

Scilab Textbook Companion for
Semiconductor Circuit Approximations
by Malvino¹

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Book Description

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

Exa Example (Solved example)

Eqn Equation (Particular equation of the above book)

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

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

Contents

List of Scilab Codes	4
2 Rectifier Diodes	7
3 Special Diodes	12
4 Diode Applications	24
5 Bipolar Transistor	29
6 Common Emitter Approximations	38
7 Common Collector Approximations	47
8 Common Base Approximations	55
9 Class A Power Amplifiers	59
10 Other Power Amplifiers	70
11 More Amplifier Theory	77
12 JFETS	80
14 Thyristors	83
16 Op Amp Negative Feedback	86

List of Scilab Codes

Exa 2.1	Output voltage	7
Exa 2.2	Output voltage	7
Exa 2.4	Maximum reverse voltage	8
Exa 2.5	Power dissipation of the diode	9
Exa 2.6	Peak forward current and PIV	9
Exa 2.7	Peak load voltage and peak inverse voltage	10
Exa 3.1	LED current	12
Exa 3.2	LED current	12
Exa 3.4	Tuning range	14
Exa 3.5	Minimum and maximum zener current	14
Exa 3.6	Minimum and maximum output voltage	15
Exa 3.7	Maximum current	16
Exa 3.8	Value of IS IL IZ	16
Exa 3.9	Values of all currents	17
Exa 3.10	Value of Change in output voltage	19
Exa 3.11	Value of IS IL IZ	20
Exa 3.12	Value of IS IL IZ	20
Exa 4.1	DC voltage across load resistance	24
Exa 4.2	DC current through each diode	25
Exa 4.3	Value of Vdc and PIV	25
Exa 4.6	DC load voltage	26
Exa 4.8	Zener current	27
Exa 4.9	Ripple across the load current	27
Exa 5.1	Value of VCE	29
Exa 5.2	DC load line	30
Exa 5.3	Value of IC and VCE	30
Exa 5.4	LED current	31
Exa 5.5	DC voltage	32

Exa 5.6	DC collector to ground voltage	32
Exa 5.7	Value of V_c	33
Exa 5.8	Minimum and maximum collector current	34
Exa 5.9	I_C and V_{CE}	35
Exa 5.10	I_C and V_{CE}	35
Exa 5.11	I_C and V_{CE}	36
Exa 5.12	DC voltage	37
Exa 6.2	Total voltage	38
Exa 6.3	Total current	38
Exa 6.4	Input impedance	39
Exa 6.5	Value of V_B	40
Exa 6.6	Ac output voltage	41
Exa 6.7	Minimum and maximum voltage gain	41
Exa 6.8	Input impedance of the amplifier	42
Exa 6.9	Input impedance of each stage	43
Exa 6.10	Ac output voltage across the final load resistor	43
Exa 6.11	Ac voltage at the final output	45
Exa 7.1	DC load line and Q point	47
Exa 7.2	AC output voltage	48
Exa 7.3	Voltage gain	49
Exa 7.4	Power gain	49
Exa 7.5	AC output voltage	50
Exa 7.7	AC output voltage	50
Exa 7.9	r_{e1} and r_{e2}	51
Exa 7.10	Input impedance	52
Exa 7.11	Zener current	53
Exa 8.1	Value of V_{CB}	55
Exa 8.2	Value of V_{CB}	55
Exa 8.3	Output voltage	56
Exa 8.4	Output voltage	57
Exa 9.1	DC and AC load line	59
Exa 9.2	Cut off value of V_{CE}	60
Exa 9.3	cutt of value of V_{CE}	61
Exa 9.4	AC compliance	62
Exa 9.5	Value of I_{CQrL}	63
Exa 9.6	Voltage divider biased stage	64
Exa 9.7	AC compliance	65
Exa 9.9	New value of AC compliance	65

Exa 9.10	Maximum ac load power	67
Exa 9.11	Efficiency	67
Exa 9.12	Power rating	68
Exa 10.1	PDQ PDmax and PLmax	70
Exa 10.2	Efficiency of the amplifier with a maximum output signal	71
Exa 10.3	DC and AC load line	71
Exa 10.4	PDQ PDmax and PLmax	72
Exa 10.5	Voltage gain of the driver stage	73
Exa 10.6	Ideal value of PP and PLmax	73
Exa 10.7	Overall voltage gain	74
Exa 10.8	Minimum base current that produces saturation	74
Exa 10.9	Input voltage required	75
Exa 11.1	Closed loop voltage gain	77
Exa 11.2	Alpha beta rdeshe and rdeshc	77
Exa 11.3	Value of rdeshb	78
Exa 11.4	Voltage gain	78
Exa 12.1	Source voltage to ground	80
Exa 12.2	Transconductance	81
Exa 12.3	Output voltage	81
Exa 12.4	Voltage gain	82
Exa 14.1	Load current	83
Exa 14.2	Input voltage	83
Exa 14.6	Ideal emitter current	84
Exa 14.7	Value of emitter supply voltage	84
Exa 16.1	Output voltage and error voltage	86
Exa 16.2	ACL Vout and Verror	87
Exa 16.3	Closed loop input and output impedance	87
Exa 16.4	Closed loop voltage gain	88
Exa 16.5	Closed loop voltage gain	89
Exa 16.6	Value of FCL	90

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 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/bita; // 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 beta= 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/beta;// 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 V_S= 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
    : ")
```
