code Exa 4.1 DC voltage across load resistance

```
1 // Example 4.1
2 format('v',5)
3 clc;
4 clear;
5 close;
6 // given data
7 V2rms= 40;// in V
8 R_L= 20;// in
9 V2peak= V2rms/0.707;// in V
10 Vout_peak= V2peak;// in V
11 // The dc voltage across the load resistor
12 Vdc=0.318*Vout_peak;// in V
13 //The peak inverse voltage across the diode
14 PIV= V2peak;// in V
15 Idc= Vdc/R_L;// in A
16 // The dc current through the diode
17 I_diode= Idc;// in A
18 disp(Vdc,"The dc voltage across the load resistor in
    volts is : ");
19 disp(PIV,"The peak inverse voltage across the diode
    in volts is : ");
```

```
20 disp(I_diode,"The dc current through the diode in A
    is : ")
```

---

#### Scilab code Exa 4.2 DC current through each diode

```
1 // Example 4.2
2 format('v',5)
3 clc;
4 clear;
5 close;
6 // given data
7 Vrms= 40;// in V
8 R_L= 20;// in
9 V2peak= Vrms/0.707;// in V
10 Vout_peak= V2peak/2;// in V
11 // The dc load voltage
12 Vdc=0.636*Vout_peak;// in V
13 // The peak inverse voltage across each diode
14 PIV= V2peak;// in V
15 Idc= Vdc/R_L;// in A
16 // The dc current through each diode
17 I_diode= Idc/2;// in A
18 disp(Vdc,"The dc load voltage in volts is : ");
19 disp(PIV,"The peak inverse voltage across each diode
    in volts is : ");
20 disp(I_diode,"The dc current through each diode in A
    is : ")
```

---

#### Scilab code Exa 4.3 Value of Vdc and PIV

```
1 // Example 4.3
2 format('v',5)
3 clc;
```

```

4 clear;
5 close;
6 // given data
7 Vrms= 40;// in V
8 R_L= 20;// in
9 V2peak= Vrms/0.707;// in V
10 Vout_peak= V2peak;// in V
11 // The value of Vdc
12 Vdc=0.636*Vout_peak;// in V
13 // The value of PIV
14 PIV= V2peak;// in V
15 Idc= Vdc/R_L;// in A
16 //The value of I_diode
17 I_diode= Idc/2;// in A
18 disp(Vdc,"The value of Vdc in volts is : ");
19 disp(PIV,"The value of PIV in volts is : ");
20 disp(I_diode,"The value of I_diode in A is : ")

```

---

#### Scilab code Exa 4.6 DC load voltage

```

1 // Example 4.6
2 format('v',5)
3 clc;
4 clear;
5 close;
6 // given data
7 Vdc= 56.6;// in V
8 R_L= 100;// in
9 f=120;// in Hz
10 C= 1000;// in F
11 C= C*10^-6;// in F
12 V2peak= Vdc;// in V
13 Idc= Vdc/R_L;// in A
14 // The peak-to-peak ripple
15 Vrip= Idc/(f*C);// in V

```

```

16 // The dc load voltage
17 Vdc= V2peak-Vrip/2;// in V
18 disp(Vrip,"The peak-to-peak ripple in volts is : ");
19 disp(Vdc,"The dc load voltage in volts is : ")

```

---

#### Scilab code Exa 4.8 Zener current

```

1 // Example 4.8
2 format('v',5)
3 clc;
4 clear;
5 close;
6 // given data
7 V2rms= 12.6;// in V
8 V_Z= 6.8;// in V
9 V2peak= V2rms/0.707;// in V
10 Vin= V2peak;// in V
11 Vout= V_Z;// in V
12 R_L= 1.2;// in k
13 R_L= R_L*10^3;//in
14 Rs= 1;// in k
15 Rs= Rs*10^3;// in
16 Is= (Vin-Vout)/Rs;// in A
17 I_L= Vout/R_L;// in A
18 // The zener current
19 Iz= Is-I_L;// in A
20 Iz= Iz*10^3;// in mA
21 disp(Iz,"The zener current in mA is : ")
22
23 // Note: The calculation in the book is not accurate

```

---

#### Scilab code Exa 4.9 Ripple across the load current

```
1 // Example 4.9
2 format('v',5)
3 clc;
4 clear;
5 close;
6 // given data
7 C= 100;//in F
8 C= C*10^-6;// in F
9 Rz= 5;//in
10 Rs= 1*10^3;//in
11 Idc= 11*10^-3;//in A
12 f=120;//in Hz
13 Vin_rip= Idc/(f*C);// in V
14 // The ripple across the load resistance
15 Vout_rip= Rz*Vin_rip/(Rs+Rz);//in A
16 Vout_rip= Vout_rip*10^3;// in mV
17 disp(Vout_rip,"The ripple across the load resistance
    in mV is : ")
```

---

# Chapter 5

## Bipolar Transistor

Scilab code Exa 5.1 Value of VCE

```
1 // Example 5.1
2 format('v',5)
3 clc;
4 clear;
5 close;
6 // given data
7 V_BB= 10; //in V
8 V_BE= 0.7; //in V
9 V_CC= 20; // in V
10 R_B= 1.5; // in M
11 R_B= R_B*10^6; //in
12 R_C= 5*10^3; //in
13 beta= 125; // unit less
14 I_B= (V_BB-V_BE)/R_B; //in A
15 I_C= beta*I_B; //in A
16 // The dc voltage between the collector and emitter
17 V_CE= V_CC-I_C*R_C; //in V
18 disp(V_CE,"The dc voltage between the collector and
    emitter in volts is : ")
```

---

### Scilab code Exa 5.2 DC load line

```
1 // Example 5.2
2 format('v',6)
3 clc;
4 clear;
5 close;
6 // given data
7 V_CC= 30; // in V
8 R_C= 1.5; //in k
9 Ver_intercept= V_CC/R_C; //in mA
10 Hor_intercept= V_CC; // in V
11 V_CE= 0:0.1:Hor_intercept; // in V
12 I_C= (V_CC-V_CE)/R_C; // in mA
13 // DC load line
14 plot(V_CE,I_C)
15 xlabel("V_CE in volts");
16 ylabel("I_C in mA")
17 title("DC load line")
```

---

### Scilab code Exa 5.3 Value of IC and VCE

```
1 // Example 5.3
2 format('v',4)
3 clc;
4 clear;
5 close;
6 // given data
7 V_BE= 0.7; //in V
8 V_CC= 30; // in V
9 R_B= 390; // in k
10 R_B= R_B*10^3; //in
```



```

11 R_C= 1.5*10^3; //in
12 bita= 80; // unit less
13 I_B= (V_CC-V_BE)/R_B; //in A
14 // The collector current ,
15 I_C= bita*I_B; //in A
16 // The value of V_CE
17 V_CE= V_CC-I_C*R_C; //in V
18 I_C= I_C*10^3; // in mA
19 disp(I_C,"The value of I_C in mA is : ")
20 disp(V_CE,"The value of V_CE in volts is : ")

```

---

#### Scilab code Exa 5.4 LED current

```

1 // Example 5.4
2 format('v',6)
3 clc;
4 clear;
5 close;
6 // given data
7 V_BE= 0.7; // in V
8 V_LED= 2; //in V
9 V_CC= 20; // in V
10 R_B= 47; // in k
11 R_B= R_B*10^3; //in
12 R_C= 1*10^3; //in
13 bita= 150; // unit less
14 // The LED current
15 I_LED= (V_CC-V_LED)/R_C; // in A
16 I_Csat= I_LED; // in A
17 I_Bsat= I_Csat/bita; // in A
18 // The input voltage ,
19 V_IN= I_Bsat*R_B+V_BE; //in V
20 I_LED= I_LED*10^3; // in mA
21 disp(I_LED,"The LED current in mA is : ");
22 disp(V_IN,"The value of Vin in volts is : ")

```

---

Scilab code Exa 5.5 DC voltage

```
1 // Example 5.5
2 format('v',5)
3 clc;
4 clear;
5 close;
6 // given data
7 Vz= 10; // in V
8 V_BE= 0.7; // in V
9 V_CC= 30; // in V
10 R_E= 5; // in k
11 R_E= R_E*10^3; //in
12 R_C= 4; // in k
13 R_C= R_C*10^3; //in
14 V_E= Vz-V_BE; // in V
15 I_E= V_E/R_E; // in A
16 I_C= I_E; // in A
17 // The collector voltage
18 V_C= V_CC-I_C*R_C; // in V
19 disp(V_C,"The collector voltage in volts is : ")
```

---

Scilab code Exa 5.6 DC collector to ground voltage

```
1 // Example 5.6
2 format('v',6)
3 clc;
4 clear;
5 close;
6 // given data
7 V_BE= 0.7; // in V
```

```

8 R2= 1*10^3; //in
9 R1= 3.9*10^3; //in
10 R_E= 100; // in
11 R_C= 150; // in k
12 V_CC= 25; // in V
13 Vz= R2*V_CC/(R1+R2); // in V
14 V_E= Vz-V_BE; // in V
15 I_E= V_E/R_E; // in A
16 I_C= I_E; // in A
17 // The collector voltage
18 V_C= V_CC-I_C*R_C; // in V
19 disp(V_C,"The collector voltage in volts is : ")

```

---

#### Scilab code Exa 5.7 Value of Vc

```

1 // Example 5.7
2 format('v',5)
3 clc;
4 clear;
5 close;
6 // given data
7 R_E= 2*10^3; // in
8 R_C= 1*10^3; // in k
9 V_E= 4.3; //in V
10 V_CC= 15; // in V
11 I_E= V_E/R_E; // in A
12 I_C= I_E; //in A
13 // In the first stage the collector voltage
14 V_C= V_CC-I_C*R_C; // in A
15 disp(V_C,"In the first stage the collector voltage
    in volts is : ");
16 // Second stage
17 V_E= 2.3; // in V
18 R_E= 220; // in
19 R_C= 470; // in

```

```

20 I_E= V_E/R_E;// in A
21 I_C= I_E;//in A
22 // In the second stage the collector voltage
23 V_C= V_CC-I_C*R_C;// in A
24 disp(V_C,"In the second stage the collector voltage
    in volts is : ");
25
26 // Note : In the book, the calculated value of
    collector voltage in first stage is not accurate.

```

---

#### Scilab code Exa 5.8 Minimum and maximum collector current

```

1 // Example 5.8
2 format('v',6)
3 clc;
4 clear;
5 close;
6 // given data
7 V_BE= 0.7;//in V
8 V_CC= 30;// in V
9 R_B= 3*10^6;// in
10 bitamin= 100;// unit less
11 bitamax= 300;// unit less
12 I_B= (V_CC-V_BE)/R_B;// in A
13 // The minimum value of collector current
14 I_Cmin= bitamin*I_B;// in A
15 // The maximum value of collector current
16 I_Cmax= bitamax*I_B;// in A
17 I_Cmin= I_Cmin*10^3;// in mA
18 I_Cmax= I_Cmax*10^3;// in mA
19 disp(I_Cmin,"The minimum value of collector current
    in mA is : ");
20 disp(I_Cmax,"The maximum value of collector current
    in mA is : ");

```

---

### Scilab code Exa 5.9 IC and VCE

```
1 // Example 5.9
2 format('v',5)
3 clc;
4 clear;
5 close;
6 // given data
7 V_BE= 0.7; //in V
8 V_CC= 15; // in V
9 R_E= 100; // in
10 R_C= 910; // in
11 R_B= 430*10^3; // in
12 bita= 300; // unit less
13 // The collector current ,
14 I_C= (V_CC-V_BE)/(R_E+R_B/bita); // in A
15 I_C= I_C*10^3; // in mA
16 disp(I_C,"The value of I_C in mA is : ");
17 I_C= I_C*10^-3; // in A
18 // The collector to emitter voltage ,
19 V_CE= V_CC-I_C*(R_C+R_E); // in V
20 disp(V_CE,"The value of V_CE in volts is : ")
```

---

### Scilab code Exa 5.10 IC and VCE

```
1 // Example 5.10
2 format('v',6)
3 clc;
4 clear;
5 close;
6 // given data
7 V_BE= 0.7; //in V
```

```

8 V_CC= 15; // in V
9 R_C= 1*10^3; // in
10 R_B= 200*10^3; // in
11 bita= 300; // unit less
12 // The collector current ,
13 I_C= (V_CC-V_BE)/(R_C+R_B/bita); // in A
14 I_C=I_C*10^3; // in mA
15 disp(I_C,"The value of I_C in mA is : ");
16 I_C=I_C*10^-3; // in A
17 // The collector to emitter voltage ,
18 V_CE= V_CC-I_C*R_C; // in V
19 disp(V_CE,"The value of V_CE in volts is : ")

```

---

#### Scilab code Exa 5.11 IC and VCE

```

1 // Example 5.11
2 format('v',5)
3 clc;
4 clear;
5 close;
6 // given data
7 V_BE= 0.7; //in V
8 V_CC= 15; // in V
9 V_EE= 15; // in V
10 R_E= 10*10^3; // in
11 R_C= 5.1*10^3; // in
12 I_E= (V_EE-V_BE)/R_E; // in A
13 // The collector current ,
14 I_C= I_E; // in A
15 V_C= V_CC-I_C*R_C; // in A
16 V_E= -V_BE; // in V
17 V_CE= V_C-V_E; // in V
18 // The collector to emitter voltage ,
19 V_CE= V_CC+V_EE-I_C*(R_C+R_E)
20 I_C= I_C*10^3; // in mA

```

```
21 disp(I_C,"The value of I_C in mA is : ");
22 disp(V_CE,"The value of V_CE in volts is : ")
```

---

### Scilab code Exa 5.12 DC voltage

```
1 // Example 5.12
2 format('v',5)
3 clc;
4 clear;
5 close;
6 // given data
7 V_BE= 0.7; //in V
8 V_CC= 30; // in V
9 Vz= 6; // in V
10 R_E= 3*10^3; // in
11 R_C= 4*10^3; // in
12 I_E= (Vz-V_BE)/R_E; // in A
13 I_C= I_E; // in A
14 // For first stage the collector voltage to ground
15 V_C= V_CC-I_C*R_C; // in v
16 disp(V_C,"For first stage the collector voltage to
    ground in volts is : ")
17 Vz= 10; // in V
18 R_E= 2*10^3; //in
19 R_C= 3*10^3; // in
20 I_E= (Vz-V_BE)/R_E; // in A
21 I_C= I_E; // in A
22 // For second stage the collector voltage to ground
23 V_C= I_C*R_C; // in v
24 disp(V_C,"For second stage the collector voltage to
    ground in volts is : ")
```

---

# Chapter 6

## Common Emitter Approximations

Scilab code Exa 6.2 Total voltage

```
1 // Example 6.2
2 format('v',4)
3 clc;
4 clear;
5 close;
6 // given data
7 R1= 10; // in
8 R2= 10010; // in
9 V1= 10; // in V
10 // The total voltage across the 10 resistance
11 V= R1/R2*V1; // in V
12 V= V*10^3; // in mV
13 disp(V,"The total voltage across the 10
    resistance in mV is :");
```

---

Scilab code Exa 6.3 Total current



```

1 // Example 6.3
2 format('v',6)
3 clc;
4 clear;
5 close;
6 // given data
7 R= 10*10^3;// in
8 V_CC= 15;// in V
9 V_BE= 0.7;// in V
10 Vt= 25*10^-3;// in V
11 Vp= 1*10^-3;// in V
12 I= (V_CC-V_BE)/R;// in A
13 r_ac= Vt/I;// in
14 // The total current through diode
15 Ip= Vp/r_ac;// in A
16 Ip= Ip*10^6;// in A
17 disp(Ip,"The total current through diode in A is :
    ")

```

---

#### Scilab code Exa 6.4 Input impedance

```

1 // Example 6.4
2 format('v',5)
3 clc;
4 clear;
5 close;
6 // given data
7 R1= 47*10^3;// in
8 R2= 15*10^3;// in
9 R_E= 8.2*10^3;// in
10 R_C= 10*10^3;// in
11 R3= 3.3*10^3;// in
12 bita= 200;
13 V_CC= 30;// in V
14 V_BE= 0.7;// in V

```

```

15 Vin= 5*10^-3; // in V
16 Vt= 25*10^-3; // in V
17 V2= R2*V_CC/(R1+R2); // in V
18 // DC voltage across emitter
19 V_E= V2-V_BE; // in V
20 // Emitter current
21 I_E= V_E/R_E; // in A
22 r_desh_e= Vt/I_E; // in
23 r_L= R_C*R3/(R_C+R3); // in
24 A= r_L/r_desh_e;
25 // The output voltage
26 Vout= A*Vin; // in V
27 Zin_base= beta*r_desh_e; // in
28 // The input impedance of amplifier
29 Zin= R1*R2*Zin_base/(R2*Zin_base+R1*Zin_base+R1*R2);
    // in
30 Vout= Vout*10^3; // in mV
31 Zin= Zin*10^-3; // in k ohm
32 disp(Vout,"The output voltage in mV is : ")
33 disp(Zin,"The input impedance of amplifier in k ohm is
    : ")

```

---

#### Scilab code Exa 6.5 Value of VB

```

1 // Example 6.5
2 format('v',5)
3 clc;
4 clear;
5 close;
6 // given data
7 R1= 10*10^3; // in
8 R2= 2.2*10^3; // in
9 R_C= 3.6*10^3; // in
10 V_CC= 10; // in V
11 I_C= 1.1*10^-3; // in A

```

```

12 // The base voltage
13 V_B= R2*V_CC/(R1+R2); // in V
14 // The collector voltage
15 V_C= V_CC-I_C*R_C; // in V
16 disp(V_B,"The base voltage in V is : ")
17 disp(V_C,"The collector voltage in V is : ")

```

---

#### Scilab code Exa 6.6 Ac output voltage

```

1 // Example 6.6
2 format('v',6)
3 clc;
4 clear;
5 close;
6 // given data
7 V2= 1.1; // in V
8 Vin= 1*10^-3; // in V
9 Vt= 25*10^-3; // in V
10 R2= 1*10^3; // in
11 R_C= 3.6*10^3; // in
12 I_E= V2/R2; // in A
13 // Emitter diode ac resistance
14 r_desh_e= Vt/I_E; // in
15 A= R_C/r_desh_e;
16 // The output voltage
17 Vout= A*Vin; // in V
18 Vout= Vout*10^3; // in mV
19 disp(Vout,"The output voltage in mV is : ")

```

---

#### Scilab code Exa 6.7 Minimum and maximum voltage gain

```

1 // Example 6.7
2 format('v',5)

```

```

3  clc;
4  clear;
5  close;
6  // given data
7  R_C= 10*10^3;// in
8  R_L= 82*10^3;// in
9  r_E= 1*10^3;// in
10 r_desh_e_min= 50;// in
11 r_desh_e_max= 100;// in
12 r_L= R_C*R_L/(R_C+R_L);// in
13 // The minimum voltage gain
14 A_min= r_L/r_desh_e_max;
15 // The maximum voltage gain
16 A_max= r_L/r_desh_e_min;
17 disp(A_min,"The minimum voltage gain is : ")
18 disp(A_max,"The maximum voltage gain is : ")

```

---

#### Scilab code Exa 6.8 Input impedance of the amplifier

```

1  // Example 6.8
2  format('v',5)
3  clc;
4  clear;
5  close;
6  // given data
7  bita= 200;
8  R1= 47*10^3;// in
9  R2= 15*10^3;// in
10 r_E= 1*10^3;// in
11 r_desh_e= 50;// in
12 Zin_base= bita*(r_E+r_desh_e);// in
13 // The input impedance of the amplifier
14 Zin= R1*R2*Zin_base/(R1*R2+R1*Zin_base+R2*Zin_base);
    // in
15 Zin= Zin*10^-3;// in k ohm

```

```
16 disp(Zin,"The input impedance of the amplifier in  
k is : ")
```

---

### Scilab code Exa 6.9 Input impedance of each stage

```
1 // Example 6.9  
2 format('v',5)  
3 clc;  
4 clear;  
5 close;  
6 // given data  
7 bita= 150;  
8 R1= 10*10^3;// in  
9 R2= 2.2*10^3;// in  
10 R_E= 1*10^3;// in  
11 V_CC= 10;// in V  
12 V_BE= 0.7;// in V  
13 Vt= 25*10^-3;// in V  
14 V_B= R2*V_CC/(R1+R2);// in V  
15 V_E= V_B-V_BE;// in V  
16 // The emitter current ,  
17 I_E= V_E/R_E;// in A  
18 r_desh_e= Vt/I_E;// in  
19 Zin_base= bita*r_desh_e;// in  
20 // The input impedance of each stage  
21 Zin= R1*R2*Zin_base/(R1*R2+R1*Zin_base+R2*Zin_base);  
    // in  
22 Zin= Zin*10^-3;// in k ohm  
23 disp(Zin,"The input impedance of each stage in k  
    is : ")
```

---

### Scilab code Exa 6.10 Ac output voltage across the final load resistor

```

1 // Example 6.10
2 format('v',5)
3 clc;
4 clear;
5 close;
6 // given data
7 bita= 150;
8 R1= 10*10^3;// in
9 R2= 2.2*10^3;// in
10 R_E= 1*10^3;// in
11 R_s= 1*10^3;// in
12 R_C= 3.6*10^3;// in
13 R_L= 1.5*10^3;// in
14 V_CC= 10;// in V
15 V_BE= 0.7;// in V
16 V_t= 25*10^-3;// in V
17 V_in= 1*10^-3;// in V
18 V_B= R2*V_CC/(R1+R2);// in V
19 V_E= V_B-V_BE;// in V
20 I_E= V_E/R_E;// in A
21 r_desh_e= V_t/I_E;// in
22 Zin_base= bita*r_desh_e;// in
23 Zin= R1*R2*Zin_base/(R1*R2+R1*Zin_base+R2*Zin_base);
    // in
24 Vb1= Zin*V_in/(R_s+Zin);// in V
25 r_L= R_C*Zin/(R_C+Zin);// in
26 V_B= R2*V_CC/(R1+R2);// in V
27 V_E= V_B-V_BE;// in V
28 I_E= V_E/R_E;// in A
29 r_desh_e= V_t/I_E;// in
30 A1= r_L/r_desh_e;
31 Vb2= A1*Vb1;// in V
32 r_L= R_C*R_L/(R_C+R_L);// in
33 A2= r_L/r_desh_e;
34 // The ac output voltage across the final load
    resistor
35 Vout= A2*Vb2;// in V
36 A= A1*A2;

```

```

37 Vout= A*Vb1;// in V
38 disp(Vout,"The ac output voltage across the final
    load resistor in volts is : ")

```

---

### Scilab code Exa 6.11 Ac voltage at the final output

```

1 // Example 6.11
2 format('v',6)
3 clc;
4 clear;
5 close;
6 // given data
7 bita= 150;
8 R1= 10*10^3;// in
9 R2= 2.2*10^3;// in
10 R_C= 3.6*10^3;// in
11 Rs= 1*10^3;// in
12 R_L= 1.5*10^3;// in
13 r_E= 180;// in
14 R_E= 1*10^3;// in
15 V_CC= 10;// in V
16 V_BE= 0.7;// in V
17 Vt= 25*10^-3;// in V
18 Vin= 1*10^-3;// in V
19 V_B= R2*V_CC/(R1+R2);// in V
20 V_E= V_B-V_BE;// in V
21 I_E= V_E/R_E;// in A
22 r_desh_e= Vt/I_E;// in
23 Zin_base= bita*(r_desh_e+r_E);// in
24 Zin= R1*R2*Zin_base/(R1*R2+R1*Zin_base+R2*Zin_base);
    // in
25 r_L= R_C*Zin/(R_C+Zin);// in
26 A1= r_L/(r_E+r_desh_e);
27 r_L= R_C*R_L/(R_C+R_L);// in
28 A2= r_L/(r_desh_e+r_E);

```

```
29 A= A1*A2;
30 Vb1= Zin*Vin/(Rs+Zin);// in V
31 // The ac voltage at the final output
32 Vout= A*Vb1;// in V
33 Vout= Vout*10^3;// in mV
34 disp(Vout,"The ac voltage at the final output in mV
    is : ")
```

---



# Chapter 7

## Common Collector Approximations

Scilab code Exa 7.1 DC load line and Q point

```
1 // Example 7.1
2 format('v',6)
3 clc;
4 clear;
5 close;
6 // given data
7 V_CC= 10; // in V
8 R_E= 430; // in
9 V_BE= 0.7; //in V
10 V_B= 5; //in V
11 // The collector saturation current ,
12 I_Csat= V_CC/R_E; // in A
13 // The collector emitter voltage ,
14 V_CEcuttoff= V_CC; // in V
15 // The collector current ,
16 I_C= (V_B-V_BE)/R_E; // in A
17 // The collector emitter voltage ,
18 V_CE= V_CC-(V_B-V_BE); // in V
19 I_C= I_C*10^3; // in mA
```

```

20 disp("Q-point is : "+string(V_CE)+" V, "+string(I_C)
    +" mA");
21 disp("DC load line shown in figure")
22 I_C= I_C*10^-3; // in A
23 V_CE= 0:0.1:V_CEcutoff; // in V
24 I_C= (V_CC-V_CE)/R_E*10^3; // in mA
25 // The plot of DC load line
26 plot(V_CE,I_C);
27 xlabel("V_CE in volts");
28 ylabel("I_C in mA");
29 title("DC load line")

```

---

#### Scilab code Exa 7.2 AC output voltage

```

1 // Example 7.2
2 format('v',5)
3 clc;
4 clear;
5 close;
6 // given data
7 Vin= 100; // in mV
8 Vin= Vin*10^-3; // in V
9 R_E= 430; // in
10 R_L= 1*10^3; // in
11 r_e= 2.5; // in
12 // The ac load resistance,
13 r_L= R_E*R_L/(R_E+R_L); // in
14 A= r_L/(r_L+r_e); // unit less
15 // The output voltage
16 Vout= A*Vin; // in V
17 Vout= Vout*10^3; // in mV
18 disp(Vout,"The output voltage in mV is : ")

```

---

### Scilab code Exa 7.3 Voltage gain

```
1 // Example 7.3
2 format('v',5)
3 clc;
4 clear;
5 close;
6 // given data
7 R_E= 430; // in
8 R_L= 100; // in
9 R1= 10*10^3; // in
10 R2= 10*10^3; // in
11 bita= 200; // unit less
12 r_e= 2.5; // in
13 r_L= R_E*R_L/(R_E+R_L); // in
14 // The voltge gain
15 A= r_L/(r_L+r_e);
16 disp(A,"The voltge gain is : ")
17 Zin_base= bita*(r_L+r_e); // in
18 // The input impedance
19 Zin= R1*R2*Zin_base/(R1*R2+R2*Zin_base+Zin_base*R1);
    // in
20 Zin= Zin*10^-3; // in k ohm
21 disp(Zin,"The input impedance in k is : ")
```

---

### Scilab code Exa 7.4 Power gain

```
1 // Example 7.4
2 format('v',6)
3 clc;
4 clear;
5 close;
6 // given data
7 R_E= 430; // in
8 R_L= 100; // in
```

```

9 R1= 10*10^3; // in
10 R2= 10*10^3; // in
11 bita= 200;
12 r_e= 2.5; // in
13 // The load resistance
14 r_L= R_E*R_L/(R_E+R_L); // in
15 // The power gain
16 G= bita*r_L/(r_L+r_e);
17 disp(G,"The power gain is : ")

```

---

#### Scilab code Exa 7.5 AC output voltage

```

1 // Example 7.5
2 format('v',5)
3 clc;
4 clear;
5 close;
6 // given data
7 R_C= 5*10^3; // in
8 r_e= 25; // in
9 Vin= 1*10^-3; // in V
10 R_L= 1*10^3; // in
11 A= R_C/r_e;
12 // Thevenin voltage ,
13 V_TH= A*Vin; // in V
14 // The ac output voltage
15 Vout= R_L*V_TH/(R_C+R_L); // in V
16 Vout= Vout*10^3; // in mV
17 disp(Vout,"The ac output voltage in mV is : ")

```

---

#### Scilab code Exa 7.7 AC output voltage

```

1 // Example 7.7

```

```

2 format('v',5)
3 clc;
4 clear;
5 close;
6 // given data
7 V_B= 1.8; // in V
8 V_E= 1.1; // in V
9 V_TH= 200*10^-3; // in V
10 I_E= 1*10^-3; // in A
11 r_e= 2.5; //in
12 bita=200;
13 V_CC= 10; // in V
14 R_C= 5*10^3; // in
15 R_E= 430; // in
16 R_L= 1*10^3; //in
17 I_C= I_E; // in A
18 // The collector voltage ,
19 V_C= V_CC-I_C*R_C; // in V
20 V_E= 4.3; // in V
21 // The emitter current ,
22 I_E= V_E/R_E; // in A
23 // The base current ,
24 I_B= I_E/bita; // in A
25 // The load resistance ,
26 r_L= R_E*R_L/(R_E+R_L); // in
27 Zin= bita*(r_L+r_e); // in
28 Vin= Zin*V_TH/(R_C+Zin); // in V
29 // The ac output voltage
30 Vout= r_L*Vin/(r_L+r_e); //in V
31 Vout= Vout*10^3; // in mV
32 disp(Vout,"The ac output voltage in mV is : ")

```

---

Scilab code Exa 7.9 re1 and re2

```
1 // Example 7.9
```

```

2 format('v',6)
3 clc;
4 clear;
5 close;
6 // given data
7 R1= 100;//in k
8 R2= 100;//in k
9 R3= 360;//in
10 bita= 100;
11 V1= 5;// in V
12 v1= 1.4;// in V
13 v2= 25;// in mV
14 // Voltage at first base
15 V2= R1/R2*V1;// in V
16 // Emitter current in second transistor
17 I_E2= (V2-v1)/R3;// in A
18 I_E2= I_E2*10^3;// in mA
19 // Resistance of second emitter diode ,
20 r_desh_e2= v2/I_E2;// in
21 // Base current
22 I_B2= I_E2/bita;// in mA
23 // Emitter current ,
24 I_E1= I_B2;// in mA
25 // First emitter diode resistance
26 r_desh_e1= v2/I_E1;// in
27 disp(r_desh_e2,"The value of r''e2 in is : ")
28 disp(r_desh_e1,"The value of r''e1 in is : ")

```

---

### Scilab code Exa 7.10 Input impedance

```

1 // Example 7.10
2 format('v',5)
3 clc;
4 clear;
5 close;

```

```

6 // given data
7 R_E= 360; // in
8 R_L= 1*10^3; // in
9 R1= 100*10^3; //in
10 R2= 100*10^3; //in
11 r_desh_e1= 250; // in
12 r_desh_e2= 2.5; // in
13 h_FE= 100;
14 h_fe= 100;
15 // The load resistance ,
16 r_L= R_E*R_L/(R_E+R_L); // in
17 Zin1= h_FE*h_fe*r_L; // in
18 Zin= R1*R2*Zin1/(R1*R2+R2*Zin1+Zin1*R1); // in
19 Zin2= h_FE*(r_L+r_desh_e2); // in
20 Zin1= h_FE*(Zin2+r_desh_e1); // in
21 // The input impedance
22 Zin= R1*R2*Zin1/(R1*R2+R2*Zin1+Zin1*R1); // in
23 Zin= Zin*10^-3; // in k ohm
24 disp(Zin,"The input impedance in k is : ")

```

---

#### Scilab code Exa 7.11 Zener current

```

1 // Example 7.11
2 format('v',5)
3 clc;
4 clear;
5 close;
6 // given data
7 Vin= 20; // in V
8 Vz= 10; // in V
9 Rs= 680; // in
10 V_BE= 0.7; // in V
11 R_L= 15; // in
12 bita= 80;
13 Is= (Vin-Vz)/Rs; // in A

```

```
14 Vout= Vz-V_BE; // in V
15 I_E= Vout/R_L; // in A
16 I_L= I_E; // in A
17 I_B= I_E/beta; // in A
18 // The current through the zener diode
19 Iz= Is-I_B; // in A
20 V_CE= Vin-Vout; // in V
21 // The transistor power dissipation
22 Po= I_L*(Vin-Vout); // in W
23 Iz= Iz*10^3; // in mA
24 disp(Iz,"The current through the zener diode in mA
      is : ");
25 disp(Po,"The transistor power dissipation in watt is
      : ")
```

---



# Chapter 8

## Common Base Approximations

Scilab code Exa 8.1 Value of VCB

```
1 // Example 8.1
2 format('v',6)
3 clc;
4 clear;
5 close;
6 // given data
7 V_EE= 10; // in V
8 V_BE= 0.7; // in V
9 R_E= 20*10^3; // in
10 V_CC= 25; // in V
11 R_C= 10*10^3; // in
12 // The emitter current
13 I_E= (V_EE-V_BE)/R_E; // in A
14 I_C= I_E; // in A
15 // The collector to base voltage ,
16 V_CB= V_CC-I_C*R_C; // in V
17 disp(V_CB,"The value of V_CB in volts is : ")
```

---

Scilab code Exa 8.2 Value of VCB

```

1 // Example 8.2
2 format('v',5)
3 clc;
4 clear;
5 close;
6 // given data
7 V_EE= 12;// in V
8 V_BE= 0.7;// in V
9 R_E= 5.6*10^3;// in
10 V_CC= 15;// in V
11 R_C= 6.8*10^3;// in
12 // The emitter current,
13 I_E= (V_EE-V_BE)/R_E;// in A
14 I_C= I_E;// in A
15 // The collector to base voltage
16 V_CB= V_CC-I_C*R_C;// in V
17 disp(V_CB,"The value of V_CB in volts is : ")
18
19 // Note : The answer in the book is not accurate.

```

---

### Scilab code Exa 8.3 Output voltage

```

1 // Example 8.3
2 format('v',6)
3 clc;
4 clear;
5 close;
6 // given data
7 V_EE= 15;// in V
8 V_BE= 0.7;// in V
9 R_E= 22*10^3;// in
10 Vin= 2*10^-3;// in V
11 V= 25*10^-3;// in V
12 R1= 10*10^3;// in
13 R2= 30*10^3;// in

```

```

14 I_E= (V_EE-V_BE)/R_E;// in A
15 // The ac resistance of emitter diode ,
16 r_desh_e= V/I_E;// in
17 r_L= R1*R2/(R1+R2);// in
18 // The voltage gain
19 A= r_L/r_desh_e;
20 // The output voltage
21 Vout= A*Vin;// in V
22 Vout= Vout*10^3;// in mV
23 disp(Vout,"The output voltage in mV is : ")

```

---

#### Scilab code Exa 8.4 Output voltage

```

1 // Example 8.4
2 format('v',5)
3 clc;
4 clear;
5 close;
6 // given data
7 V_EE= 10;// in V
8 V_BE= 0.7;// in V
9 R_E= 6.8*10^3;// in
10 Rs= 100;// in
11 R1= 3.3*10^3;// in
12 R2= 1.5*10^3;// in
13 V= 25*10^-3;// in V
14 Vs= 1*10^-3;// in V
15 I_E= (V_EE-V_BE)/R_E;// in A
16 r_desh_e= V/I_E;// in
17 Zin= r_desh_e;// in
18 // The input voltage to the emitter ,
19 Vin= Zin*Vs/(Rs+Zin);// in V
20 r_L= R1*R2/(R1+R2);// in
21 // The voltage gain ,
22 A= r_L/r_desh_e;

```

```
23 // The output voltage
24 Vout= A*Vin;// in V
25 Vout= Vout*10^3;// in mV
26 disp(Vout,"The output voltage in mV is : ")
```

---

# Chapter 9

## Class A Power Amplifiers

Scilab code Exa 9.1 DC and AC load line

```
1 // Example 9.1
2 format('v',6)
3 clc;
4 clear;
5 close;
6 // given data
7 V_CC= 10; // in V
8 V_BE= 0.7; // in V
9 R1= 2.2; // in k
10 R2= 10; // in k
11 R_E= 1; // in k
12 R_C= 3.6; // in k
13 R= 1.5; // in k
14 // The base voltage
15 V_B= R1*V_CC/(R1+R2); // in V
16 // The emitter current,
17 I_E= (V_B-V_BE)/R_E; // in mA
18 // The collector current,
19 I_CQ= I_E; // in mA
20 // The collector emitter voltage,
21 V_CE= V_CC-I_E*(R_C+R_E); // in V
```

```

22 V_CEQ= V_CE;// in V
23 // The saturation current ,
24 I_Csat= V_CC/(R_C+R_E);// in mA
25 V_CEcutoff= V_CC;// in V
26 V_CE= 0:0.1:V_CEcutoff;// in V
27 I_C= (V_CC-V_CE)/(R_C+R_E);// in mA
28 // The dc and ac load line
29 subplot(121)
30 plot(V_CE,I_C)
31 xlabel("V_CE in volts")
32 ylabel("I_C in mA");
33 title("DC load line")
34 r_L= R_C*R/(R_C+R);// in k
35 I_Csat= I_CQ+V_CEQ/r_L;// in mA
36 Vce_cutoff= V_CEQ+I_CQ*r_L;// in V
37 x=[0 Vce_cutoff];
38 y=[I_Csat 0]
39 subplot(122)
40 plot(x,y)
41 xlabel("V_CE in volts")
42 ylabel("I_C in mA");
43 title("AC load line")
44 disp("DC and AC load line shown in figure.")

```

---

### Scilab code Exa 9.2 Cut off value of VCE

```

1 // Example 9.2
2 format('v',5)
3 clc;
4 clear;
5 close;
6 // given data
7 V_BE= 0.7;// in V
8 V_CC= 30;// in V
9 R_E= 8.2;// in

```

```

10 R1= 22; // in
11 R2= 47; // in
12 R_C= 10; // in
13 R_L= 30; //in
14 // The base to ground voltage ,
15 V_B= R1*V_CC/(R1+R2); // in V
16 // The emitter current ,
17 I_E= (V_B-V_BE)/R_E; // in A
18 // The collector current ,
19 I_CQ= I_E; // in A
20 // The collector emitter voltage ,
21 V_CEQ= V_CC-I_E*(R_E+R_C); // in V
22 // The load resistance ,
23 r_L= R_C*R_L/(R_C+R_L); // in
24 I_Csat= I_E+V_CEQ/r_L; // in A
25 Vce_cutoff= V_CEQ+I_CQ*r_L; // in V
26 disp(Vce_cutoff,"The cut off value of V_CE in volts
    is : ")

```

---

### Scilab code Exa 9.3 cutt of value of VCE

```

1 // Example 9.3
2 format('v',6)
3 clc;
4 clear;
5 close;
6 // given data
7 V_BE= 0.7; // in V
8 V_CC= 20; // in V
9 V_B= 10; // in V
10 R_E= 50; // in
11 // The collector current ,
12 I_CQ= (V_B-V_BE)/R_E; // in A
13 // The collector emitter voltage ,
14 V_CEQ= V_CC-I_CQ*R_E; // in V

```

```

15 R1= 50; // in
16 R2= 50; // in
17 // The load resistance ,
18 r_L= R1*R2/(R1+R2); // in
19 I_Csat= I_CQ+V_CEQ/r_L; // in A
20 Vce_cutoff= V_CEQ+I_CQ*r_L; // in V
21 disp(Vce_cutoff,"The cut off value of V_CE in volts
      is : ")

```

---

#### Scilab code Exa 9.4 AC compliance

```

1 // Example 9.4
2 format('v',5)
3 clc;
4 clear;
5 close;
6 // given data
7 V_E= 1; // in V
8 R_E=1*10^3; // in
9 V_CC= 10; // in V
10 R_C= 4*10^3; // in
11 R_L= 10*10^3; // in
12 // The collector current ,
13 I_CQ= V_E/R_E; // in A
14 I_C= I_CQ; // in A
15 // The collector emitter voltage ,
16 V_CEQ= V_CC-I_C*(R_C+R_E); // in V
17 // The load resistance ,
18 r_L= R_L*R_C/(R_L+R_C); // in
19 //The ac compliance ,
20 PP= 2*I_CQ*r_L; // in V
21 disp(PP,"The ac compliance in volts is : ")

```

---



### Scilab code Exa 9.5 Value of ICQrL

```
1 // Example 9.5
2 format('v',5)
3 clc;
4 clear;
5 close;
6 // given data
7 V_E= 1;// in V
8 R_E=1*10^3;// in
9 R_C= 4*10^3;// in
10 V_CC= 10;// in V
11 I_CQ= V_E/R_E;// in A
12 I_C= I_CQ;// in A
13 V_CEQ= V_CC-I_C*(R_C+R_E);// in V
14 // (i) when R_L = 1 M , the value of 2I_CQrL
15 R_L= 1*10^6;// in
16 r_L= R_L*R_C/(R_L+R_C);// in
17 I_CQrL= I_CQ*r_L;//in A
18 disp(2*I_CQrL,"When R_L = 1 M , the value of 2
    I_CQrL in volts is : ")
19 // (ii) when R_L = 100 k , the value of 2I_CQrL
20 R_L= 100*10^3;// in
21 r_L= R_L*R_C/(R_L+R_C);// in
22 I_CQrL= I_CQ*r_L;//in A
23 disp(2*I_CQrL,"When R_L = 100 k , the value of 2
    I_CQrL in volts is : ")
24 // (iii) when R_L = 10 k , the value of 2I_CQrL
25 R_L= 10*10^3;// in
26 r_L= R_L*R_C/(R_L+R_C);// in
27 I_CQrL= I_CQ*r_L;//in A
28 disp(2*I_CQrL,"When R_L = 10 k , the value of 2
    I_CQrL in volts is : ")
29 // (iv) when R_L = 1 k , the value of 2I_CQrL
30 R_L= 1*10^3;// in
31 r_L= R_L*R_C/(R_L+R_C);// in
32 I_CQrL= I_CQ*r_L;//in A
33 disp(2*I_CQrL,"When R_L = 1 k , the value of 2
```

```

    I_CQrL in volts is : ")
34 // (v) when R_L = 100    , the value of 2I_CQrL
35 R_L= 100;// in
36 r_L= R_L*R_C/(R_L+R_C);// in
37 I_CQrL= I_CQ*r_L;//in A
38 disp(2*I_CQrL,"When R_L = 100    , the value of 2
    I_CQrL in volts is : ")

```

---

### Scilab code Exa 9.6 Voltage divider biased stage

```

1 // Example 9.6
2 format('v',6)
3 clc;
4 clear;
5 close;
6 // given data
7 V_CC= 12;// in V
8 V_BE= 0.7;// in V
9 I_CQ= 5*10^-3;// in A
10 bita= 200;// unit less
11 // The emitter voltage ,
12 V_E= 0.1*V_CC;// in V
13 // The emitter current ,
14 I_E= I_CQ;// in A
15 // The emitter resistance ,
16 R_E= V_E/I_E;// in
17 // The collector resistance ,
18 R_C= 4*R_E;// in
19 // The base voltage ,
20 V_B= V_E+V_BE;// in V
21 I_C= I_CQ;// in A
22 I_B= I_C/bita;// in A
23 R= V_CC/(10*I_B);// in
24 R2= V_B/(10*I_B);// in
25 R1= R-R2;// in

```

```

26 R1= R1*10^-3; // in k ohm
27 R2= R2*10^-3; // in k ohm
28 R_C= R_C*10^-3; // in k ohm
29 disp("The value of R1 is      : "+string(R1)+" k      (
    standard value : 39 k  )")
30 disp("The value of R2 is      : "+string(R2)+" k      (
    standard value : 7.5 k  )")
31 disp("The value of R_E is     : "+string(R_E)+"      (
    standard value : 240    )")
32 disp("The value of R_C is     : "+string(R_C)+" k      (
    standard value : 1 k   )")

```

---

#### Scilab code Exa 9.7 AC compliance

```

1 // Example 9.7
2 format('v',6)
3 clc;
4 clear;
5 close;
6 // given data
7 I_CQ= 5*10^-3; // in A
8 R_C= 1*10^3; // in
9 R_L= 1*10^3; // in
10 // The load resistance
11 r_L= R_C*R_L/(R_C+R_L); // in
12 // The ac compliance ,
13 PP= 2*I_CQ*r_L; // in V
14 I_CQ= 5.15*10^-3; // in A
15 PP= 2*I_CQ*r_L; // in V
16 disp(PP,"The ac compliance in volts is : ")

```

---

#### Scilab code Exa 9.9 New value of AC compliance

```

1 // Example 9.9
2 format('v',6)
3 clc;
4 clear;
5 close;
6 // given data
7 V_CC= 12;// in V
8 V_BE= 0.7;// in V
9 R_C= 1*10^3;// in
10 R_E= 240;// in
11 r_L= 500;// in
12 beta= 200;// unit less
13 // The required collector current ,
14 I_CQ= V_CC/(R_C+R_E+r_L);// in A
15 // The emitter voltage ,
16 V_E= I_CQ*R_E;// in V
17 // The base voltage ,
18 V_B= V_E+V_BE;// in V
19 I_C= I_CQ;// in A
20 I_B= I_C/beta;// in A
21 // The total resistance of the voltage divider ,
22 R= V_CC/(10*I_B);// in
23 R2= V_B/(10*I_B);// in
24 R1= R-R2;// in
25 R1= R1*10^-3;// in k ohm
26 R2= R2*10^-3;// in k ohm
27 R_C= R_C*10^-3;// in k ohm
28 disp("The value of R1 is      : "+string(R1)+" k      (
    standard value : 27 k  )")
29 disp("The value of R2 is      : "+string(R2)+" k      (
    standard value : 6.8 k  )")
30 disp("The value of R_E is     : "+string(R_E)+"      (
    standard value : 240   )")
31 disp("The value of R_C is     : "+string(R_C)+" k      (
    standard value : 1 k   )")

```

---

### Scilab code Exa 9.10 Maximum ac load power

```
1 // Example 9.10
2 format('v',6)
3 clc;
4 clear;
5 close;
6 // given data
7 R_C= 3.6; // in k
8 R_L= 1.5; // in k
9 V_CEQ= 4.94; // in V
10 I_CQ= 1.1; // in mA
11 // The quiescent power dissipation of the transistor
12 P_DQ= V_CEQ*I_CQ; // in mW
13 r_L= R_C*R_L/(R_C+R_L); // in k
14 PP= 2*I_CQ*r_L; // in V
15 // The maximum ac load power,
16 P_Lmax= PP^2/(8*R_L); // in mW
17 disp(P_Lmax,"The maximum ac load power in mW is : ")
```

---

### Scilab code Exa 9.11 Efficiency

```
1 // Example 9.11
2 format('v',6)
3 clc;
4 clear;
5 close;
6 // given data
7 V_E= 1.71; // in V
8 R_E= 240; // in
9 V_CC= 12; // in V
```

```

10 R_C= 1*10^3; // in
11 R_L= 1*10^3; // in
12 I= 0.355*10^-3; // in A
13 I_CQ= V_E/R_E; // in A
14 I_C= I_CQ; // in A
15 // The collector emitter voltage ,
16 V_CEQ= V_CC-I_C*(R_C+R_E); // in V
17 r_L= R_C*R_L/(R_C+R_L); // in
18 PP= 2*V_CEQ; // in V
19 // The maximum ac load power ,
20 P_Lmax= PP^2/(8*R_L); // in W
21 I_CC= I_C+I; // in A
22 P_CC= V_CC*I_CC; // in W
23 // The efficiency
24 Eta= P_Lmax/P_CC*100; // in %
25 disp(Eta,"The efficiency in % is : ")

```

---

### Scilab code Exa 9.12 Power rating

```

1 // Example 9.12
2 format('v',6)
3 clc;
4 clear;
5 close;
6 // given data
7 Ta= 70; // ambient temperature in C
8 P= 30; // in power dissipation in W
9 theta_CS= 0.5; // in C /W
10 theta_SA= 1.5; // in C /W
11 // The case temperature
12 Tc= Ta+P*(theta_CS+theta_SA); // in C
13 // The power rating
14 P_Dmax= 60; // in W
15 disp(Tc,"The case temperature in C is : ");
16 disp(P_Dmax,"The power rating in watt is : ")

```



# Chapter 10

## Other Power Amplifiers

Scilab code Exa 10.1 PDQ PDmax and PLmax

```
1 // Example 10.1
2 format('v',6)
3 clc;
4 clear;
5 close;
6 // given data
7 V_CEQ= 7.5; // in V
8 R_L= 50; // in
9 I_Csat= V_CEQ/R_L; // in A
10 I_CQ= 0.01*I_Csat; // in A
11 P_DQ= V_CEQ*I_CQ; // in W
12 PP= 2*V_CEQ; // in V
13 P_Dmax= PP^2/(40*R_L); // in W
14 P_Lmax= PP^2/(8*R_L); // in W
15 // The value of P_DQ
16 P_DQ= P_DQ*10^3; // in mW
17 // The value of P_Dmax
18 P_Dmax= P_Dmax*10^3; // in mW
19 // The value of P_Lmax
20 P_Lmax= P_Lmax*10^3; // in mW
21 disp(P_DQ,"The value of P_DQ in mW is : ")
```



```
22 disp(P_Dmax,"The value of P_Dmax in mW is : ")
23 disp(P_Lmax,"The value of P_Lmax in mW is : ")
```

---

**Scilab code Exa 10.2** Efficiency of the amplifier with a maximum output signal

```
1 // Example 10.2
2 format('v',6)
3 clc;
4 clear;
5 close;
6 // given data
7 V_CC= 15;// in V
8 I_Csat= 150;// in mA
9 P_Lmax= 563;// in mW
10 I= 0.02*I_Csat;// in mA
11 Idc= 0.318*I_Csat;// in mA
12 I_CC= I+Idc;// in mA
13 P_CC= V_CC*I_CC;// in mW
14 // The efficiency of amplifier
15 Eta= P_Lmax/P_CC*100;// in %
16 disp(Eta,"The efficiency of amplifier in % is : ");
17
18 // Note: The answer in the book is not accurate
```

---

**Scilab code Exa 10.3** DC and AC load line

```
1 // Example 10.3
2 format('v',6)
3 clc;
4 clear;
5 close;
6 // given data
7 V_CC= 40;// in V
```

```

8 V_CEQ= 20; // in V
9 R_L= 10; // in
10 I_Csat= V_CEQ/R_L; // in A
11 V_CEcutoff= V_CEQ; // in V
12 V_CE= 0:0.1:V_CEcutoff; // in V
13 I_C= (V_CEQ-V_CE)/R_L; // in A
14 // The plot of ac load line ,
15 plot(V_CE,I_C)
16 xlabel("V_CE in volts")
17 ylabel("I_C in A")
18 title("AC load line")
19 disp("AC load line shown in figure")

```

---

#### Scilab code Exa 10.4 PDQ PDmax and PLmax

```

1 // Example 10.4
2 format('v',6)
3 clc;
4 clear;
5 close;
6 // given data
7 V_CC= 40; // in V
8 V_BE= 0.7; // in V
9 R= 1*10^3; // in
10 R_L= 10; // in
11 V_CEQ= 20; // in V
12 I_CQ= (V_CC-2*V_BE)/(2*R); // in A
13 // The value of P_DQ
14 P_DQ= V_CEQ*I_CQ; // in W
15 disp(P_DQ,"The value of P_DQ in W is : ")
16 PP= 2*V_CEQ; // in V
17 // The value of P_Lmax
18 P_Lmax= PP^2/(8*R_L); // in W
19 // The value of P_Dmax
20 P_Dmax= PP^2/(40*R_L); // in W

```

```
21 disp(P_Lmax,"The value of P_Lmax in W is : ")
22 disp(P_Dmax,"The value of P_Dmax in W is : ")
```

---

#### Scilab code Exa 10.5 Voltage gain of the driver stage

```
1 // Example 10.5
2 format('v',6)
3 clc;
4 clear;
5 close;
6 // given data
7 V_E= 1.43; // in V
8 R_E= 100; // in
9 R_L= 100; // in
10 R_C= 1*10^3; // in
11 bita= 200;
12 Vt= 25*10^-3; // in V
13 I_E= V_E/R_E; // in A
14 I_CQ= I_E; // in A
15 Zin= bita*R_L; // in
16 r_desh_e= Vt/I_CQ; // in
17 // The voltage gain of the driver stage
18 A= (R_C*Zin/(R_C+Zin))/(R_E+r_desh_e);
19 disp(A,"The voltage gain of the driver stage is : ")
20 // On ignoring Zin and r_desh_e ,
21 A= R_C/R_E;
22 disp(A,"On ignoring the value of Zin and r''e, the
    voltage gain is : ")
```

---

#### Scilab code Exa 10.6 Ideal value of PP and PLmax

```
1 // Example 10.6
2 format('v',6)
```

```

3  clc;
4  clear;
5  close;
6  // given data
7  V_CC= 30; // in V
8  PP= V_CC; // in V
9  R_L= 100; // in
10 // The value of P_Lmax
11 P_Lmax= PP^2/(8*R_L); // in W
12 disp(PP,"The value of PP in volts is : ")
13 disp(P_Lmax,"The value of P_Lmax in W is : ")

```

---

#### Scilab code Exa 10.7 Overall voltage gain

```

1 // Example 10.7
2 format('v',6)
3 clc;
4 clear;
5 close;
6 // given data
7 R_C= 1*10^3; // in
8 r_desh_e= 2.5; //in
9 Zin= 1*10^3; // in
10 A2= 10; // unit less
11 A3= 1; // unit less
12 A1= (R_C*Zin/(R_C+Zin))/r_desh_e; // unit less
13 // The overall voltage gain
14 A= A1*A2*A3;
15 disp(A,"The overall voltage gain is : ")

```

---

#### Scilab code Exa 10.8 Minimum base current that produces saturation

```

1 // Example 10.8

```

```

2 format('v',5)
3 clc;
4 clear;
5 close;
6 // given data
7 V_CC= 50; // in V
8 V_CEsat= 1; // in V
9 R_L= 5; // in
10 beta_dc= 90; // unit less
11 I_Csat= (V_CC-V_CEsat)/R_L; // in A
12 // The minimum base current that produces saturation
13 I_Bsat= I_Csat/beta_dc; // in A
14 I_Bsat= I_Bsat*10^3; // in mA
15 disp(I_Bsat,"The minimum base current that produces
    saturation in mA is : ")

```

---

#### Scilab code Exa 10.9 Input voltage required

```

1 // Example 10.9
2 format('v',5)
3 clc;
4 clear;
5 close;
6 // given data
7 I_Csat= 109*10^-3; // in A
8 beta_dc= 200;
9 R_B= 1*10^3; // in
10 V_BE1= 0.7; // in V
11 V_BE2= 1.6; // in V
12 // The base current ,
13 I_Bsat= I_Csat/beta_dc; // in A
14 // The input voltage
15 Vin= I_Bsat*R_B+V_BE1+V_BE2; // in V
16 disp(Vin,"The input voltage in volts is : ")

```

---

# Chapter 11

## More Amplifier Theory

Scilab code Exa 11.1 Closed loop voltage gain

```
1 // Example 11.1
2 format('v',5)
3 clc;
4 clear;
5 close;
6 // given data
7 r_F= 220; // in
8 r_E= 4.7; //in
9 // The closed loop voltage gain
10 A_CL= r_F/r_E+1;
11 disp(A_CL,"The closed loop voltage gain is : ")
```

---

Scilab code Exa 11.2 Alpha bita rdeshe and rdeshc

```
1 // Example 11.2
2 format('v',6)
3 clc;
4 clear;
```

```

5 close;
6 // given data
7 h_ie= 3.5*10^3;//in
8 h_fe= 120;
9 h_re= 1.3*10^-4;
10 h_oe= 8.5*10^-6;// in S
11 bita= h_fe;// unit less
12 // The value of alpha
13 alpha= h_fe/(h_fe+1);
14 disp(alpha,"The value of alpha is : ")
15 // The value of r'e
16 r_desh_e= h_ie/h_fe;// in
17 r_desh_c= h_fe/h_oe;// in
18 disp(r_desh_e,"The value of r''e in is : ")
19 // The value of r'c
20 r_desh_c= r_desh_c*10^-6;// in Mohm
21 disp(r_desh_c,"The value of r''c in M is : ")

```

---

### Scilab code Exa 11.3 Value of rdeshb

```

1 // Example 11.3
2 format('v',6)
3 clc;
4 clear;
5 close;
6 // given data
7 h_rb= 1.75*10^-4;
8 h_ob= 10^-6;// in S
9 r_desh_b= h_rb/h_ob;// in
10 disp(r_desh_b,"The value of r''b in is : ")

```

---

### Scilab code Exa 11.4 Voltage gain

```
1 // Example 11.4
2 format('v',5)
3 clc;
4 clear;
5 close;
6 // given data
7 h_fe= 120;// unit less
8 h_ie= 3.5*10^3;//in
9 r_L= 2*10^3;// in
10 h_oe= 8.5*10^-6;// in S
11 h_re= 1.3*10^-4;// unit less
12 // The voltage gain
13 A= h_fe*r_L/(h_ie*(1+h_oe*r_L)-h_re*h_fe*r_L)
14 disp(A,"The voltage gain is : ")
```

---



# Chapter 12

## JFETS

Scilab code Exa 12.1 Source voltage to ground

```
1 // Example 12.1
2 format('v',5)
3 clc;
4 clear;
5 close;
6 // given data
7 R1= 20;// in k
8 R2= 10;// in k
9 R_E= 10;// in k
10 R_D= 8.2;// in k
11 V_G= 10;// in V
12 V_BE= 0.7;// in V
13 V_GS= -2;// in V
14 V_DD= 30;// in V
15 V_B= R2*V_DD/(R1+R2);// in V
16 I_E= (V_B-V_BE)/R_E;// in mA
17 I_D= I_E;// in mA
18 // The dc voltage from the drain to ground
19 V_D= V_DD-I_D*R_D;// in V
20 // The source voltage to ground
21 Vs= V_G-V_GS;// in V
```

```

22 disp(V_D,"The dc voltage from the drain to ground in
    volts is : ");
23 disp(Vs,"The source voltage to ground in volts is :
    ")

```

---

### Scilab code Exa 12.2 Transconductance

```

1 // Example 12.2
2 format('v',6)
3 clc;
4 clear;
5 close;
6 // given data
7 gmo= 3000;// in mhoS
8 V_GSoff= -4;// in V
9 I_DSS= 10;// in mA
10 disp("Part (i) When V_GS= -1");
11 V_GS= -1;// in V
12 // The value of gm
13 gm= gmo*(1-V_GS/V_GSoff);// in S
14 disp(gm,"The value of gm in S is : ")
15 disp("Part (ii) When I_D= 2.5 mA")
16 I_D= 2.5;// in mA
17 // The value of gm
18 gm= gmo*2*I_D/I_DSS;// in S
19 disp(gm,"The value of gm in S is : ")

```

---

### Scilab code Exa 12.3 Output voltage

```

1 // Example 12.3
2 format('v',6)
3 clc;
4 clear;

```

```

5 close;
6 // given data
7 gm= 2000;// in S
8 gm=gm*10^-6;// in S
9 R_D= 4.7;// in k
10 Vin= 2;// in mV
11 R_L= 10;// in k
12 r_D= R_D*R_L/(R_D+R_L);// in k
13 r_D= r_D*10^3;// in
14 A= gm*r_D;// unit less
15 // The output voltage
16 Vout= A*Vin;// in mV
17 disp(Vout,"The output voltage in mV is : ")
18
19 // Note: The calculated value of A in the book is
    wrong. Correct value of A is : 6.39, So the
    answer in the book is wrong.

```

---

#### Scilab code Exa 12.4 Voltage gain

```

1 // Example 12.4
2 format('v',6)
3 clc;
4 clear;
5 close;
6 // given data
7 R_D= 7.5;// in k
8 R_L= 3;// in k
9 r_s= R_D*R_L/(R_D+R_L);// in k
10 r_s= r_s*10^3;// in
11 gm= 2500*10^-6;// in S
12 // The voltage gain
13 A= gm*r_s/(1+gm*r_s);// unit less
14 disp(A,"The voltage gain is : ")

```

---

# Chapter 14

## Thyristors

Scilab code Exa 14.1 Load current

```
1 // Example 14.1
2 format('v',6)
3 clc;
4 clear;
5 close;
6 // given data
7 V1=15; // in V
8 V2=1; // in V
9 R= 100; // in
10 // The load current
11 I= (V1-V2)/R; // in A
12 I= I*10^3; // in mA
13 disp(I,"The load current in mA is : ")
```

---

Scilab code Exa 14.2 Input voltage

```
1 // Example 14.2
2 format('v',6)
```

```

3  clc;
4  clear;
5  close;
6  // given data
7  I= 4; // in mA
8  I=I*10-3; // in A
9  V1=0.5; // voltage across diode in V
10 R=100; // in
11 // The input voltage
12 V= V1+I*R; // in V
13 disp(V,"The input voltage in volts is : ")

```

---

#### Scilab code Exa 14.6 Ideal emitter current

```

1  // Example 14.6
2  format('v',6)
3  clc;
4  clear;
5  close;
6  // given data
7  Eta= 0.85;
8  V= 10; // in V
9  V1= Eta*V; // in V
10 V= 20; // in V
11 R= 400; // in
12 // The emitter current
13 I_E= V/R; // in A
14 I_E= I_E*103; // in mA
15 disp(I_E,"The emitter current in mA is : ")

```

---

#### Scilab code Exa 14.7 Value of emitter supply voltage

```

1  // Example 14.7

```

```
2 format('v',6)
3 clc;
4 clear;
5 close;
6 // given data
7 V_E= 1;// in V
8 R= 400;// in
9 I= 7*10^-3;// in A
10 // The emitter supply voltage
11 V= V_E+I*R;// in V
12 disp(V,"The emitter supply voltage in volts is : ")
```

---

# Chapter 16

## Op Amp Negative Feedback

Scilab code Exa 16.1 Output voltage and error voltage

```
1 // Example 16.1
2 format('v',5)
3 clc;
4 clear;
5 close;
6 // given data
7 A=100000;//unit less
8 R1= 98*10^3;// in
9 R2= 2*10^3;// in
10 Vin= 1*10^-3;// in V
11 B= R2/(R1+R2);// unit less
12 A_CL= 1/B;// unit less
13 A_CL= A/(1+A*B);// unit less
14 // The output voltage
15 Vout= Vin*A_CL;// in V
16 // The error voltage
17 Verror= Vout/A;// in V
18 Vout= Vout*10^3;// in mV
19 Verror= Verror*10^6;// in V
20 disp(Vout,"The output voltage in mV is : ")
21 disp(Verror,"The error voltage in V is : ")
```

---

Scilab code Exa 16.2 ACL Vout and Verror

```
1 // Example 16.2
2 format('v',6)
3 clc;
4 clear;
5 close;
6 // given data
7 A=20000;
8 B= 0.02;
9 Vin= 1;// in mV
10 Vin= Vin*10^-3;// in V
11 // The closed loop voltage gain ,
12 A_CL= A/(1+A*B);
13 // The output voltage ,
14 Vout= Vin*A_CL;// in V
15 // The error voltage ,
16 Verror= Vout/A;// in V
17 Vout= Vout*10^3;// in mV
18 Verror= Verror*10^6;// in V
19 disp(A_CL,"The value of A_CL is : ");
20 disp(Vout,"The value of Vout in mV is : ")
21 disp(Verror,"The value of Verror in V is : ")
```

---

Scilab code Exa 16.3 Closed loop input and output impedance

```
1 // Example 16.3
2 format('v',6)
3 clc;
4 clear;
5 close;
```



```

6 // given data
7 A=100000;
8 R1= 100*10^3;// in
9 R2= 100;// in
10 r_in= 2*10^6;// in
11 r_out= 75;// in
12 B= R2/(R1+R2);// unit less
13 // The closed loop input impedance
14 r_in_CL= (1+A*B)*r_in;// in
15 // The closed loop output impedance
16 r_out_CL= r_out/(1+A*B);// in
17 r_in_CL=r_in_CL*10^-6;// in Mohm
18 disp(r_in_CL,"The closed loop input impedance in M
    is : ")
19 disp(r_out_CL,"The closed loop output impedance in
    is : ")

```

---

#### Scilab code Exa 16.4 Closed loop voltage gain

```

1 // Example 16.4
2 format('v',6)
3 clc;
4 clear;
5 close;
6 // given data
7 A=100;
8 R_B= 39*10^3;// in
9 r_in= 2*10^6;// in
10 r_out= 75;// in
11 Vin_off= 2*10^-3;// in V
12 I_B1= 90*10^-9;// in A
13 I_in_off= 20*10^-9;// in A
14 // The closed loop voltage gain
15 B=1;// unit less
16 // The closed-loop input impedance

```

```

17 r_in_CL= (1+A*B)*r_in; // in
18 r_in_CL= r_in_CL*10^-6; // in Mohm
19 disp(B,"The closed loop voltage gain is : ")
20 disp(r_in_CL,"The closed-loop input impedance in M
    is : ")
21 A=100000;
22 // The closed-loop output impedance
23 r_out_CL= r_out/A; // in
24 disp(r_out_CL,"The closed-loop output impedance in
    is : ")
25 //Let V= V1-V2 = Vin_off+I_B1*R_B
26 V= Vin_off+I_B1*R_B; // in A
27 // The output offset voltage
28 Voo_CL= A*V/A; // in V
29 Voo_CL= Voo_CL*10^3; // in mV
30 disp(Voo_CL,"The output offset voltage in mV is : ")

```

---

#### Scilab code Exa 16.5 Closed loop voltage gain

```

1 // Example 16.5
2 format('v',6)
3 clc;
4 clear;
5 close;
6 // given data
7 R_F= 22*10^3; // in
8 R_S= 1*10^3; // in
9 A= 100000; // unit less
10 // The closed-loop voltage gain
11 A_CL= R_F/R_S;
12 // The desensitivity
13 desensitivity= A/A_CL;
14 disp(A_CL,"The closed-loop voltage gain is : ")
15 disp(desensitivity,"The desensitivity is : ")

```

---

### Scilab code Exa 16.6 Value of FCL

```
1 // Example 16.6
2 format('v',6)
3 clc;
4 clear;
5 close;
6 // given data
7 f_unity= 1*10^6;// in Hz
8 // For A_CL= 1000, The value of f_CL
9 A_CL= 1000;
10 f_CL= f_unity/A_CL;// in Hz
11 f_CL= f_CL*10^-3;// in kHz
12 disp(f_CL,"For A_CL= 1000, The value of f_CL in kHz
    is : ")
13 // For A_CL= 100, The value of f_CL
14 A_CL= 100;
15 f_CL= f_unity/A_CL;// in Hz
16 f_CL= f_CL*10^-3;// in kHz
17 disp(f_CL,"For A_CL= 100, The value of f_CL in kHz
    is : ")
18 // For A_CL= 10, The value of f_CL
19 A_CL= 10;
20 f_CL= f_unity/A_CL;// in Hz
21 f_CL= f_CL*10^-3;// in kHz
22 disp(f_CL,"For A_CL= 10, The value of f_CL in kHz is
    : ")
23 // For A_CL= 1, The value of f_CL
24 A_CL= 1;
25 f_CL= f_unity/A_CL;// in Hz
26 f_CL= f_CL*10^-6;// in MHz
27 disp(f_CL,"For A_CL= 1, The value of f_CL in MHz is
    : ")
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