

Scilab Textbook Companion for
Electronic Principles
by A. Malvino And D. J. Bates¹

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

Exa Example (Solved example)

Eqn Equation (Particular equation of the above book)

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

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

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Chapter 1

Introduction

Scilab code Exa 1.1 example1

```
1
2 // Example 1-1, page 9
3
4 clear;clc; close;
5
6 // Given data
7 R(1)=50; //source resistance of ac voltage in ohms
8
9 // Calculations
10 R(2)=R(1)*100; // minimum load resistance
11 disp("ohms", R(2),"Load resistance =")
```

Scilab code Exa 1.2 example2

```
1
2 // Example 1-2, page 12
3
```

```

4 clear;clc; close;
5
6 // Given data
7 i=2; // current source, in milli amperes
8 R=10*10^6; //internal source resistance, in ohms
9
10 // Calculations
11 Rlmin=0; // minimum load resistance in ohms
12 Rlmax=0.01*R; // maximum load resistance
13 disp("ohms", Rlmin, "Minimum Load resistance =")
14 disp("ohms", Rlmax, "Maximum Load resistance =")

```

Scilab code Exa 1.4 example4

```

1 // find thevenin voltage and resistance
2 // Electronic Principles
3 // By Albert Malvino, David Bates
4 // Seventh Edition
5 // The McGraw-Hill Companies
6 // Example 1-4, page 14
7
8 clear;clc; close;
9
10 // Given data
11 Vs=72; // source voltage in volts
12
13 // Calculations
14 // open load resistor to get thevenin voltage
15 Vth=24; // in volts as 8 mA flows through 6Kohms in
    series with 3Kohms, no current through 4Kohms
16 // reduce source to zero to get thevenin resistance
17 Rth=4+((3*6)/(3+6)); // in Kohms
18

```

```
19 disp(" Volts", Vth," Thevenin Voltage =")
20 disp(" ohms",Rth," Thevenin Resistance =")
21
22 // Result
23 // Thevenin voltage is 24 volts
24 // Thevenin resistance is 6 Kohms
```

Scilab code Exa 1.6 example6

```
1
2
3
4
5
6 // Given data
7 Vth=10;// Thevenin voltage in volts
8 Rth=2000;// Thevenin resistance in ohms
9
10 // Calculations
11 In=Vth/Rth;// Norton current in amperes
12 disp(" Amperes",In," Norton Current=")
```

Chapter 2

Semiconductors

Scilab code Exa 2.5 example5

```
1
2
3
4 // Given data
5 V(1)=0.7; // barrier potential in volts at 25 degree
   celcius
6 T(1)=25; // temperature in degree celcius at which
   vbarrier potential is known
7 T(2)=100; T(3)=0; // temperature in degree celcius
   at which barrier potential has to be found
8
9 // Calculations
10 dT(2)=T(2)-T(1); // difference in temperature
11 dT(3)=T(3)-T(1); // difference in temperature
12 dV(3)=(-0.002)*dT(3); // barrier potential for
   silicon decreases by 0.002 volts for each degree
   celcius rise
13 dV(2)=(-0.002)*dT(2) // barrier potential for silicon
   decreases by 0.002 volts for each degree celcius
   rise
14 V(2)=V(1)+dV(2); // to find barrier potential at T(2)
```

```

15 V(3)=V(1)+dV(3); // to find barrier potential at T(3)
16 disp("Volts",V(2),"Barrier Potential at 100 Degree
    celcius =")
17 disp("Volts",V(3),"Barrier Potential at 0 Degree
    celcius =")
18
19 // Result
20 // barrier potential at 100 degree celcius is 0.55
    volts
21 // barrier potential at 0 degree celcius is 0.75
    volts

```

Scilab code Exa 2.6 example6

```

1
2 // Example 2-6, page 51
3
4 clear;clc; close;
5
6 // Given data
7 I(1)=5; // saturation current at given temperature in
    nano amperes
8 T(1)=25; // temperature in degree celcius at which
    saturation current is known
9 T(2)=100; // temperature in degree celcius at which
    saturation current is to be found
10
11 // Calculations
12 I(2)=(2^7)*I(1); // 7 doublings between 25 and 95
    degree celcius
13 I(3)=((1.07)^5)*I(2); // additional 5 degree between
    95 and 100 degree celcius
14 disp("Amperes",I(3),"Saturation Current =")

```



```
15
16 // Result
17 // saturation current at 100 degree celcius is 898
    nano amperes.
```

Scilab code Exa 2.7 example7

```
1
2 // Example 2-7, page 52
3
4 clear;clc; close;
5
6 // Given data
7 I(1)=2*10^-9;// surface leakage current in amperes
    at given reverse voltage
8 V(1)=25;// reverse voltage in volts at which surface
    leakage is known
9 V(2)=35;// reverse voltage in volts at which surface
    leakage current is to be found
10
11 // Calculations
12 I(2)=V(2)*I(1)/V(1);// surface leakage current is
    directly proportional to reverse voltage
13 disp("Amperes",I(2),"Surface leakage Current =")
14
15 // result
16 // surface leakage current is 2.8 nano amperes.
```

Chapter 3

Diode Theory

Scilab code Exa 3.2 example2

```
1
2 // Example 3-2, page 63
3
4 clear;clc; close;
5
6 // Given data
7 v=1.2; // diode voltage in volts
8 i=1.75; // diode current in amperes
9 P(1)=5; // power rating in watts
10
11 // Calculations
12 P(2)=v*i; // power dissipation
13 disp("Watts",P(2),"Power dissipation")
14
15 // Result
16 // As power dissipation is lower than power rating
    the diode will not get destroyed.
```

Scilab code Exa 3.3 example3

```
1 // to find load voltage and load current using ideal
  diode
2
3 // Example 3-3, page 65
4
5 clear;clc; close;
6
7 // Given data
8 // diode is forward biased, equivalent to a closed
  switch.
9
10 // Calculations
11 V=10;// load voltage in volts
12 R=1000;// load resistance in ohms
13 I=V/R;// all the source voltage appears across the
  load resistor
14 disp(" Amperes",I,"Load Current=")
15 disp(" Volts",V,"Load Voltage=")
```

Scilab code Exa 3.4 example4

```
1
2 // Example 3-4, page 65'
3
4 clear;clc; close;
5
```

```

6 // Given data
7 // refer to the diagram, thevenize the circuit to
  the left of the diode.
8 // looking at the diode back toward the source,we
  see a voltage divider with 6 killo-ohms and 3
  killo-ohms.
9 R=2000;// thevenin resistance in ohms
10 V=12;// thevenin voltage in volts
11
12 // Calculations
13 disp("Using Thevenin Thm")
14 // we have a series circuit and the diode is forward
  biased.
15 // visualize the diode as a closed switch
16 I=V/3000; // load current in amperes
17 V(1)=I*1000;// load voltage
18 disp("Amperes",I,"Load Current=")
19 disp("Volts",V(1),"Load Voltage=")

```

Scilab code Exa 3.5 example5

```

1
2 // Example 3-5, page 67'
3
4 clear;clc; close;
5
6 // Given data
7 // the diode is forward biased, equivalent to a
  battery of 0.7 volts
8 V=10;// voltage of battery in volts
9 Vd=0.7;// diode drop in volts
10
11 // Calculations

```

```

12 V1=V-Vd;// load voltage in volts
13 R=1000;// load resistance in ohms
14 I1=V1/R;// load current in amperes
15 Pd=I1*Vd;// diode power in watts
16 disp(" Amperes",I1,"Load Current=")
17 disp(" Volts",V1,"Load Voltage=")
18 disp(" Watts",Pd,"Diode power=")

```

Scilab code Exa 3.6 example6

```

1
2 // Example 3-6, page 67'
3
4 clear;clc; close;
5
6 // Given data
7 // thevenize the circuit to the left of the diode.
8 // looking at the diode back toward the source,we
   see a voltage divider with 6 killo-ohms and 3
   killo-ohms.
9 R=2000;// thevenin resistance in ohms
10 V(1)=12;// thevenin voltage in volts
11
12 // Calculations
13 disp(" Using Thevenin Thm")
14 V(2)=0.7;// diode voltage in volts
15 I=(V(1)-V(2))/3000// load current in amperes
16 P=V(2)*I // diode power in watts
17 V=I*1000// load voltage in volts
18 disp(" Amperes",I,"Load Current=")
19 disp(" Volts",V,"Load Voltage=")
20 disp(" Watts",P,"Diode power=")

```

Scilab code Exa 3.7 example7

```
1
2 // Example 3-7, page 68
3
4 clear;clc; close;
5
6 // Given data
7 Vd=0.7;// diode drop in volts
8 V=10;// source voltage
9 R=1000;// resistance in ohms
10
11 // Calculations
12 V1=V-Vd;// load voltage in volts
13 I=V1/R;// load current in amperes
14 P=(V-V1)*I;// diode power in watts
15 disp("Amperes",I,"Load Current=")
16 disp("Volts",V1,"Load Voltage=")
17 disp("Watts",P,"Diode power=")
```

Scilab code Exa 3.8 example8

```
1
2 // Example 3-8, page 69
3
4 clear;clc; close;
5
6 // Given data
```

```
7 Rl=10; // load resistance in ohms
8 Rb=0.23; // bulk resistance in ohms
9 // diode drop=0.7 volts
10
11 // Calculations
12 Rt=Rl+Rb; // total resistance in ohms
13 Vt=10-0.7; // voltage of battery-diode drop
14 I=Vt/Rt; // load current
15 Vl=I*10; // load voltage
16 Vd=10-Vl; // source voltage-load voltage
17 P=Vd*I;
18 disp(" Amperes",I," Load Current=")
19 disp(" Volts",Vl," Load Voltage=")
20 disp(" Watts",P," Diode power=")
```

Chapter 4

Diode Circuits

Scilab code Exa 4.1 example1

```
1 //Theory Example
```

Scilab code Exa 4.2 example2

```
1
2 // Example 4-2, page 95
3
4 clear;clc; close;
5
6 // Given data
7 // refer to the diagram
8 // turns ratio 5:1
9 V1=120;// primary voltage in volts
10
11 // Calculations
12
13 V2=V1/5;// secondary voltage in volts
```



```

14 Vpin=V2/0.707; // peak secondary voltage in volts
15 // with ideal diode
16 Vpout=Vpin;
17 Vdc=Vpout/%pi;
18 disp("Volts",Vpout,"Peak voltage =")
19 disp("Volts",Vdc,"dc load voltage=")
20 // with second approximation
21
22 Vpout=Vpin-0.7; // peak load voltage in volts
23 Vdc=Vpout/%pi;
24 disp("Volts",Vpout,"Peak voltage =")
25 disp("Volts",Vdc,"dc load voltage=")

```

Scilab code Exa 4.3 example3

```

1
2 // Example 4-3, page 97
3
4 clear;clc; close;
5
6 // Given data
7 Vrms=120; // in volts
8 // 10:1 step down transformer
9
10 // Calculations
11
12 Vp1=Vrms/0.707; // peak primary voltage in volts
13 Vp2=Vp1/10; // peak secondary voltage in volts
14 // the full wave rectifier acts like 2 back-to-back
    // half-wave rectifiers. because of the center tap,
    // the input voltage to each half-wave rectifier is
    // only half the secondary voltage
15 Vpin=0.5*Vp2;

```

```
16 disp(" Volts",Vpin,"Peak input voltage =")
17
18 Vpout=Vpin;// ideally
19 disp(" Volts",Vpout,"Peak voltage =")
20
21 Vpout=Vpin-0.7;// using second approximation
22 disp(" Volts",Vpout,"Peak voltage =")
```

Scilab code Exa 4.5 example5

```
1 //Theory Example
```

Scilab code Exa 4.6 example6

```
1 //Theory Example
```

Scilab code Exa 4.7 example7

```
1 //Theory Example
```

Scilab code Exa 4.8 example8

```
1 // calculating of dc load voltage and ripple
2 // Electronic Principles
3 // By Albert Malvino , David Bates
4 // Seventh Edition
5 // The McGraw-Hill Companies
6 // Example 4-8, page 110
7
8 clear;clc; close;
9
10 // Given data
11 V1=120;// rms input voltage in volts
12 R1=5000;// dc load resistance in ohms
13 f=60;// frequency in hertz
14 C=100*10^-6// capacitance in farads
15 // 5:1 step down transformer
16
17 // Calculations
18 V2=V1/5;// rms secondary voltage in volts
19 Vp=V2/0.707;// peak secondary voltage
20 V1=Vp;// ideal diode and small ripple
21 I1=V1/R1;// dc load current in amperes
22 Vr=I1/(2*f*C);// ripple in vpp,bridge rectifier
23 disp("Volts",V1,"dc load voltage =")
24 disp("Volts",Vr,"riple =")
25
26 // Result
27 // dc load voltage is 34 volts
28 // ripple is 0.57 Vpp
```

Scilab code Exa 4.9 example9

```

1 // calculating of dc load voltage and ripple
2 // Electronic Principles
3 // By Albert Malvino , David Bates
4 // Seventh Edition
5 // The McGraw–Hill Companies
6 // Example 4–9, page 111
7
8 clear;clc; close;
9
10 // Given data
11 V1=120;// rms input voltage in volts
12 R1=500;// dc load resistance in ohms
13 f=60;// frequency in hertz
14 C=4700*10-6// capacitance in farads
15 // 15:1 step down transformer
16
17 // Calculations
18 V2=V1/15;// rms secondary voltage in volts
19 Vp=V2/0.707;// peak secondary voltage
20 V1=Vp-1.4;// using second approximation
21 I1=V1/R1;// dc load current in amperes
22 Vr=I1/(2*f*C);// ripple in vpp,bridge rectifier
23 disp(" Volts",V1,"dc load voltage =")
24 disp(" Volts",Vr,"riple =")
25
26 // Result
27 // dc load voltage is 9.9 volts
28 // ripple is 35 mVpp

```

Scilab code Exa 4.10 example10

```

1
2 // Example 4–10, page 114

```

```
3
4 clear;clc; close;
5
6 // Given data
7 V1=120;// rms input voltage in volts
8 // turns ratio 8:1
9
10 // Calculations
11 V2=V1/8;// rms secondary voltage in volts
12 Vp=V2/0.707;// peak secondary voltage
13 PIV=Vp;// peak inverse voltage
14 disp(PIV)
15 disp(" Volts",PIV,"Peak inverse voltage =")
16
17 // Result
18 // peak inverse voltage is 21.2 volts
```

Chapter 5

Special Purpose Diodes

Scilab code Exa 5.1 example1

```
1 // find minimum and maximum zener currents
2 // Electronic Principles
3 // By Albert Malvino , David Bates
4 // Seventh Edition
5 // The McGraw-Hill Companies
6 // Example 1-1, page 9
7
8 clear;clc; close;
9
10 // Given data
11 R=820;// resistance in ohms
12 V=10;// breakdown voltage of diode
13 Vinmin=20;// minimum input voltage in volts
14 Vinmax=40;// maximum input voltage in volts
15
16 // Calculations
17 // voltage across resistor=input voltage-breakdown
    voltage
18 Ismin=(Vinmin-V)/R;// minimum zener current in
    amperes
19 Ismax=(Vinmax-V)/R;// maximum zener current in
```

```

    amperes
20 disp(" Amperes",Imin,"Minimum zener current =")
21 disp(" Amperes",Imax,"Maximum zener current =")
22
23 // results
24 // minimum zener current is 12.2 mAmperes
25 // maximum zener current is 36.6 mAmperes

```

Scilab code Exa 5.2 example2

```

1 // to check if zener diode shown in the figure is
  operating in the breakdown region
2 // Electronic Principles
3 // By Albert Malvino , David Bates
4 // Seventh Edition
5 // The McGraw–Hill Companies
6 // Example 5–2, page 149
7
8 clear;clc; close;
9
10 // Given data
11 R1=1*10^3;// in ohms
12 Rs=270;// in ohms
13 Vs=18;// in volts
14 Vz=10;// zener voltage in volts
15
16 // Calculations
17 Vth=(R1/(Rs+R1))*Vs;// Thevenin voltage facing the
  diode
18 disp(" Volts",Vth,"Thevenin voltage=")
19 disp(" Vth>Vz")
20
21 // Result

```

```
22 // Since thevenin voltage is greater than zener
    voltage , zener diode is operating in the breakdown
        region
```

Scilab code Exa 5.3 example3

```
1 // to find zener current
2 // Electronic Principles
3 // By Albert Malvino , David Bates
4 // Seventh Edition
5 // The McGraw-Hill Companies
6 // Example 5-3, page 149
7
8 clear;clc; close;
9
10 // Given data
11 V1=10; // load voltage in volts
12 R1=1*10^3; // in ohms
13 Rs=270; // in ohms
14 Vs=18; // in volts
15 Vz=10; // zener voltage in volts
16
17 // Calculations
18 Is=(Vs-Vz)/Rs; // current through series resistor in
    amperes
19 I1=V1/R1; // in amperes
20 Iz=Is-I1; // zener current in amperes
21 disp(" Amperes" ,Iz, "zener current =")
22
23 // Result
24 // Zener current is 19.6 mAmperes
```

Scilab code Exa 5.7 example7

```
1 // using second approximation find load voltage
2 // Electronic Principles
3 // By Albert Malvino , David Bates
4 // Seventh Edition
5 // The McGraw-Hill Companies
6 // Example 5-7, page 153
7
8 clear;clc; close;
9
10 // Given data
11 Iz=20*10^-3;// zener current in amperes
12 Rz=8.5;// zener resistance in ohms
13 Vz=10;// breakdown voltage in volts
14
15 // Calculations
16 dVl=Iz*Rz;// change in load voltage in volts
17 Vl=Vz+dVl;// load voltage in volts
18 disp("Volts",Vl,"load voltage=")
19
20 // Result
21 // load voltage is 10.17 volts
```

Scilab code Exa 5.8 example8

```
1 // find approximate ripple voltage across load
2 // Electronic Principles
```

```

3 // By Albert Malvino , David Bates
4 // Seventh Edition
5 // The McGraw–Hill Companies
6 // Example 5–8, page 154
7
8 clear;clc; close;
9
10 // Given data
11 Rs=270; // series resistance in ohms
12 Vrin=2; // input ripple in volts
13 Rz=8.5; // zener resistance in ohms
14 Vz=10; // breakdown voltage in volts
15
16 // Calculations
17 Vrout=(Rz/Rs)*Vrin; // output ripple in volts
18 disp("Volts",Vrout,"load ripple=")
19
20 // Result
21 // approximate load ripple is 63 mVolts

```

Scilab code Exa 5.10 example10

```

1 // find maximum allowable series resistance
2 // Electronic Principles
3 // By Albert Malvino , David Bates
4 // Seventh Edition
5 // The McGraw–Hill Companies
6 // Example 5–10, page 157
7
8 clear;clc; close;
9
10 // Given data
11 Rlmin=140; // minimum load resistance in ohms

```

```

12 Vsmin=22; // minimum input voltage in volts
13 Vz=12; // zener voltage in volts
14
15 // Calculations
16 Rsmax=((Vsmin/Vz)-1)*Rlmin; // maximum series
    resistance in ohms
17 disp("ohms",Rsmax,"Series resistance=")
18
19 // Result
20 // maximum series resistance is 117 ohms

```

Scilab code Exa 5.11 example11

```

1 // find maximum allowable series resistance
2 // Electronic Principles
3 // By Albert Malvino , David Bates
4 // Seventh Edition
5 // The McGraw-Hill Companies
6 // Example 5-11, page 157
7
8 clear;clc; close;
9
10 // Given data
11 Ilmax=20*10^-3; // maximum load current in amperes
12 Vsmin=15; // minimum input voltage in volts
13 Vz=6.8; // zener voltage in volts
14
15 // Calculations
16 Rsmax=(Vsmin-Vz)/Ilmax; // maximum series resistance
    in ohms
17 disp("ohms",Rsmax,"Series resistance=")
18
19 // Result

```

20 // maximum series resistance is 410 ohms

Scilab code Exa 5.12 example12

```
1 // find approximate load current
2 // Electronic Principles
3 // By Albert Malvino , David Bates
4 // Seventh Edition
5 // The McGraw-Hill Companies
6 // Example 5-12, page 168
7
8 clear;clc; close;
9
10 // Given data
11 Vs=50;// dc input voltage in volts
12 Vd=2;// forward voltage in volts
13 Rs=2.2*10^3;// series resistance in ohms
14
15 // Calculations
16 Is=(Vs-Vd)/Rs;// load current in amperes
17 disp(" Amperes",Is,"load current =")
18
19 // Result
20 // approximate load current is 21.8 mAmperes.
```

Scilab code Exa 5.13 example13

```
1 // find load current
2 // Electronic Principles
```

```

3 // By Albert Malvino , David Bates
4 // Seventh Edition
5 // The McGraw-Hill Companies
6 // Example 5-13, page 168
7
8 clear;clc; close;
9
10 // Given data
11 // input terminals are shorted
12 Vs=9; // dc input voltage in volts
13 Vd=2; // forward voltage in volts
14 Rs=470; // series resistance in ohms
15
16 // Calculations
17 Is=(Vs-Vd)/Rs; // load current in amperes
18 disp(" Amperes" ,Is,"load current =")
19
20 // Result
21 // approximate load current is 14.9 mAmperes.

```

Scilab code Exa 5.14 example14

```

1 // find average LED current ,power dissipation in
   series resistor
2 // Electronic Principles
3 // By Albert Malvino , David Bates
4 // Seventh Edition
5 // The McGraw-Hill Companies
6 // Example 5-14, page 169
7
8 clear;clc; close;
9
10 // Given data

```

```

11 V=20; // ac source rms voltage in volts
12 Rs=680; // series resistance in ohms
13
14 // Calculations
15 Vp=sqrt(2)*V; // peak voltage in volts
16 Is1=Vp/Rs; // peak current in amperes
17 Is2=Is1/%pi; // average of the half-wave current
    through LED
18 P=(V)^2/Rs; // power dissipated in watts
19 disp("Amperes",Is2,"average LED current =")
20 disp("Watts",P,"dissipated power=")
21
22 // Result
23 // Average LED current is 13.1 mAmperes
24 // Power dissipated is 0.588 watts.

```

Scilab code Exa 5.15 example15

```

1 // find average LED current
2 // Electronic Principles
3 // By Albert Malvino , David Bates
4 // Seventh Edition
5 // The McGraw-Hill Companies
6 // Example 5-15, page 170
7
8 clear;clc; close;
9
10 // Given data
11 f=60; // frequency in hertz
12 C=0.68*10^-6; // capacitance in faradays
13 V=170; // voltage in volts
14
15 // Calculations

```

```
16 Xc=1/(2*pi*f*C); // capacitive resistance in ohms
17 Is1=V/Xc; // peak current in amperes
18 Is2=Is1/pi; // average of the half-wave current
    through LED
19 disp("Amperes",Is2,"average LED current =")
20
21 // Result
22 // Average LED current is 13.9 mAmperes
```

Chapter 6

Bipolar Junction Transistor

Scilab code Exa 6.1 example1

```
1 // to find current gain of the transistor
2 // Electronic Principles
3 // By Albert Malvino , David Bates
4 // Seventh Edition
5 // The McGraw-Hill Companies
6 // Example 6-1, page 194
7
8 clear;clc; close;
9
10 // Given data
11 Ic=10*10^-3;// collector current in amperes
12 Ib=40*10^-6;// base current in amperes
13
14 // Calculations
15 Bdc=Ic/Ib;// current gain
16 disp(Bdc)
17 disp(Bdc," current gain =")
18
19 // Result
20 // current gain is 250.
```

Scilab code Exa 6.2 example2

```
1 // to find collector current of the transistor
2 // Electronic Principles
3 // By Albert Malvino , David Bates
4 // Seventh Edition
5 // The McGraw-Hill Companies
6 // Example 6-2, page 194
7
8 clear;clc; close;
9
10 // Given data
11 Bdc=175;// current gain
12 Ib=0.1*10^-3;// base current in amperes
13
14 // Calculations
15 Ic=Bdc*Ib;// collector current in amperes
16 disp("Amperes",Ic,"collector current =")
17
18 // Result
19 // Collector current is 17.5 mAmperes.
```

Scilab code Exa 6.3 example3

```
1 // to find base current of the transistor
2 // Electronic Principles
3 // By Albert Malvino , David Bates
4 // Seventh Edition
```

```

5 // The McGraw–Hill Companies
6 // Example 6–3, page 195
7
8 clear;clc; close;
9
10 // Given data
11 Ic=2*10^-3;// collector current in amperes
12 Bdc=135;// current gain
13
14 // Calculations
15 Ib=Ic/Bdc;// collector current in amperes
16 disp("Amperes",Ib,"base current =")
17
18 // Result
19 // Base current is 14.8 micro Amperes.

```

Scilab code Exa 6.4 example4

```

1 // to find base current
2 // Electronic Principles
3 // By Albert Malvino , David Bates
4 // Seventh Edition
5 // The McGraw–Hill Companies
6 // Example 6–4, page 197
7
8 clear;clc; close;
9
10 // Given data
11 Bdc=200;// current gain
12 Vbb=2;// base source voltage in volts
13 Vbe=0.7;// emitter diode in volts
14 Rb=100*10^3;// resistance in ohms
15

```

```

16 // Calculations
17 Ib=(Vbb-Vbe)/Rb;// current through base resistor in
    amperes
18 Ic=Ib*Bdc;// collector current in amperes
19 disp("Amperes",Ic,"collector current =")
20
21 // Result
22 // collector current is 2.6mAmperes

```

Scilab code Exa 6.5 example5

```

1 // find Ib,Ic,Vce,Pd
2 // Electronic Principles
3 // By Albert Malvino , David Bates
4 // Seventh Edition
5 // The McGraw-Hill Companies
6 // Example 6-5, page 201
7
8 clear;clc; close;
9
10 // Given data
11 Rc=2*10^3;// resistance in ohms
12 Bdc=300;// current gain
13 Vbb=10;// base source voltage in volts
14 Vbe=0.7;// emitter diode in volts
15 Rb=1*10^6;// resistance in ohms
16 Vcc=10;// in volts
17
18 // Calculations
19 Ib=(Vbb-Vbe)/Rb;// current through base resistor in
    amperes
20 Ic=Ib*Bdc;// collector current in amperes
21 Vce=Vcc-(Ic*Rc);// collector-emitter voltage in

```

```

        volts
22 Pd=Vce*Ic;// collector power dissipation in watts
23 disp("Amperes",Ib,"base current =")
24 disp("Amperes",Ic,"collector current =")
25 disp("Volts",Vce,"collector-emitter voltage =")
26 disp("watts",Pd,"dissipated power=")
27
28 // Result
29 // Ib is 9.3 microAmperes,Ic is 2.79 mAmperes,Vce is
    4.42 volts ,Pd is 12.3 mWatts

```

Scilab code Exa 6.6 example6

```

1 // calculate current gain for 2N4424
2 // Electronic Principles
3 // By Albert Malvino , David Bates
4 // Seventh Edition
5 // The McGraw-Hill Companies
6 // Example 6-6, page 202
7
8 clear;clc; close;
9
10 // Given data
11 Rc=470;// resistance in ohms
12 Vbb=10;// base source voltage in volts
13 Vbe=0.7;// emitter diode in volts
14 Rb=330*10^3;// resistance in ohms
15 Vce=5.45;// collector-emitter voltage in volts
16
17 // Calculations
18 V=Vbb-Vce;// voltage across collector-resistance in
    volts
19 Ic=V/Rc;// collector current in amperes

```

```

20 Ib=(Vbb-Vbe)/Rb;// current through base resistor in
    amperes
21 Bdc=Ic/Ib;// current gain
22 disp(Bdc,"current gain")
23
24 // Result
25 // current gain is 343

```

Scilab code Exa 6.7 example7

```

1 // find collector-emmitter voltage
2 // Electronic Principles
3 // By Albert Malvino , David Bates
4 // Seventh Edition
5 // The McGraw-Hill Companies
6 // Example 6-7, page 204
7
8 clear;clc; close;
9
10 // Given data
11 Rb=470*10^3;// resistance in ohms
12 Vbe=0;// as emmitter diode is ideal
13 Bdc=100;// current gain
14 Vbb=15;// base source voltage in volts
15 Rc=3.6*10^3;// resistance in ohms
16 Vcc=15;// collector-supply voltage in volts
17
18 // Calculations
19 Ib=(Vbb-Vbe)/Rb;// current through base resistor in
    amperes
20 Ic=Ib*Bdc;// collector current in amperes
21 Vce=Vcc-(Ic*Rc);// collector-emitter voltage in
    volts

```

```

22 disp(" Volts",Vce," collector-emitter voltage =")
23
24 // Result
25 // collector-emitter voltage is 3.52 Volts

```

Scilab code Exa 6.8 example8

```

1 // find collector-emitter voltage
2 // Electronic Principles
3 // By Albert Malvino , David Bates
4 // Seventh Edition
5 // The McGraw-Hill Companies
6 // Example 6-8, page 205
7
8 clear;clc; close;
9
10 // Given data
11 Rb=470*10^3;// resistance in ohms
12 Vbe=0.7;// using second approximation
13 Bdc=100;// current gain
14 Vbb=15;// base source voltage in volts
15 Rc=3.6*10^3;// resistance in ohms
16 Vcc=15;// collector-supply voltage in volts
17
18 // Calculations
19 Ib=(Vbb-Vbe)/Rb;// current through base resistor in
    amperes
20 Ic=Ib*Bdc;// collector current in amperes
21 Vce=Vcc-(Ic*Rc);// collector-emitter voltage in
    volts
22 disp(" Volts",Vce," collector-emitter voltage =")
23
24 // Result

```

```
25 // collector-emmitter voltage is 4.06 Volts.
```

Scilab code Exa 6.9 example9

```
1 // find collector-emmitter voltage
2 // Electronic Principles
3 // By Albert Malvino , David Bates
4 // Seventh Edition
5 // The McGraw-Hill Companies
6 // Example 6-9, page 206
7
8 clear;clc; close;
9
10 // Given data
11 Rb=470*10^3;// resistance in ohms
12 Vbe=1;// voltage across emitter diode in volts
13 Bdc=100;// current gain
14 Vbb=15;// base source voltage in volts
15 Rc=3.6*10^3;// resistance in ohms
16 Vcc=15;// collector-supply voltage in volts
17
18 // Calculations
19 Ib=(Vbb-Vbe)/Rb;// current through base resistor in
    amperes
20 Ic=Ib*Bdc;// collector current in amperes
21 Vce=Vcc-(Ic*Rc);// collector-emitter voltage in
    volts
22 disp(" Volts",Vce," collector-emitter voltage =")
23
24 // Result
25 // collector-emmitter voltage is 4.27 Volts
```

Scilab code Exa 6.11 example11

```
1 // find power dissipation
2 // Electronic Principles
3 // By Albert Malvino , David Bates
4 // Seventh Edition
5 // The McGraw-Hill Companies
6 // Example 6-11, page 211
7
8 clear;clc; close;
9
10 // Given data
11 Vce=10;// collector-emmitter voltage in volts
12 Ic=20*10^-3;// collector-current in amperes
13 T=25;// ambient temperature
14 P=625*10^-3;// power rating in watts at 25 degree
    celcius
15
16 // Calculations
17 Pd=Vce*Ic;// power dissipation in watts
18 disp("watts",Pd,"dissipated power=")
19
20 // Result
21 // As power dissipation is less than rated power at
    ambient temperature,transistor(2N3904) is safe
```

Scilab code Exa 6.12 example12


```

1 // find if transistor is safe
2 // Electronic Principles
3 // By Albert Malvino , David Bates
4 // Seventh Edition
5 // The McGraw-Hill Companies
6 // Example 6-12, page 212
7
8 clear;clc; close;
9
10 // Given data
11 T1=100;// ambient temperature
12 T2=25;// in degree celcius
13 P=625*10^-3;// power rating in watts at 25 degree
    celcius
14 d=5*10^-3;// derating factor with respect to
    temperature
15
16 // Calculations
17 dT=T1-T2;// difference in temperature
18 dP=d*dT;// difference in power
19 Pd=P-dP;// maximum power dissipated in watts when
    ambient temperature is 100 degree celcius
20 disp(" watts",Pd," dissipated power=")
21
22 // Result
23 // If power dissipation is less than rated power at
    ambient temperatureor ambient temperature doesnt
    increase ,transistor is safe

```

Chapter 7

Transistor Fundamentals

Scilab code Exa 7.1 example1

```
1 // calculate saturation current and cutoff voltage
2 // Electronic Principles
3 // By Albert Malvino , David Bates
4 // Seventh Edition
5 // The McGraw-Hill Companies
6 // Example 7-1, page 228
7
8 clear;clc; close;
9
10 // Given data
11 Vcc=30;// collector supply voltage in volts
12 Rc=3*10^3;// collector resistance in ohms
13
14 // Calculations
15 Icsat=Vcc/Rc;// saturation current in amperes
16 Vcecutoff=Vcc;// cutoff voltage in volts
17 disp(" Amperes",Icsat," Saturation Current")
18 disp(" Volts",Vcecutoff," cutoff voltage")
19
20 // Result
21 // saturation current is 10 mAmperes
```

22 // cutoff voltage is 30 Volts

Scilab code Exa 7.2 example2

```
1 // calculate saturation current and cutoff voltage
2 // Electronic Principles
3 // By Albert Malvino , David Bates
4 // Seventh Edition
5 // The McGraw-Hill Companies
6 // Example 7-2, page 228
7
8 clear;clc; close;
9
10 // Given data
11
12 Vcc=9;// collector supply voltage in volts
13 Rc=3*10^3;// collector resistance in ohms
14
15 // Calculations
16 Icsat=Vcc/Rc;// saturation current in amperes
17 Vcecutoff=Vcc;// cutoff voltage in volts
18 disp(" Amperes",Icsat," Saturation Current")
19 disp(" Volts",Vcecutoff," cutoff voltage")
20
21 // Result
22 // saturation current is 3 mAmperes
23 // cutoff voltage is 9 Volts
```

Scilab code Exa 7.3 example3

```

1 // calculate saturation current and cutoff voltage
2 // Electronic Principles
3 // By Albert Malvino , David Bates
4 // Seventh Edition
5 // The McGraw–Hill Companies
6 // Example 7–3, page 229
7
8 clear;clc; close;
9
10 // Given data
11
12 Vcc=15;// collector supply voltage in volts
13 Rc=1*10^3;// collector resistance in ohms
14
15 // Calculations
16 Icsat=Vcc/Rc;// saturation current in amperes
17 Vcecuttoff=Vcc;// cutoff voltage in volts
18 disp("Amperes",Icsat,"Saturation Current")
19 disp("Volts",Vcecuttoff,"cutoff voltage")
20
21
22 // Result
23 // saturation current is 15 mAmperes
24 // cutoff voltage is 15 Volts

```

Scilab code Exa 7.4 example4

```

1 // calculate saturation current and cutoff voltage
2 // Electronic Principles
3 // By Albert Malvino , David Bates
4 // Seventh Edition
5 // The McGraw–Hill Companies
6 // Example 7–4, page 229

```

```

7
8 clear;clc; close;
9
10 // Given data
11 Vcc=15;// collector supply voltage in volts
12 Rc=3*10^3;// collector resistance in ohms
13
14 // Calculations
15 Icsat=Vcc/Rc;// saturation current in amperes
16 Vcecutoff=Vcc;// cutoff voltage in volts
17 disp("Amperes",Icsat,"Saturation Current")
18 disp("Volts",Vcecutoff,"cutoff voltage")
19
20 // Result
21 // saturation current is 5 mAmperes
22 // cutoff voltage is 15 Volts

```

Scilab code Exa 7.5 example5

```

1 // calculate collector-emitter resistance voltage
2 // Electronic Principles
3 // By Albert Malvino , David Bates
4 // Seventh Edition
5 // The McGraw-Hill Companies
6 // Example 7-5, page 232
7
8 clear;clc; close;
9
10 // Given data
11 Bdc=100
12 Vbb=15;// in volts
13 Vcc=15;// collector supply voltage in volts
14 Vbe=0.7;// in volts

```

```

15 Rb=1*10^6; // base resistance in ohms
16 Rc=3*10^3; // collector resistance in ohms
17
18 // Calculations
19 Ib=(Vbb-Vbe)/Rb; // base current in amperes
20 Ic=Bdc*Ib; // collector current in amperes
21 Vce=Vcc-(Ic*Rc); // collector-emitter voltage in
    volts
22 disp("Volts",Vce,"collector-emitter voltage")
23
24 // Result
25 // collector-emitter voltage is 10.7 volts

```

Scilab code Exa 7.6 example6

```

1 // find whether transistor remains in saturated
    region
2 // Electronic Principles
3 // By Albert Malvino , David Bates
4 // Seventh Edition
5 // The McGraw-Hill Companies
6 // Example 7-6, page 235
7
8 clear;clc; close;
9
10 // Given data
11 Vcc=20; // collector supply voltage in volts
12 Vbb=10; // base voltage in volts
13 Rc=10*10^3; // collector resistance in ohms
14 Rb=1*10^6; // base resistance in ohms
15 Bdc=50;
16
17 // Calculations

```

```

18 Ib=Vbb/Rb;// base current in amperes
19 Ic=Bdc*Ib;// collector current in amperes
20 Vce=Vcc-(Ic*Rc);// collector-emitter voltage in
    volts
21 disp("Volts",Vce,"collector-emitter voltage")
22
23 // Result
24 // as Vce>0 ,the transistor is not saturated

```

Scilab code Exa 7.7 example7

```

1 // find whether transistor remains in saturated
    region
2 // Electronic Principles
3 // By Albert Malvino , David Bates
4 // Seventh Edition
5 // The McGraw-Hill Companies
6 // Example 7-7, page 235
7
8 clear;clc; close;
9
10 // Given data
11 Vcc=20;// collector supply voltage in volts
12 Vbb=10;// base voltage in volts
13 Rc=5*10^3;// collector resistance in ohms
14 Rb=1*10^6;// base resistance in ohms
15 Bdc=50;
16
17 // Calculations
18 Icsat=Vcc/Rc;// saturation current in amperes
19 Ib=Vbb/Rb;// base current in amperes
20 Ic=Bdc*Ib;// collector current in amperes
21 disp(Ic)

```

```
22 disp(Icsat)
23 disp("Ic>Icsat")
24
25 // Result
26 // as Ic>Icsat ,the transistor is saturated
```

Scilab code Exa 7.8 example8

```
1 // find the 2 values of output voltage
2 // Electronic Principles
3 // By Albert Malvino , David Bates
4 // Seventh Edition
5 // The McGraw-Hill Companies
6 // Example 7-8, page 236
7
8 clear;clc; close;
9
10 // Given data
11 Vcc=5;// collector supply voltage in volts
12 Vbb=10;// base voltage in volts
13 Rc=1*10^3;// collector resistance in ohms
14 Rb=10*10^3;// base resistance in ohms
15 Bdc=50;// current gain
16 Vcesat=0.15;// saturation voltage in volts
17 Iceo=50*10^-9;// collector leakage current in
    amperes
18
19 // Calculations
20 Vce=Vcc-(Iceo*Rc);// collector-emitter voltage in
    volts
21 disp("Volts",Vcesat,"Output voltage")
22 disp("Volts",Vce,"Output voltage")
23
```



```
24 // Result
25 // the 2 output voltages are 5 volts and 0.15 volts
```

Scilab code Exa 7.9 example9

```
1 // find voltage between collector and ground and
  // between collector and emitter
2 // Electronic Principles
3 // By Albert Malvino , David Bates
4 // Seventh Edition
5 // The McGraw-Hill Companies
6 // Example 7-9, page 239
7
8 clear;clc; close;
9
10 // Given data
11 Vcc=15;// collector supply voltage in volts
12 Vbb=5;// base voltage in volts
13 Rc=2*10^3;// collector resistance in ohms
14 Re=1*10^3;// emitter resistance in ohms
15
16 // Calculations
17 Ve=Vbb-0.7;// emitter voltage in volts
18 Ie=Ve/Re;// emitter current in amperes
19 Ic=Ie;// collector current is equal to emitter
  // current
20 Vc=Vcc-(Ic*Rc);// collector voltage in volts
21 Vce=Vc-Ve;// collector-emitter voltage in volts
22 disp("Volts",Vce,"collector-emitter voltage")
23 disp("Volts",Vc,"collector-ground voltage")
24
25 // Result
26 // collector-to-ground voltage is 6.4 volts
```

27 // collector-emitter voltage is 2.1 volts

Chapter 8

Transistor Biasing

Scilab code Exa 8.1 example1

```
1 // calculate the collector-emmitter voltage
2 // Electronic Principles
3 // By Albert Malvino , David Bates
4 // Seventh Edition
5 // The McGraw-Hill Companies
6 // Example 8-1, page 263
7
8 clear;clc; close;
9
10 // Given data
11
12 Vcc=10;// collector supply voltage in volts
13 R1=10*10^3;// in ohms
14 R2=2.2*10^3;// in ohms
15 Rc=3.6*10^3;// collector resistance
16 Re=1*10^3;// emitter resistance
17
18 // Calculations
19
20 Vbb=R2*Vcc/(R1+R2);// base voltage in ohms
21 Ve=Vbb-0.7;// emitter voltage
```

```

22 Ie=Ve/Re; // emitter current in amperes
23 Ic=Ie; // collector current is approximately equal to
    emitter current
24 Vc=Vcc-(Ic*Rc); // collector-to-ground voltage in
    volts
25 Vce=Vc-Ve; // collector-emitter voltage in volts
26 disp("Volts",Vce,"Collector-Emmitter Voltage")
27
28 // Result
29 // collector-emitter voltage is 4.92 volts.

```

Scilab code Exa 8.3 example3

```

1 // find emitter current
2 // Electronic Principles
3 // By Albert Malvino , David Bates
4 // Seventh Edition
5 // The McGraw-Hill Companies
6 // Example 8-3, page 266
7
8 clear;clc; close;
9
10 // Given data
11 R1=10*10^3; // in ohms
12 R2=2.2*10^3; // in ohms
13 Rc=3.6*10^3; // in ohms
14 Re=1*10^3; // in ohms
15 Bdc=200; // current gain
16 Vbb=1.8; // base supply voltage in volts
17 Vbe=0.7; // voltage across emitter in volts
18
19 // Calculations
20 Rth=(R1*R2)/(R1+R2); // thevenin voltage in volts(R1

```

```

    ||R2)
21 Rin=Bdc*Re;// input resistance of base
22 // as Rth<0.01*Rin, voltage divider is stiff
23 Ie=(Vbb-Vbe)/(Re+(Rth/Bdc));// emitter current in
    amperes
24 disp(" Amperes",Ie," Emitter Current")
25
26 // Result
27 // voltage divider is stiff, emitter current is 1.09
    milliamperes

```

Scilab code Exa 8.4 example4

```

1 // find resistances to fit in the given VDB design
2 // Electronic Principles
3 // By Albert Malvino , David Bates
4 // Seventh Edition
5 // The McGraw-Hill Companies
6 // Example 8-4, page 269
7
8 clear;clc; close;
9
10 // Given data
11 // 2N3904
12 Bdc=100;// current gain
13 Vcc=10 ;// supply voltage in volts
14 Ic=10*10^-3;// collector current in amperes
15
16 // Calculations
17 Ve=0.1*Vcc;// emitter voltage in volts
18 Ie=Ic;// collector current is equal to emitter
    current
19 Re=Ve/Ie;// emitter resistance in ohms

```

```

20 Rc=4*Re; // collector resistance in ohms
21 R2max=0.01*Bdc*Re; // in ohms
22 V2=Ve+0.7; // in volts
23 V1=Vcc-V2; // in volts
24 R1=(V1*R2max)/V2; // in ohms
25 disp("Ohms",R1,"R1=")
26 disp("Ohms",R2max,"R2=")
27 disp("Ohms",Rc," Collector Resistance=")
28 disp("Ohms",Re," Emitter Resistance=")
29
30 // Result
31 // R1=488 ohms, R2=100 ohms, Rc=400 ohms, Re=100
    ohms

```

Scilab code Exa 8.5 example5

```

1 // find collector voltage
2 // Electronic Principles
3 // By Albert Malvino , David Bates
4 // Seventh Edition
5 // The McGraw-Hill Companies
6 // Example 8-5, page 271
7
8 clear;clc; close;
9
10 // Given data
11 Re=1.8*10^3; // emitter current in ohms
12 Rc=3.6*10^3; // collector resistance in ohms
13 Rb=2.7*10^3; // in ohms
14 Vre=1.3; // voltage across the emitter resistor in
    volts
15 Vcc=10; // collector supply voltage in volts
16

```

```

17 // Calculations
18 Ie=Vre/Re;// emitter current in amperes
19 Ic=Ie;// collector current is equal to emitter
    current
20 Vc=Vcc-Ic*Rc;// collector voltage in volts
21 disp(" Volts",Vc," Collector Voltage")
22
23 // Result
24 // collector voltage is 7.4 volts

```

Scilab code Exa 8.6 example6

```

1 // find collector to ground voltage
2 // Electronic Principles
3 // By Albert Malvino , David Bates
4 // Seventh Edition
5 // The McGraw-Hill Companies
6 // Example 8-6, page 271
7
8 clear;clc; close;
9
10 // Given data
11 Vee=15;// in volts
12 Vcc=15;// in volts
13 Rc=10*10^3;// in ohms
14 Re=20*10^3;// in ohms
15
16 // Calculations
17 Ie=(Vee-0.7)/Re;// emitter current in amperes
18 Ic=Ie;// collector current is equal to emitter
    current
19 Vc=Vcc-Ic*Rc;// collector voltage in volts
20 disp(" Volts",Vc," Collector Voltage")

```

```
21
22 // Result
23 // collector to ground voltage is 7.85 volts
```

Scilab code Exa 8.7 example7

```
1 // calculate the 3 transistor voltages for pnp
  circuit
2 // Electronic Principles
3 // By Albert Malvino , David Bates
4 // Seventh Edition
5 // The McGraw-Hill Companies
6 // Example 8-7, page 278
7
8 clear;clc; close;
9
10 // Given data
11 Vee=10;// in volts
12 Vcc=10;// in volts
13 Rc=3.6*10^3;// in ohms
14 Re=1*10^3;// in ohms
15 R1=10*10^3;// in ohms
16 R2=2.2*10^3;// in ohms
17
18 // Calculations
19 V2=(R2/(R2+R1))*Vee;//voltage across R2
20 Ve=V2-0.7;// voltage across emitter resistor in
  volts
21 Ie=Ve/Re;// emitter current in amperes
22 Ic=Ie;// collector current is equal to emitter
  current
23 Vc=Ic*Rc;// collector-ground voltage in volts
24 Vb=Vcc-V2;// base-ground voltage in volts
```



```
25 Vee=Vcc-Ve; // emitter-ground voltage in volts
26 disp("Volts",Vc,"Collector Voltage")
27 disp("Volts",Vb,"Base Voltage")
28 disp("Volts",Vee,"Emitter Voltage")
29
30 // Result
31 // collector-ground voltage is 3.96 volts
32 // base-ground voltage is 8.2 volts
33 // emitter-ground voltage is 8.9 volts
```

Chapter 9

AC Models

Scilab code Exa 9.1 example1

```
1 // find the value of capacitance
2 // Electronic Principles
3 // By Albert Malvino , David Bates
4 // Seventh Edition
5 // The McGraw-Hill Companies
6 // Example 9-1, page 289
7
8 clear;clc; close;
9
10 // Given data
11 R=2*10^3;// resistance in ohms
12 fmin=20;// lower frequency range
13 fmax=20*10^3;// higher frequency range
14
15 // Calculations
16 Xc=200;// Xc<0.1*R at 20 Hertz
17 C=1/(2*%pi*fmin*Xc);// in faraday
18 disp(" Faraday" ,C," Capacitance=")
19
20 // Result
21 // Capacitance required is 39.8 micro Faraday
```

Scilab code Exa 9.2 example2

```
1 // find the value of capacitance
2 // Electronic Principles
3 // By Albert Malvino , David Bates
4 // Seventh Edition
5 // The McGraw-Hill Companies
6 // Example 9-2, page 293
7
8 clear;clc; close;
9
10 // Given data
11 R1=600;// resistance in ohms
12 R2=1*10^3;// resistance in ohms
13 R=(R1*R2)/(R1+R2);// R=R1||R2
14 f=1*10^3;// frequency in hertz
15
16 // Calculations
17 Xc=37.5;// Xc<0.1*R at 1000 Hertz
18 C=1/(2*pi*f*Xc);// in faraday
19 disp("Faraday",C,"Capacitance=")
20
21 // Result
22 // Capacitance required is 4.2 micro Faraday
```

Scilab code Exa 9.3 example3

```

1 // find maximum small signal emitter current
2 // Electronic Principles
3 // By Albert Malvino , David Bates
4 // Seventh Edition
5 // The McGraw–Hill Companies
6 // Example 9–3, page 297
7
8 clear;clc; close;
9
10 // Given data
11 Vee=2;// in volts
12 Vbe=0.7;// in volts
13 Re=1*10^3;// in ohms
14
15 // Calculations
16 Ieq=(Vee-Vbe)/Re;// Q point emitter current in
    amperes
17 ieppmax=0.1*Ieq;// maximum small signal emitter
    current in amperes
18 disp(ieppmax,"maximum small signal emitter current")
19
20 // Result
21 // Maximum small signal emitter current is 130
    microApp.

```

Scilab code Exa 9.4 example4

```

1 // find re(ac)
2 // Electronic Principles
3 // By Albert Malvino , David Bates
4 // Seventh Edition
5 // The McGraw–Hill Companies
6 // Example 9–4, page 301

```

```

7
8 clear;clc; close;
9
10 // Given data
11 Ie=3*10^-3;// emitter current in amperes
12
13 // Calculations
14 re=25*10^-3/Ie;// ac emitter resistance in ohms
15 disp("Ohms",re,"re(ac)=")
16
17 // Result
18 // re(ac) of the base-biased amplifier is 8.33 ohms

```

Scilab code Exa 9.5 example5

```

1 // find re(ac)
2 // Electronic Principles
3 // By Albert Malvino , David Bates
4 // Seventh Edition
5 // The McGraw-Hill Companies
6 // Example 9-5, page 301
7
8 clear;clc; close;
9
10 // Given data
11 Ie=1.1*10^-3;// emitter current in amperes
12
13 // Calculations
14 re=25*10^-3/Ie;// ac emitter resistance in ohms
15 disp("Ohms",re,"re(ac)=")
16
17 // Result
18 // re(ac) of the base-biased amplifier is 22.7 ohms

```

Scilab code Exa 9.6 example6

```
1 // find re(ac)
2 // Electronic Principles
3 // By Albert Malvino , David Bates
4 // Seventh Edition
5 // The McGraw-Hill Companies
6 // Example 9-6, page 301
7
8 clear;clc; close;
9
10 // Given data
11 Ie=1.3*10^-3;// emitter current in amperes
12
13 // Calculations
14 re=25*10^-3/Ie;// ac emitter resistance in ohms
15 disp("Ohms",re,"re(ac)=")
16
17 // Result
18 // re(ac) of the base-biased amplifier is 19.2 ohms
```

Chapter 10

Voltage Amplifiers

Scilab code Exa 10.1 example1

```
1 // find voltage gain and voltage across load
  resistor
2 // Electronic Principles
3 // By Albert Malvino , David Bates
4 // Seventh Edition
5 // The McGraw-Hill Companies
6 // Example 10-1, page 322
7
8 clear;clc; close;
9
10 // Given data
11 R1=10*10^3;// in ohms
12 R2=2.2*10^3;// in ohms
13 Re=1*10^3;// in ohms
14 Rl=10*10^3;// in ohms
15 Rc=3.6*10^3;// in ohms
16 Vin=2.2*10^-3;// in volts
17 Vcc=10;// in volts
18
19 // Calculations
20 rc=(Rc*Rl)/(Rc+Rl);// ac collector resistance in
```

```

    ohms,Rc||Rl
21 re_=22.7;// ac resistance in ohms
22 Av=rc/re_;// voltage gain
23 vout=Av*Vin;// output voltage in volts
24 disp("Volts",vout,"Output voltage")
25
26 // Results
27 // output voltage is 256 mVolts

```

Scilab code Exa 10.2 example2

```

1 // find voltage gain and output voltage across load
  resistor
2 // Electronic Principles
3 // By Albert Malvino , David Bates
4 // Seventh Edition
5 // The McGraw-Hill Companies
6 // Example 10-2, page 323
7
8 clear;clc; close;
9
10 // Given data
11 R1=10*10^3;// in ohms
12 R2=2.2*10^3;// in ohms
13 Re=10*10^3;// in ohms
14 Vin=5*10^-3;// in volts
15 Vcc=9;// in volts
16 Rc=3.6*10^3;// in ohms
17 Rl=2.2*10^3;// in ohms
18
19 // Calculations
20 rc=(Rc*Rl)/(Rc+Rl);// ac collector resistance in
    ohms,Rc||Rl

```



```

21 Ie=(Vcc-0.7)/Re;// dc emitter current in amperes
22 re_=(25*10^-3)/Ie;// ac resistance of the emitter
    diode
23 Av=rc/re_;// voltage gain
24 vout=Av*Vin;// output voltage in volts
25 disp("Volts",vout,"Output voltage")
26
27 // Results
28 // Output voltage is 228 mVolts.

```

Scilab code Exa 10.3 example3

```

1 // find output voltage
2 // Electronic Principles
3 // By Albert Malvino , David Bates
4 // Seventh Edition
5 // The McGraw-Hill Companies
6 // Example 10-3, page 325
7
8 clear;clc; close;
9
10 // Given data
11 B=300;
12 R1=10*10^3;// in ohms
13 R2=2.2*10^3;// in ohms
14 Re=1*10^3;// in ohms
15 Rl=10*10^3;// in ohms
16 Rc=3.6*10^3;// in ohms
17 Rg=600;// internal resistance of ac generator in
    ohms
18 vg=2*10^-3;// in volts
19 Vcc=10;// in volts
20

```

```

21 // Calculations
22 rc=(Rc*Rl)/(Rc+Rl); // ac collector resistance in
    ohms,Rc||Rl
23 re_=22.7; // ac resistance in ohms
24 Av=rc/re_; // voltage gain
25 zinbase=B*re_; // input impedance of base in ohms
26 zinstage_=(1/R1)+(1/R2)+(1/zinbase); // input
    impedance of base in ohms
27 zinstage=zinstage_^-1
28 vin=(zinstage/(Rg+zinstage))*vg; // input voltage in
    volts
29 vout=Av*vin; // output voltage in volts
30 disp(" Volts",vout,"Output voltage")
31
32 // Results
33 // Output voltage is 165 mVolts.

```

Scilab code Exa 10.4 example4

```

1 // find output voltage
2 // Electronic Principles
3 // By Albert Malvino , David Bates
4 // Seventh Edition
5 // The McGraw-Hill Companies
6 // Example 10-4, page 325
7
8 clear;clc; close;
9
10 // Given data
11 B=50;
12 R1=10*10^3; // in ohms
13 R2=2.2*10^3; // in ohms
14 Re=1*10^3; // in ohms

```

```

15 R1=10*10^3; // in ohms
16 Rc=3.6*10^3; // in ohms
17 Rg=600; // internal resistance of ac generator in
    ohms
18 vg=2*10^-3; // in volts
19 Vcc=10; // in volts
20
21 // Calculations
22 rc=(Rc*R1)/(Rc+R1); // ac collector resistance in
    ohms,Rc||R1
23 re_=22.7; // ac resistance in ohms
24 Av=rc/re_; // voltage gain
25 zinbase=B*re_; // input impedance of base in ohms
26 zinstage_=(1/R1)+(1/R2)+(1/zinbase); // input
    impedance of base in ohms
27 zinstage=zinstage_^-1
28 vin=(zinstage/(Rg+zinstage))*vg; // input voltage in
    volts
29 vout=Av*vin; // output voltage in volts
30 disp("Volts",vout,"Output voltage")
31
32 // Results
33 // Output voltage is 126 mVolts.

```

Scilab code Exa 10.5 example5

```

1 // calculate ac collector voltage ,ac output voltage
    across load resistor
2 // Electronic Principles
3 // By Albert Malvino , David Bates
4 // Seventh Edition
5 // The McGraw-Hill Companies
6 // Example 10-5, page 327

```

```

7
8 clear;clc; close;
9
10 // Given data
11 B=100;
12 R1=10*10^3;// in ohms
13 R2=2.2*10^3;// in ohms
14 Re=1*10^3;// in ohms
15 Rl=10*10^3;// in ohms
16 Rc=3.6*10^3;// in ohms
17 Rg=600;// internal resistance of ac generator in
    ohms
18 Vg=1*10^-3;// in volts
19 Vcc=10;// in volts
20
21 // Calculations
22 re_=22.7;// ac resistance in ohms
23 zinbase=B*re_;// input impedance of first base in
    ohms
24 zinstage_=(1/R1)+(1/R2)+(1/zinbase);// input
    impedance of base in ohms
25 zinstage=zinstage_^-1
26 vin=(zinstage/(Rg+zinstage))*Vg;// input voltage in
    volts
27 rc1=Rc*zinstage/(Rc+zinstage);// rc=Rc||zinstage in
    ohms in first stage
28 Av1=rc1/zinbase;// voltage gain
29 vc1=Av1*vin;// collector voltage in volts in first
    stage
30 rc2=Rc*Rl/(Rc+Rl);// rc2=Rc||Rl in ohms in second
    stage
31 Av2=rc2/zinbase;// voltage gain
32 vc2=Av2*vc1;// output voltage across load resistor
    in volts
33 disp("Volts",vc1,"ac collector voltage in first
    stage=")
34 disp("Volts",vc2,"ac output voltage across the load
    resistor")

```

```
35
36 // Results
37 // ac collector voltage in first stage is 216 *10-6
    Volts
38 // ac output voltage across the load resistor is 252
    *10-6 Volts
```

Scilab code Exa 10.6 example6

```
1 // calculate output across load resistor
2 // Electronic Principles
3 // By Albert Malvino , David Bates
4 // Seventh Edition
5 // The McGraw-Hill Companies
6 // Example 10-6, page 331
7
8 clear;clc; close;
9
10 // Given data
11 B=200;
12 re=180;// in ohms
13 R1=10*103;// in ohms
14 R2=2.2*103;// in ohms
15 Rc=3.6*103;// in ohms
16 Vg=50*10-3;// in volts
17 Vcc=10;// in volts
18 Rg=600;// internal resistance in ohms
19
20 // Calculations
21 rc=2.65*103;// in ohms
22 zinbase=B*re;// input impedance of base in ohms
23 zinstage_=(1/R1)+(1/R2)+(1/zinbase);// input
    impedance of base in ohms
```

```

24 zinstage=zinstage_^-1
25 vin=(zinstage/(Rg+zinstage))*Vg;// input voltage in
    volts
26 Av=rc/re;// voltage gain
27 vout=Av*vin;// output voltage across load resistor
    in volts
28 disp("Volts",vout,"Output voltage")
29
30 // Results
31 // output voltage across load resistor is 544 mVolts

```

Scilab code Exa 10.7 example7

```

1 // calculate output across load resistor
2 // Electronic Principles
3 // By Albert Malvino , David Bates
4 // Seventh Edition
5 // The McGraw-Hill Companies
6 // Example 10-7, page 332
7
8 clear;clc; close;
9
10 // Given data
11 B=200;
12 re_=22.7;// in ohms
13 re=180;// in ohms
14 R1=10*10^3;// in ohms
15 R2=2.2*10^3;// in ohms
16 Rc=3.6*10^3;// in ohms
17 Vg=50*10^-3;// in volts
18 Vcc=10;// in volts
19 Rg=600;// internal resistance in ohms
20

```

```

21 // Calculations
22 rc=2.65*10^3;// in ohms
23 zinbase=B*(re+re_);// input impedance of base in
    ohms
24 zinstage_=(1/R1)+(1/R2)+(1/zinbase);// input
    impedance of base in ohms
25 zinstage=zinstage_^-1
26 vin=(zinstage/(Rg+zinstage))*Vg;// input voltage in
    volts
27 Av=rc/(re+re_);// voltage gain
28 vout=Av*vin;// output voltage across load resistor
    in volts
29 disp(" Volts",vout,"Output voltage")
30
31 // Results
32 // output voltage across load resistor is 485 mVolts

```

Scilab code Exa 10.8 example8

```

1 // calculate output across load resistor
2 // Electronic Principles
3 // By Albert Malvino , David Bates
4 // Seventh Edition
5 // The McGraw–Hill Companies
6 // Example 10–8, page 333
7
8 clear;clc; close;
9
10 // Given data
11 B=200;
12 re=180;// in ohms
13 R1=10*10^3;// in ohms
14 R2=2.2*10^3;// in ohms

```

```

15 Rc=3.6*10^3;// in ohms
16 Vg=1*10^-3;// in volts
17 Vcc=10;// in volts
18 Rg=600;// internal resistance in ohms
19
20 // Calculations
21 zinbase=B*re;// input impedance of base in ohms
22 zinstage_=(1/R1)+(1/R2)+(1/zinbase);// input
    impedance of base in ohms
23 zinstage=zinstage_^-1;
24 vin=(zinstage/(Rg+zinstage))*Vg;// input voltage in
    volts
25 rc1=Rc*zinstage/(Rc+zinstage);//in ohms
26 Av1=rc1/re;// voltage gain
27 vc=Av1*vin;// output voltage across load resistor in
    volts
28 rc2=2.65*10^3;// in ohms
29 Av2=rc2/re;// voltage gain
30 vout=Av2*vc;// outout voltage in volts
31 disp("Volts",vout,"Output voltage")
32
33 // Results
34 // output voltage across load resistor is 70 mVolts

```

Scilab code Exa 10.9 example9

```

1 // calculate minimum and maximum voltage gai of 2
    stage amplifier
2 // Electronic Principles
3 // By Albert Malvino , David Bates
4 // Seventh Edition
5 // The McGraw–Hill Companies
6 // Example 10–9, page 335

```



```
7
8 clear;clc; close;
9
10 // Given data
11 rmin=0;// minimum adjustable resistance in ohms
12 rmax=10*10^3;// maximum adjustable resistance in
    ohms
13 re=100;// in ohms
14
15 // Calculations
16 rfmin=rmin+1*10^3;// minimum feedback resistance in
    ohms
17 rfmax=rmax+1*10^3;// maximum feedback resistance in
    ohms
18 Avmin=rfmin/re;// minimum voltage gain
19 Avmax=rfmax/re;// maximum voltage gain
20 disp(Avmin,"Minimum Voltage gain=")
21 disp(Avmax,"Maximum Voltage gain=")
22
23 // Results
24 // minimum voltage gain is 10
25 // maximum voltage gain is 110
```

Chapter 12

Power Amplifiers

Scilab code Exa 12.1 example1

```
1 // calculate dc collector current ,dc collector-  
   emitter voltage ,ac resistance seen by collector  
2 // Electronic Principles  
3 // By Albert Malvino , David Bates  
4 // Seventh Edition  
5 // The McGraw-Hill Companies  
6 // Example 12-1, page 384  
7  
8 clear;clc; close;  
9  
10 // Given data  
11 R1=490; // in ohms  
12 R2=68; // in ohms  
13 Rc=120; // in ohms  
14 Re=20; // in ohms  
15 Vcc=30; // in volts  
16 Rl=180; // in ohms  
17 Vc=12; // in volts  
18  
19 // Calculations  
20 Vb=R2*Vcc/(R2+R1); // in volts
```

```

21 Ve=Vb-0.7;
22 Ie=Ve/Re; // in amperes
23 Icq=Ie; // dc collector current in amperes
24 Vceq=Vc-Ve; // dc collector-emitter voltage in volts
25 rc=Rc*Rl/(Rc+Rl); // rc=Rc||Rl
26 disp("Amperes",Icq,"dc collector current=")
27 disp("Volts",Vceq,"dc collector-emitter voltage=")
28 disp("ohms",rc,"ac resistance =")
29
30 // Results
31 // dc collector current is 147 mAmperes
32 // dc collector-emitter voltage is 9 volts
33 // ac resistance seen by collector is 72 ohms

```

Scilab code Exa 12.2 example2

```

1 // calculate ac load line saturation , cutoff points ,
  // maximum peak-to-peak output voltage
2 // Electronic Principles
3 // By Albert Malvino , David Bates
4 // Seventh Edition
5 // The McGraw-Hill Companies
6 // Example 12-2, page 384
7
8 clear;clc; close;
9
10 // Given data
11 R1=490; // in ohms
12 R2=68; // in ohms
13 Rc=120; // in ohms
14 Re=20; // in ohms
15 Vcc=30; // in volts
16 Rl=180; // in ohms

```

```

17 Vc=12; // in volts
18
19 // Calculations
20 Vb=R2*Vcc/(R2+R1); // in volts
21 Ve=Vb-0.7;
22 Ie=Ve/Re; // in amperes
23 Icq=Ie; // dc collector current in amperes
24 Vceq=Vc-Ve; // dc collector-emitter voltage in volts
25 rc=Rc*Rl/(Rc+Rl); // rc=Rc||Rl
26 Icsat=Icq+Vceq/rc; // ac saturation current in
    amperes
27 Vcecutoff=Vceq+(Icq*rc); // in volts
28 // as supply voltage is 30 volts MPP<30
29 MPP=2*Vceq ; // as (Icq*rc)>Vceq
30 disp("Amperes",Icsat,"ac load line saturation")
31 disp("Volts",Vcecutoff,"ac cutoff voltage")
32 disp("Volts",MPP,"maximum peak-to-peak output
    voltage=")
33
34 // Results
35 // ac load line saturation is 273 mAmpere
36 // ac voltage at cutoff point is 19.7 volts
37 // maximum peak-to-peak output voltage is 18 volts

```

Scilab code Exa 12.3 example3

```

1 // calculate power output gain
2 // Electronic Principles
3 // By Albert Malvino , David Bates
4 // Seventh Edition
5 // The McGraw-Hill Companies
6 // Example 12-3, page 387
7

```

```

8  clear;clc; close;
9
10 // Given data
11 R1=490;// in ohms
12 R2=68;// in ohms
13 Rc=120;// in ohms
14 Re=20;// in ohms
15 Vcc=30;// in volts
16 Rl=180;// in ohms
17 Ri=100;// input independence in ohms
18 PP=18;// peak-to-peak voltage in volts
19 Vin=200*10^-3;// in volts
20
21 // Calculations
22 zinstage=490*68*100/((490*68)+(490*100)+(68*100));//
    in ohms
23 Pin=(Vin)^2/(8*zinstage);// ac input power in watts
24 Pout=(PP)^2/(8*Rl);// ac output power in watts
25 Ap=Pout/Pin;// power gain
26 disp(Ap,"Power gain=")
27
28 // Result
29 // power gain is 1682

```

Scilab code Exa 12.4 example4

```

1 // calculate transistor power dissipation and
    efficiency
2 // Electronic Principles
3 // By Albert Malvino , David Bates
4 // Seventh Edition
5 // The McGraw-Hill Companies
6 // Example 12-4, page 387

```

```

7
8 clear;clc; close;
9 // Given data
10 R1=490;// in ohms
11 R2=68;// in ohms
12 Rc=120;// in ohms
13 Re=20;// in ohms
14 Vcc=30;// in volts
15 Rl=180;// in ohms
16 Ri=100;// input independence in ohms
17 PP=18;// peak-to-peak voltage in volts
18 Vin=200*10^-3;// in volts
19 Vc=12;// in volts
20
21 // Calculations
22 Vb=R2*Vcc/(R2+R1);// in volts
23 Ve=Vb-0.7;
24 Ie=Ve/Re;// in amperes
25 Icq=Ie;// dc collector current in amperes
26 Vceq=Vc-Ve;// dc collector-emitter voltage in volts
27 Pdq=Vceq*Icq;// transistor power dissipation
28 // to find stage efficiency
29 Ibias=Vcc/(R1+R2);// in amperes
30 Idc=Ibias+Icq;// in amperes
31 Pdc=Idc*Vcc;// dc input power in watts
32 Pout=(PP)^2/(8*Rl);// ac output power in watts
33 n=(Pout/Pdc)*100;// efficiency
34 disp("Watts",Pdq,"transistor power dissipation=")
35 disp("%",n,"efficiency=")
36
37 // Results
38 // transistor power dissipation is 1.34 watts
39 // efficiency of stage is 3.72%

```

Scilab code Exa 12.6 example6

```
1 // calculate dc collector current,dc collector-
   emitter voltage,ac resistance seen by collector
2 // Electronic Principles
3 // By Albert Malvino , David Bates
4 // Seventh Edition
5 // The McGraw-Hill Companies
6 // Example 12-6, page 391
7
8 clear;clc; close;
9 // Given data
10 R1=50;// in ohms
11 R2=100;// in ohms
12 Re=16;// in ohms
13 Vcc=12;// in volts
14 Rl=16;// in ohms
15
16 // Calculations
17 Vb=R2*Vcc/(R2+R1);// in volts
18 Ve=Vb-0.7;
19 Ie=Ve/Re;// in amperes
20 Icq=Ie;// dc collector current in amperes
21 Vceq=Vcc-Ve;// dc collector-emitter voltage in volts
22 re=Re/2;// in ohms,re=Re|| Rl
23 disp(" Amperes",Icq,"dc collector current=")
24 disp(" Volts",Vceq,"dc collector-emitter voltage=")
25 disp(" ohms",re,"ac resistance =")
26
27 // Results
28 // Icq=456 mAmperes ,Vceq=4.7 ohms ,re=8 ohms
```

Scilab code Exa 12.7 example7

```

1 // calculate ac load line saturation , cutoff points ,
   maximum peak-to-peak output voltage
2 // Electronic Principles
3 // By Albert Malvino , David Bates
4 // Seventh Edition
5 // The McGraw-Hill Companies
6 // Example 12-7, page 392
7
8 clear;clc; close;
9 // Given data
10 R1=50;// in ohms
11 R2=100;// in ohms
12 Re=16;// in ohms
13 Vcc=12;// in volts
14 Rl=16;// in ohms
15
16 // Calculations
17 Vb=R2*Vcc/(R2+R1);// in volts
18 Ve=Vb-0.7;
19 Ie=Ve/Re;// in amperes
20 Icq=Ie;// dc collector current in amperes
21 Vceq=Vcc-Ve;// dc collector-emitter voltage in volts
22 re=Re/2;// in ohms,re=Re||Rl
23 icsat=Icq+(Vceq/re);// ac load line saturation in
   amperes
24 Vceutoff=Vceq+(Icq*re);// cutoff point in volts
25 MPP=2*Icq*re;// MPP output voltage in Vpp
26 disp("Amperes",icsat,"ac load line saturation")
27 disp("Volts",Vceutoff,"ac cutoff voltage")
28 disp("Volts",MPP,"maximum peak-to-peak output
   voltage=")
29
30 // Result
31 // ac load line saturation is 1.04 amperes
32 // cutoff voltage is 8.35 volts
33 // MPP output voltage is 7.3 Vpp.

```

Scilab code Exa 12.8 example8

```
1 // calculate transistor power dissipation and
  // maximum output power
2 // Electronic Principles
3 // By Albert Malvino , David Bates
4 // Seventh Edition
5 // The McGraw-Hill Companies
6 // Example 12-8, page 397
7
8 clear;clc; close;
9 // Given data
10 R1=100; // in ohms
11 R2=100; // in ohms
12 Vcc=20; // in volts
13 Rl=8; // in ohms
14
15 // Calculations
16 MPP=Vcc; // in volts
17 Pdmax=(MPP^2)/(40*R1); // maximum transistor power
  // dissipation in watts
18 Poutmax=(MPP^2)/(8*R1); // maximum output power in
  // watts
19 disp("Watts",Pdmax,"maximum power dissipation=")
20 disp("Watts",Poutmax,"maximum output power=")
21
22
23 // Result
24 // maximum power dissipation is 1.25 watts
25 // maximum output power is 6.25 watts
```

Scilab code Exa 12.9 example9

```
1 // calculate efficiency
2 // Electronic Principles
3 // By Albert Malvino , David Bates
4 // Seventh Edition
5 // The McGraw-Hill Companies
6 // Example 12-9, page 398
7
8 clear;clc; close;
9 // Given data
10 R=15;// adjustable resistance in ohms
11 R1=100;// in ohms
12 R2=100;// in ohms
13 Vcc=20;// in volts
14 Rl=8;// in ohms
15 Vceq=10;// in volts
16
17 // Calculations
18 Ibias=Vcc/(R1+R2+R);// dc current through biasing
    resistors
19 Icsat=Vceq/Rl;// saturation current in amperes
20 Iav=Icsat/%pi;// collector current in the conducting
    transistor
21 Idc=Ibias+Iav;// total current drain in amperes
22 Pdc=Vcc*Idc;// dc input power in watts
23 MPP=Vcc;// in volts
24 Poutmax=(MPP^2)/(8*Rl);// maximum output power in
    watts
25 E=(Poutmax/Pdc)*100;// efficiency in percentage
26 disp("%",E," efficiency=")
27
```

```
28 // Result
29 // efficiency is 63.6%
```

Scilab code Exa 12.10 example10

```
1 // calculate efficiency
2 // Electronic Principles
3 // By Albert Malvino , David Bates
4 // Seventh Edition
5 // The McGraw-Hill Companies
6 // Example 12-10, page 400
7
8 clear;clc; close;
9 // Given data
10 R=3.9*10^3;// resistance in ohms
11 R1=3.9*10^3;// in ohms
12 Vcc=20;// in volts
13 Rl=10;// in ohms
14 Vceq=10;// in volts
15 Vbe=0.7;// in volts
16
17 // Calculations
18 Ibias=(Vcc-(2*Vbe))/(2*R);// dc current through
    biasing resistors
19 Iq=Ibias;// quiescent collector current assuming
    compensating diodes match the emitter diodes
20 Icsat=Vceq/Rl;// saturation current in amperes
21 Iav=Icsat/%pi;// collector current in the conducting
    transistor
22 Idc=Ibias+Iav;// total current drain in amperes
23 Pdc=Vcc*Idc;// dc input power in watts
24 MPP=Vcc;// in volts
25 Poutmax=(MPP^2)/(8*Rl);// maximum output power in
```

```

    watts
26 E=(Poutmax/Pdc)*100; // efficiency in percentage
27 disp("%",E," efficiency=")
28 disp(" Amperes",Iq," quiescent collector current=")
29
30 // Result
31 // efficiency is 78%
32 // quiescent collector current is 2.38 mAmperes

```

Scilab code Exa 12.12 example12

```

1 // calculate bandwidth of amplifier
2 // Electronic Principles
3 // By Albert Malvino , David Bates
4 // Seventh Edition
5 // The McGraw-Hill Companies
6 // Example 12-12, page 410
7
8 clear;clc; close;
9 // Given data
10 c=470*10^-12; // capacitance in faraday
11 l=2*10^-6; // inductance in henry
12 Rl=1*10^3; // load resistance in ohms
13 Ql=100;
14
15 // Calculations
16 fr=1/(2*pi*sqrt(l*c)); // resonant frequency in
    hertz
17 Xl=2*pi*fr*l; // in ohms
18 Rp=Ql*Xl; // equivalent parallel resistance of coil
    in ohms
19 rc=(Rp*Rl)/(Rp+Rl); // ac collector resistance in
    ohms

```

```

20 Q=rc/Xl;// Q of the overall circuit
21 BW=fr/Q;// band width in hertz
22 disp("Hertz",BW,"bandwidth=")
23
24 // Result
25 // bandwidth is 390 KHertz

```

Scilab code Exa 12.13 example13

```

1 // calculate worst-case power dissipation
2 // Electronic Principles
3 // By Albert Malvino , David Bates
4 // Seventh Edition
5 // The McGraw-Hill Companies
6 // Example 12-13, page 411
7
8 clear;clc; close;
9 // Given data
10 c=470*10^-12;// capacitance in faraday
11 l=2*10^-6;// inductance in henry
12 Rl=1*10^3;// load resistance in ohms
13 Ql=100;
14 Vcc=15;// in volts
15
16 // Calculations
17 MPP=2*Vcc;// maximum peak-to-peak output in volts
18 fr=1/(2*pi*sqrt(l*c));// resonant frequency in
    hertz
19 Xl=2*pi*fr*l;// in ohms
20 Rp=Ql*Xl;// equivalent parallel resistance of coil
    in ohms
21 rc=(Rp*Rl)/(Rp+Rl);// ac collector resistance in
    ohms

```

```

22 Pd=MPP^2/(40*rc); // worst-case power dissipation of
    the transistor in watts
23 disp("Watts",Pd,"worst-case power dissipation=")
24
25 // Result
26 // worst-case power dissipation is 26 mWatts

```

Scilab code Exa 12.14 example14

```

1 // calculate maximum power rating
2 // Electronic Principles
3 // By Albert Malvino , David Bates
4 // Seventh Edition
5 // The McGraw-Hill Companies
6 // Example 12-14, page 414
7
8 clear;clc; close;
9 // Given data
10 // 2N3904
11 Pd=625*10^-3; // power rating at 25 degree celcius
    ambient
12 D=5*10^-3; // derating factor in watts per degree
    celcius
13 T2=50; // highest range in celcius
14 T1=25; // ambient temperature in degree celcius
15
16 // Calculations
17 dT=T2-T1; // in degree celcius
18 dP=D*dT; // change in power
19 Pdmax=Pd-dP; // in watts
20 disp("Watts",Pdmax,"maximum power rating=")
21
22 // Result

```

23 // maximum power rating is 500 mWatts.

Chapter 13

JFETs

Scilab code Exa 13.1 example1

```
1 // calculate input resistance of JFET
2 // Electronic Principles
3 // By Albert Malvino , David Bates
4 // Seventh Edition
5 // The McGraw-Hill Companies
6 // Example 13-1, page 428
7
8 clear;clc; close;
9
10 // Given data
11 // 2N5486 JFET
12 Vgs=20; // reverse gate voltage in volts
13 Ig=1*10^-9 ; // gate current in amperes
14
15 // Calculations
16 Rin=Vgs/Ig; // in ohms
17 disp("ohms",Rin,"input resistance=")
18
19 // Result
20 // input resistance is 20,000 Mohms
```

Scilab code Exa 13.2 example2

```
1 // calculate ohmic resistance , gate-source cutoff
  voltage
2 // Electronic Principles
3 // By Albert Malvino , David Bates
4 // Seventh Edition
5 // The McGraw-Hill Companies
6 // Example 13-2, page 430
7
8 clear; clc; close;
9
10 // Given data
11 // MPF4857
12 Vp=6;// pinchoff voltage in volts
13 Idss=100*10^-3 ;// maximum drain current in amperes
14
15 // Calculations
16 Rds=Vp/Idss;// ohmic resistance in ohms
17 Vgsoff=-Vp;// gate source cutoff voltage is negative
  of pinchoff voltage
18 disp("ohms",Rds,"input resistance=")
19 disp("Volts",Vgsoff,"gate-source cutoff voltage=")
20
21 // Result
22 // input resistance is 60 ohms
23 // gate-source cutoff voltage is -6 Volts
```

Scilab code Exa 13.3 example3

```
1 // calculate gate voltage and drain current at half
  cutoff point
2 // Electronic Principles
3 // By Albert Malvino , David Bates
4 // Seventh Edition
5 // The McGraw-Hill Companies
6 // Example 13-3, page 431
7
8 clear; clc; close;
9
10 // Given data
11 // 2N5668
12 Vgsoff=-4; // gate-source cutoff voltage in volts
13 Idss=5*10^-3 ; // maximum drain current in amperes
14
15 // Calculations
16 Vgs=-Vgsoff/2 ; // gate voltage at half cutoff point
  in volts
17 Id=Idss/4 ; // drain current at half cutoff point in
  amperes
18 disp(" Amperes",Id," Drain current=")
19 disp(" Volts",Vgs," gate Voltage=")
20
21
22 // Result
23 // Gate voltage at half cutoff point is -2 Volts
24 // Drain current is 1.25 mAmperes
```

Scilab code Exa 13.4 example4

```
1 // calculate drain current at half cutoff point
```

```

2 // Electronic Principles
3 // By Albert Malvino , David Bates
4 // Seventh Edition
5 // The McGraw-Hill Companies
6 // Example 13-4, page 432
7
8 clear; clc; close;
9
10 // Given data
11 // 2N5459
12 Vgsoff=-8; // gate-source cutoff voltage in volts
13 Idss=16*10^-3 ; // maximum drain current in amperes
14
15 // Calculations
16 Id=Idss/4 ; // drain current at half cutoff point in
    amperes
17 disp(" Amperes" ,Id," Drain current=")
18
19 // Result
20 // Drain current is 4 mAmperes

```

Scilab code Exa 13.6 example6

```

1 // calculate medium source resistance , drain voltage
2 // Electronic Principles
3 // By Albert Malvino , David Bates
4 // Seventh Edition
5 // The McGraw-Hill Companies
6 // Example 13-6, page 436
7
8 clear; clc; close;
9
10 // Given data

```

```

11 Vp=4 ;// pinchoff voltage in volts
12 Idss=10*10^-3 ;// maximum drain current in amperes
13 Vdd=30; // in volts
14 Rd=2*10^3; // drain resistance in ohms
15
16 // Calculations
17 Rds=Vp/Idss; // medium source resistance in ohms
18 Id=Idss/4 ;// drain current in amperes
19 Vd=Vdd-(Id*Rd); // drain voltage in volts
20 disp("ohms",Rds,"medium source resistance=")
21 disp("Volts",Vd,"Drain Voltage=")
22
23
24 // Result
25 // medium source resistance is 400 ohms
26 // drain voltage is 25 volts

```

Scilab code Exa 13.8 example8

```

1 // find Q point
2 // Electronic Principles
3 // By Albert Malvino , David Bates
4 // Seventh Edition
5 // The McGraw-Hill Companies
6 // Example 13-8, page 440
7
8 clear; clc; close;
9
10 // Given data
11 Vdd=30; // in volts
12 Rd=1*10^3; // drain resistance in ohms
13 Rs=2*10^3; // source resistance in ohms
14

```

```

15 // Calculations
16 // 3:1 voltage divider produces a gate voltage of 10
    Volts
17 Vs=10;// voltage across source resistor in volts
18 Id=Vs/Rs;// drain current in amperes
19 Vd=Vdd-(Id*Rd);// drain voltage in volts
20 Vds=Vd-Vs;// drain-source voltage in volts
21 disp(" Amperes",Id," Drain current=")
22 disp(" Volts",Vds," Drain-source Voltage=")
23
24
25 // Result
26 // Q point is (15,5*10-3)

```

Scilab code Exa 13.10 example10

```

1 // find drain current ,voltage between drain and
    ground
2 // Electronic Principles
3 // By Albert Malvino , David Bates
4 // Seventh Edition
5 // The McGraw-Hill Companies
6 // Example 13-10, page 443
7
8 clear; clc; close;
9
10 // Given data
11 Vdd=15;// in volts
12 Rd=1*103;// drain resistance in ohms
13 Rs=3*103;// source resistance in ohms
14
15 // Calculations
16 // 15 Volts occur across source resistor

```

```

17 Vs=15; // voltage across source resistor in volts
18 Id=Vs/Rs; // drain current in amperes
19 Vd=Vdd-(Id*Rd); // drain voltage in volts
20 disp(" Amperes" ,Id," Drain current=")
21 disp(" Volts" ,Vd," Drain Voltage=")
22
23
24 // Result
25 // Drain current is 5 mAmperes
26 // Voltage between drain and ground is 10 Volts

```

Scilab code Exa 13.11 example11

```

1 // find drain current ,drain voltage
2 // Electronic Principles
3 // By Albert Malvino , David Bates
4 // Seventh Edition
5 // The McGraw-Hill Companies
6 // Example 13-11, page 444
7
8 clear; clc; close;
9
10 // Given data
11 Vdd=10; // in volts
12 Vee=5; // in volts
13 Rd=1*10^3; // drain resistance in ohms
14 Re=2*10^3; // source resistance in ohms
15
16 // Calculations
17 Id=(Vee-0.7)/Re; // drain current set up by bipolar
    junction transistor in amperes
18 Vd=Vdd-(Id*Rd); // drain voltage in volts
19 disp(" Amperes" ,Id," Drain current=")

```

```

20 disp(" Volts",Vd," Drain Voltage=")
21
22 // Result
23 // Drain current is 2.15 mAmperes
24 // Drain voltage is 7.85 Volts

```

Scilab code Exa 13.12 example12

```

1 // find gate-source cutoff voltage and
  transconductance
2 // Electronic Principles
3 // By Albert Malvino , David Bates
4 // Seventh Edition
5 // The McGraw-Hill Companies
6 // Example 13-12, page 447
7
8 clear; clc; close;
9
10 // Given data
11 Idss=5*10^-3; // maximum drain current in amperes
12 gmo=5000*10^-6; // maximum transconductance in Seimen
13 Vgs=-1; // Gate-source voltage in volts
14
15 // Calculations
16 Vgsoff=-2*Idss/gmo; // gate-source cutoff voltage in
  volts
17 gm=gmo*(1-(Vgs/Vgsoff)); // Transconductance at given
  Vgs
18 disp(" Volts",Vgsoff," Gate source cutoff voltage=")
19 disp(" Seimen",gm," transconductance=")
20
21 // Result
22 // Gate source cutoff voltage is -2 Volts

```

23 // Transconductance is 2500 MicroSeimens

Scilab code Exa 13.13 example13

```
1 // calculate output voltage
2 // Electronic Principles
3 // By Albert Malvino , David Bates
4 // Seventh Edition
5 // The McGraw-Hill Companies
6 // Example 13-13, page 449
7
8 clear; clc; close;
9
10 // Given data
11 Rd=3.6*10^3;// in ohms
12 Rl=10*10^3;// in ohms
13 gm=5000*10^-6;// transconductance in Seimen
14 Vin=10^-3;// input voltage in Vpp
15
16 // Calculations
17 rd=Rd*Rl/(Rd+Rl);// ac drain resistance in ohms
18 Av=gm*rd;// voltage gain
19 Vout=Vin*Av;// output voltage in volts
20 disp(" Volts",Vout," Output voltage=")
21
22 // Result
23 // Output voltage is 13.3 mVpp
```

Scilab code Exa 13.14 example14


```

1 // calculate output voltage
2 // Electronic Principles
3 // By Albert Malvino , David Bates
4 // Seventh Edition
5 // The McGraw-Hill Companies
6 // Example 13-14, page 450
7
8 clear; clc; close;
9
10 // Given data
11 Rs=10^3; // in ohms
12 Rl=10^3; // in ohms
13 gm=2500*10^-6; // transconductance in Seimen
14 Vin=10^-3; // input voltage in Vpp
15
16 // Calculations
17 rs=Rs*Rl/(Rs+Rl); // ac drain resistance in ohms
18 Av=gm*rs/(1+(gm*rs)); // voltage gain
19 Vout=Vin*Av; // output voltage in volts
20 disp("Volts",Vout,"Output voltage=")
21
22 // Result
23 // Output voltage is 0.556 mVpp

```

Scilab code Exa 13.15 example15

```

1 // calculate voltage gain
2 // Electronic Principles
3 // By Albert Malvino , David Bates
4 // Seventh Edition
5 // The McGraw-Hill Companies
6 // Example 13-15, page 450
7

```

```

8 clear; clc; close;
9
10 // Given data
11 Rs1=220; // in ohms
12 Rs2=780; // in ohms
13 Rl=3*10^3; // in ohms
14 gm=2000*10^-6; // transconductance in Seimen
15
16
17 // Calculations
18 Rs=Rs1+Rs2; // total dc source resistance in ohms
19 rs=Rs*Rl/(Rs+Rl); // ac drain resistance in ohms
20 Av=gm*rs/(1+(gm*rs)); // voltage gain
21 disp(Av,"Votage gain=")
22
23 // Result
24 // voltage gain is 0.6

```

Scilab code Exa 13.16 example16

```

1 // calculate drain current ,voltage gain
2 // Electronic Principles
3 // By Albert Malvino , David Bates
4 // Seventh Edition
5 // The McGraw-Hill Companies
6 // Example 13-16, page 451
7
8 clear; clc; close;
9
10 // Given data
11 Vdd=30; // in voltage
12 Rs=2.2*10^3; // in ohms
13 Rl=3.3*10^3; // in ohms

```

```
14 gm=3500*10^-6; // transconductance in Seimen
15
16 // Calculations
17 // 3:1 voltage divider produces a gate voltage of 10
    Volts
18 Vs=10; // voltage across source resistor in volts
19 Id=Vs/Rs; // drain current in amperes
20 rs=Rs*R1/(Rs+R1); // ac drain resistance in ohms
21 Av=gm*rs/(1+(gm*rs)); // voltage gain
22 disp("Amperes", Id, "Drain Current=")
23 disp(Av, "Votage gain=")
24
25 // Results
26 // Drain current is 4.55 mAmperes
27 // Voltage gain is 0.822
```

Chapter 14

MOSFETs

Scilab code Exa 14.1 example1

```
1 // calculate drain current at given gate-source
  voltages
2 // Electronic Principles
3 // By Albert Malvino , David Bates
4 // Seventh Edition
5 // The McGraw-Hill Companies
6 // Example 14-1, page 482
7
8 clear; clc; close;
9
10 // Given data
11 // D-MOSFET
12 Vgsoff=-3; // gate-source cutoff voltage in volts
13 Idss=6*10^-3 ; // maximum drain current in amperes
14 Vgs1=-1 ; // gate source voltage in volts
15 Vgs2=-2 ; // gate source voltage in volts
16 Vgs3=0 ; // gate source voltage in volts
17 Vgs4=1 ; // gate source voltage in volts
18 Vgs5=2 ; // gate source voltage in volts
19
20 // Calculations
```

```

21 Id1=Idss*(1-(Vgs1/Vgsoff))^2 ;// drain current in
    amperes
22 Id2=Idss*(1-(Vgs2/Vgsoff))^2 ;// drain current in
    amperes
23 Id3=Idss*(1-(Vgs3/Vgsoff))^2 ;// drain current in
    amperes
24 Id4=Idss*(1-(Vgs4/Vgsoff))^2 ;// drain current in
    amperes
25 Id5=Idss*(1-(Vgs5/Vgsoff))^2 ;// drain current in
    amperes
26 disp(" amperes",Id1," drain current 1=")
27 disp(" amperes",Id2," drain current 2=")
28 disp(" amperes",Id3," drain current 3=")
29 disp(" amperes",Id4," drain current 4=")
30 disp(" amperes",Id5," drain current 5=")
31
32 // Result
33 // Values of Drain current is 2.67, 0.667, 6, 10.7,
    16.7 mAmperes respectively.

```

Scilab code Exa 14.2 example2

```

1 // calculate the circuit's output voltage
2 // Electronic Principles
3 // By Albert Malvino , David Bates
4 // Seventh Edition
5 // The McGraw-Hill Companies
6 // Example 14-2, page 482
7
8 clear; clc; close;
9
10 // Given data
11 // D-MOSFET amplifier

```

```

12 Vgsoff=-2 ;// gate-source cutoff voltage in volts
13 Idss=4*10^-3 ;// maximum drain current in amperes
14 gmo=2000*10^-6 ;// in seimens
15 Vdd=15; // in volts from the figure
16 Rd=2*10^3; // in ohms from the figure
17 Rl=10*10^3; // in ohms from the figure
18 Vin=20*10^-3 ;// input voltage in volts
19
20 // Calculations
21 Vds=Vdd-(Idss*Rd) ;// drain source voltage in volts
22 rd=(Rd*Rl)/(Rd+Rl) ;// ac drain resistance in ohms
23 gm=gmo ; // as Vgs=0
24 Av=gm*rd ;// amplifier's voltage gain
25 Vout=Av*Vin; // in volts
26 disp("Volts ",Vout,"output voltage=")
27
28 // Result
29 // Output voltage is 66.8 mVolts

```

Scilab code Exa 14.6 example6

```

1 // calculate output voltage
2 // Electronic Principles
3 // By Albert Malvino , David Bates
4 // Seventh Edition
5 // The McGraw-Hill Companies
6 // Example 14-6, page 496
7
8 clear; clc; close;
9
10 // Given data
11 Vdd=20; // supply voltage in volts
12 Rd=10*10^3; // resistance in ohms

```

```

13 Rdson=50; // static drain-source on-resistance in
    ohms
14
15 // Calculations
16 Voutlow=Vdd; // when input voltage is low, the lower
    MOSFET is open and the output voltage= supply
    voltage
17 Vouthigh=Vdd*(Rdson/(Rdson+Rd)) ; // when input
    voltage is high, the lower MOSFET has a
    resistance of Rd and the output voltage= ground
    voltage
18 disp("Volts ",Vouthigh,"output voltage at high input
    voltage=")
19 disp("Volts ",Voutlow,"output voltage at low input
    voltage=")
20
21 // Result
22 // Output voltage is 20 Volts when input voltage is
    low
23 // Output voltage is 100 mVolts when input voltage
    is high

```

Scilab code Exa 14.7 example7

```

1 // calculate output voltage
2 // Electronic Principles
3 // By Albert Malvino , David Bates
4 // Seventh Edition
5 // The McGraw-Hill Companies
6 // Example 14-7, page 496
7
8 clear; clc; close;
9

```

```

10 // Given data
11 Vdd=10;// supply voltage in volts
12 Rd=2*10^3;// resistance in ohms
13 Rdson=500;// static drain-source on-resistance in
    ohms
14
15 // Calculations
16 Voutlow=Vdd; // when input voltage is low, the lower
    MOSFET is open and the output voltage= supply
    voltage
17 Vouthigh=Vdd*(Rdson/(Rdson+Rd)) ;// when input
    voltage is high, the lower MOSFET has a
    resistance of Rd and the output voltage= ground
    voltage
18 disp("Volts ",Vouthigh,"output voltage at high input
    voltage=")
19 disp("Volts ",Voutlow,"output voltage at low input
    voltage=")
20
21 // Result
22 // Output voltage is 10 Volts when input voltage is
    low
23 // Output voltage is 2 Volts when input voltage is
    high

```

Scilab code Exa 14.9 example9

```

1 // calculate current through the motor winding
2 // Electronic Principles
3 // By Albert Malvino , David Bates
4 // Seventh Edition
5 // The McGraw-Hill Companies
6 // Example 14-9, page 502

```



```

7
8 clear; clc; close;
9
10 // Given data
11 // MTP4N80E
12 Vgson=10 ;// gate-source on-voltage in volts
13 Idon=2; // on-state drain current in amperes
14 Rdson=1.95; // static drain-source on resistance in
    ohms
15 Vdd=30; // drain cutoff voltage in volts
16 Rd=30; // drain cutoff voltage in ohms
17
18 // Calculations
19 Idsat=Vdd/Rd; // drain saturation current in amperes
20 // as Idsat<Idon the power FET is equivalent to a
    resistance of Rdson so Rdson will have to be
    included to find the actual current
21 Id=Vdd/(Rd+Rdson) ;// current in amperes
22 disp("Amperes",Id,"Current through the motor
    windings=")
23
24 // Result
25 // Current through the motor windings is 0.939
    Amperes

```

Scilab code Exa 14.12 example12

```

1 // calculate the RC time constant and lamp power at
    full brightness
2 // Electronic Principles
3 // By Albert Malvino , David Bates
4 // Seventh Edition
5 // The McGraw-Hill Companies

```

```

6 // Example 14-12, page 504
7
8 clear; clc; close;
9
10 // Given data
11 R1=2*10^6; // resistance in ohms
12 R2=1*10^6; // resistance in ohms
13 R=10; // resistance of the lamp in ohms
14 Rdson=1.07; // static drain-source on-resistance in
    ohms
15 Vdd=30; // drain cutoff voltage in volts
16 C=10*10^-6; // capacitance in faraday
17
18 // Calculations
19 Rth=R1*R2/(R1+R2); // thevenin resistance in ohms
20 RC=Rth*C; // time constant in seconds
21 Id=Vdd/(R+Rdson) ; // lamp current in amperes
22 P=Id*Id*R; // lamp power in watts at full brightness
23 disp("seconds",RC,"time constant=")
24 disp("watts",P,"lamp power =")
25
26 // Result
27 // RC time constant is 6.67 seconds
28 // Lamp power is 73.4 Watts

```

Scilab code Exa 14.13 example13

```

1 // find the constant k value and drain current of E-
    MOSFET
2 // Electronic Principles
3 // By Albert Malvino , David Bates
4 // Seventh Edition
5 // The McGraw-Hill Companies

```

```

6 // Example 14-13, page 506
7
8 clear; clc; close;
9
10 // Given data
11 // 2N7000
12 Idon=600*10^-3 ;// in amperes
13 Vgson=4.5;// from data sheet in volts
14 Vgsth=2.1;// from data sheet in volts
15 Vgs1=3 ;// gate source voltage in volts
16 Vgs2=4.5 ;// gate source voltage in volts
17
18 // Calculations
19 k=Idon/([Vgson-Vgsth]^2)
20 Id1=k*([Vgs1-Vgsth]^2)
21 Id2=k*([Vgs2-Vgsth]^2)
22 disp(k," constant=")
23 disp(" amperes",Id1," drain current 1=")
24 disp(" amperes",Id2," drain current 2=")
25
26 // Result
27 // Constant k is 104 mAmperes/Volts^2
28 // Drain current when Vgs is 3 Volts is 84.4
   mAmperes
29 // Drain current when Vgs is 4.5 Volts is 600
   mAmperes

```

Scilab code Exa 14.14 example14

```

1 // find value of Rd for the MOSFET
2 // Electronic Principles
3 // By Albert Malvino , David Bates
4 // Seventh Edition

```

```

5 // The McGraw-Hill Companies
6 // Example 14-14, page 507
7
8 clear; clc; close;
9
10 // Given data
11 Idon=3*10^-3; // from the data sheet of the E-MOSFET
    in amperes
12 Vdson=10; // from data sheet of the E-MOSFET in volts
13 Vdd=25 ; // drain cutoff voltage in volts
14
15 // Calculations
16 Rd=(Vdd-Vdson)/Idon ; // Rd in ohms
17 disp(" ohms",Rd," resistance=")
18
19 // Result
20 // A resistance of 5kohms will allow the MOSFET to
    operate at a specified Q point.

```

Scilab code Exa 14.15 example15

```

1 // find Vgs,Id,gm,Vout
2 // Electronic Principles
3 // By Albert Malvino , David Bates
4 // Seventh Edition
5 // The McGraw-Hill Companies
6 // Example 14-15, page 508
7
8 clear; clc; close;
9
10 // Given data
11 k=104*10^-3 ; // constant k of the E-MOSFET
12 Idon=600*10^-3 ; // in amperes

```

```

13 Vgsth=2.1; // in volts
14 R1=10^6; // in ohms from the given figure
15 R2=350*10^3; // in ohms from the given figure
16 Vin=100*10^-3; // in volts from the given figure
17 Rd=68; // in ohms from the given figure
18 Rl=10^3; // in ohms from the given figure
19 Vdd=12; // drain cutoff voltage in volts from the
    given figure
20
21 // Calculations
22 Vg=(R2/(R1+R2))*Vdd ; // ground voltage in volts
23 Vgs=Vg; // Vgs = ground voltage
24 Id=k*([Vgs-Vgsth]^2)
25 gm=2*k*(Vgs-Vgsth); //transconductance in Seimens
26 rd=Rd*Rl/(Rd+Rl) ; // rd=Rd||Rl in ohms
27 Av=gm*rd; // voltage gain
28 Vout=Av*Vin; // output voltage in volts
29 disp(" Volts",Vgs," gate-source voltage=")
30 disp(" Amperes",Id," drain current=")
31 disp(" Seimen",gm," transconductane=")
32 disp(" Volts",Vout," output voltage=")
33
34 // Result
35 // Vgs is 3.11 Volts
36 // Drain current is 106 mAmperes
37 // Transconductance is 210 mSeimens
38 // Output voltage is 1.34 mVolts

```

Chapter 15

Thyristors

Scilab code Exa 15.1 example1

```
1 // find diode current
2 // Electronic Principles
3 // By Albert Malvino , David Bates
4 // Seventh Edition
5 // The McGraw-Hill Companies
6 // Example 15-1, page 524
7
8 clear; clc; close;
9
10 // Given data
11 Vb=10; // breakover voltage of the diode
12 V=15; // input voltage in volts
13 Ih=4*10^-3; // holding current in amperes
14 Vd=0.7 ; // voltage across diode in volts
15 R=100; // resistance in ohms
16
17 // Calculations
18 // as  $V > V_b$  ,the diode breaks over .Taking into
   // consideration the voltage across the diode
19 I=(V-Vd)/R; // diode current in amperes
20 disp(" Amperes" ,I," diode current=")
```

```
21
22 // Result
23 // Diode current is 143 mAmperes
```

Scilab code Exa 15.4 example4

```
1 // find input and supply voltage for the SCR
2 // Electronic Principles
3 // By Albert Malvino , David Bates
4 // Seventh Edition
5 // The McGraw-Hill Companies
6 // Example 15-4, page 531
7
8 clear; clc; close;
9
10 // Given data
11 Vgt=0.75 ;// gate trigger voltage in volts
12 Igt=7*10^-3;// gate trigger current in amperes
13 Rg=10^3;// in ohms
14 Rl=100;// in ohms
15 Ih=6*10^-3;// holding current in amperes
16
17 // Calculations
18 Vin=Vgt + (Igt*Rg);// input voltage in volts
19 Vcc=0.7 + (Ih*Rl);// supply voltage in volts
20 disp(" Volts",Vin,"Input voltage=")
21 disp(" Volts",Vcc,"Supply voltage=")
22
23 // Result
24 // Minimum input voltage needed to trigger the SCR
   is 7.75 Volts
25 // Supply voltage that turns off the SCR is 1.3
   Volts
```

Scilab code Exa 15.5 example5

```
1 // find peak output voltage and frequency
2 // Electronic Principles
3 // By Albert Malvino , David Bates
4 // Seventh Edition
5 // The McGraw-Hill Companies
6 // Example 15-5, page 532
7
8 clear; clc; close;
9
10 // Given data
11 R1=900; // from the figure in ohms
12 R2=100; // from the figure in ohms
13 Vgt=1 ; // gate trigger voltage in volts
14 Igt=200*10^-6; // gate trigger current in amperes
15 C=0.2*10^-6; // capacitance in faraday
16 R=50; // thevenin resistance facing the capacitance
    when the SCR is off
17
18 // Calculations
19 Rth=R1*R2/(R1+R2); // thevenin resistance
20 Rg=Rth; // in ohms
21 Vin=Vgt + (Igt*Rg); // input voltage in volts
22 Vpeak=10*Vin; // because of 10:1 voltage divider , the
    output voltage is 10(Vin)
23 T=0.2*R*C ; // period of sawtooth is 20% of time
    constant in seconds
24 f=1/T; // frequency in Hertz
25 disp(" Volts",Vpeak,"Peak output voltage=")
26 disp(" hertz",f,"frequency=")
27
```



```
28 // Results
29 // Peak output voltage is 10.1 Volts
30 // Frequency is 50 KHertz
```

Scilab code Exa 15.6 example6

```
1 // find supply voltage
2 // Electronic Principles
3 // By Albert Malvino , David Bates
4 // Seventh Edition
5 // The McGraw-Hill Companies
6 // Example 15-6, page 536
7
8 clear; clc; close;
9
10 // Given data Vz=5.6; // breakdown voltage in volts
11 Vgt=0.75; // gate trigger voltage in volts
12 Vz=5.6; // breakdown voltage in volts
13
14 // Calculations
15 Vcc=Vz+Vgt; // overvoltage firing the SCR in volts
16 disp("Volts",Vcc,"Supply voltage=")
17
18 // Results
19 // Supply voltage that turns the crowbar is 6.35
    volts
```

Scilab code Exa 15.8 example8

```
1 // find current through the resistor
2 // Electronic Principles
3 // By Albert Malvino , David Bates
4 // Seventh Edition
5 // The McGraw-Hill Companies
6 // Example 15-8, page 546
7
8 clear; clc; close;
9
10 // Given data
11 R1=82; // given in ohms
12 R2=22; // given in ohms
13 Vgt=75; // in volts
14
15 // Calculations
16 // Ideally the triac has 0 volts across it when
   conducting
17 I=Vgt/R2; // current through 22 ohm resistor in
   amperes
18 disp("Amperes",I,"current through 22 ohm resistor=")
19
20 // Results
21 // Current through the 22 ohm resistor is 3.41
   Amperes
```

Chapter 16

Frequency Effects

Scilab code Exa 16.1 example1

```
1 // calculate voltage gain of ac amplifier
2 // Electronic Principles
3 // By Albert Malvino , David Bates
4 // Seventh Edition
5 // The McGraw-Hill Companies
6 // Example 16-1, page 567
7
8 clear; clc; close;
9
10 // Given data
11 f1=20;// cutoff frequency in hertz
12 f2=20*10^3;// cutoff frequency in hertz
13 fin1=5;// input frequency in hertz
14 fin2=200*10^3;// input frequency in hertz
15 Avmid=200;// midband voltage gain
16
17 // Calculations
18 Av1=Avmid/((1+((f1/fin1)^2))^0.5) // Voltage gain for
    input frequency below midband
19 Av2=Avmid*1/((1+((fin2/f2)^2))^0.5); // Voltage gain
    for input frequency above midband
```

```

20 disp(Av1,"Voltage gain for input frequency below
    midband")
21 disp(Av2,"Voltage gain or input frequency above
    midband")
22
23 // Result
24 // Voltage gain for an input frequency of 5 Hertz is
    48.5
25 // Voltage gain for an input frequency of 20 KHertz
    is 19.9

```

Scilab code Exa 16.3 example3

```

1 // calculate voltage gain
2 // Electronic Principles
3 // By Albert Malvino , David Bates
4 // Seventh Edition
5 // The McGraw-Hill Companies
6 // Example 16-3, page 569
7
8 clear; clc; close;
9
10 // Given data
11 f=10;// cutoff frequency in hertz
12 Avmid=100000;// midband voltage gain
13 f1=100;// input frequency in hertz
14 f2=10^3;// input frequency in hertz
15 f3=10^4;// input frequency in hertz
16 f4=10^5;// input frequency in hertz
17 f5=10^6;// input frequency in hertz
18
19 // Calculations
20 Av1=Avmid/((1+(f1/f)^2)^0.5) // Voltage gain for

```

```

    input frequency below midband
21 Av2=Avmid/((1+(f2/f)^2)^0.5) // Voltage gain for
    input frequency below midband
22 Av3=Avmid/((1+(f3/f)^2)^0.5) // Voltage gain for
    input frequency below midband
23 Av4=Avmid/((1+(f4/f)^2)^0.5) // Voltage gain for
    input frequency below midband
24 Av5=Avmid/((1+(f5/f)^2)^0.5) // Voltage gain for
    input frequency below midband
25 disp(Av1," Voltage gain 1=")
26 disp(Av2," Voltage gain 2=")
27 disp(Av3," Voltage gain 3=")
28 disp(Av4," Voltage gain 4=")
29 disp(Av5," Voltage gain 5=")
30
31 // Result
32 // Voltage gain for an input frequency of 100 Hertz
    is approximately 10000
33 // Voltage gain for an input frequency of 1000 Hertz
    is approximately 1000
34 // Voltage gain for an input frequency of 1000 Hertz
    is approximately 100
35 // Voltage gain for an input frequency of 10000 Hertz
    is approximately 10
36 // Voltage gain for an input frequency of 100000
    Hertz is approximately 1

```

Scilab code Exa 16.4 example4

```

1 // calculate decibel power gain
2 // Electronic Principles
3 // By Albert Malvino , David Bates
4 // Seventh Edition

```

```

5 // The McGraw–Hill Companies
6 // Example 16–4, page 571
7
8 clear; clc; close;
9
10 // Given data
11 Ap1=1; // power gain
12 Ap2=2; // power gain
13 Ap3=4; // power gain
14 Ap4=8; // power gain
15
16 // Calculations
17 Apdb1=10*log10(Ap1) // decibel power gain
18 Apdb2=10*log10(Ap2) // decibel power gain
19 Apdb3=10*log10(Ap3) // decibel power gain
20 Apdb4=10*log10(Ap4) // decibel power gain
21 disp("dB",Apdb1,"decibel power gain 1=")
22 disp("dB",Apdb2,"decibel power gain 2=")
23 disp("dB",Apdb3,"decibel power gain 3=")
24 disp("dB",Apdb4,"decibel power gain 4=")
25
26 // Result
27 // decibal power gain for a voltage gain of 1 is 0
    dB
28 // decibal power gain for a voltage gain of 2 is 3
    dB
29 // decibal power gain for a voltage gain of 4 is 6
    dB
30 // decibal power gain for a voltage gain of 8 is 9
    dB

```

Scilab code Exa 16.5 example5

```

1 // calculate decibel power gain
2 // Electronic Principles
3 // By Albert Malvino , David Bates
4 // Seventh Edition
5 // The McGraw-Hill Companies
6 // Example 16-5, page 571
7
8 clear; clc; close;
9
10 // Given data
11 Ap1=1; // power gain
12 Ap2=0.5; // power gain
13 Ap3=0.25; // power gain
14 Ap4=0.125; // power gain
15
16 // Calculations
17 Apdb1=10*log10(Ap1) // decibel power gain
18 Apdb2=10*log10(Ap2) // decibel power gain
19 Apdb3=10*log10(Ap3) // decibel power gain
20 Apdb4=10*log10(Ap4) // decibel power gain
21 disp("dB", Apdb1, "decibel power gain 1=")
22 disp("dB", Apdb2, "decibel power gain 2=")
23 disp("dB", Apdb3, "decibel power gain 3=")
24 disp("dB", Apdb4, "decibel power gain 4=")
25
26
27 // Result
28 // decibal power gain for a voltage gain of 1 is 0
    dB
29 // decibal power gain for a voltage gain of 0.5 is
    -3 dB
30 // decibal power gain for a voltage gain of 0.25 is
    -6 dB
31 // decibal power gain for a voltage gain of 0.125 is
    -9 dB

```

Scilab code Exa 16.6 example6

```
1 // calculate decibel power gain
2 // Electronic Principles
3 // By Albert Malvino , David Bates
4 // Seventh Edition
5 // The McGraw-Hill Companies
6 // Example 16-6, page 572
7
8 clear; clc; close;
9
10 // Given data
11 Ap1=1; // power gain
12 Ap2=10; // power gain
13 Ap3=100; // power gain
14 Ap4=1000; // power gain
15
16 // Calculations
17 Apdb1=10*log10(Ap1) // decibel power gain
18 Apdb2=10*log10(Ap2) // decibel power gain
19 Apdb3=10*log10(Ap3) // decibel power gain
20 Apdb4=10*log10(Ap4) // decibel power gain
21 disp("dB",Apdb1,"decibel power gain 1=")
22 disp("dB",Apdb2,"decibel power gain 2=")
23 disp("dB",Apdb3,"decibel power gain 3=")
24 disp("dB",Apdb4,"decibel power gain 4=")
25
26
27 // Result
28 // decibal power gain for a voltage gain of 1 is 0
    dB
29 // decibal power gain for a voltage gain of 10 is 10
```



```
    dB
30 // decibal power gain for a voltage gain of 100 is
    20 dB
31 // decibal power gain for a voltage gain of 1000 is
    30 dB
```

Scilab code Exa 16.7 example7

```
1 // calculate decibel power gain
2 // Electronic Principles
3 // By Albert Malvino , David Bates
4 // Seventh Edition
5 // The McGraw-Hill Companies
6 // Example 16-7, page 572
7
8 clear; clc; close;
9
10 // Given data
11 Ap1=1; // power gain
12 Ap2=0.1; // power gain
13 Ap3=0.01; // power gain
14 Ap4=0.001; // power gain
15
16 // Calculations
17 Apdb1=10*log10(Ap1) // decibel power gain
18 Apdb2=10*log10(Ap2) // decibel power gain
19 Apdb3=10*log10(Ap3) // decibel power gain
20 Apdb4=10*log10(Ap4) // decibel power gain
21 disp("dB", Apdb1, " decibal power gain 1=")
22 disp("dB", Apdb2, " decibal power gain 2=")
23 disp("dB", Apdb3, " decibal power gain 3=")
24 disp("dB", Apdb4, " decibal power gain 4=")
25
```

```
26 // Result
27 // decibal power gain for a voltage gain of 1 is 0
    dB
28 // decibal power gain for a voltage gain of 0.1 is
    -10 dB
29 // decibal power gain for a voltage gain of 0.01 is
    -20 dB
30 // decibal power gain for a voltage gain of 0.001 is
    -30 dB
```

Chapter 17

Differential Amplifiers

Scilab code Exa 17.1 example1

```
1 // find ideal currents and voltages
2 // Electronic Principles
3 // By Albert Malvino , David Bates
4 // Seventh Edition
5 // The McGraw-Hill Companies
6 // Example 17-1, page 625
7
8 clear; clc; close;
9
10 // Given data
11 Vee=15; // in volts from the figure
12 Vcc=15; // in volts from the figure
13 Re=7.5*10^3; // emitter resistance in ohms
14 Rc=5*10^3; // collector resistance in ohms
15
16 // Calculations
17 It=Vee/Re; // tail current in amperes
18 Ie=It/2; // emitter current in amperes
19 Ic=Ie; // collector current is equal to emitter
    current
20 Vc=Vcc-(Ic*Rc); // quiescent voltage in volts
```

```

21 disp(" Amperes",It," tail current=")
22 disp(" Amperes",Ie," emitter current=")
23 disp(" Volts",Vc," quiescent collector voltage=")
24
25 // Result
26 // Tail current is 2 mAmperes
27 // Emitter current is 1 mAmperes
28 // Collector has a quiescent voltage of 10 Volts

```

Scilab code Exa 17.2 example2

```

1 // calculate currents and voltages using second
  approximation
2 // Electronic Principles
3 // By Albert Malvino , David Bates
4 // Seventh Edition
5 // The McGraw-Hill Companies
6 // Example 17-2, page 626
7
8 clear; clc; close;
9
10 // Given data
11 Vee=15;// in volts from the figure
12 Vcc=15;// in volts from the figure
13 Re=7.5*10^3;// emitter resistance in ohms
14 Rc=5*10^3;// collector resistance in ohms
15 Vin=10^-3;// in volts
16 B=300;// given
17
18 // Calculations
19 It=(Vee-0.7)/Re;// tail current in amperes using
  second approximation
20 Ie=It/2;// emitter current in amperes

```

```

21 Ic=Ie;// collector current is equal to emitter
    current
22 Vc=Vcc-(Ic*Rc);// quiescent voltage in volts
23 disp("Amperes",It,"tail current=")
24 disp("Amperes",Ie,"emitter current=")
25 disp("Volts",Vc,"quiescent collector voltage=")
26
27 // Result
28 // Tail current is 1.91 mAmperes
29 // Emitter current is 0.955 mAmperes
30 // Collector has a quiescent voltage of 10.2 Volts

```

Scilab code Exa 17.3 example3

```

1 // find currents and voltages
2 // Electronic Principles
3 // By Albert Malvino , David Bates
4 // Seventh Edition
5 // The McGraw-Hill Companies
6 // Example 17-3, page 626
7
8 clear; clc; close;
9
10 // Given data
11 Vee=12;// in volts from the figure
12 Vcc=12;// in volts from the figure
13 Re=5*10^3;// emitter resistance in ohms
14 Rcrigh=3*10^3;// collector resistance in ohms
15 Rcleft=0;// collector resistance in ohms
16
17 // Calculations
18 It=Vee/Re;// tail current in amperes
19 Ie=It/2;// emitter current in amperes

```

```

20 Ic=Ie;// collector current is equal to emitter
    current
21 Vcright=Vcc-(Ic*Rcright);// quiescent voltage of
    right collector in volts
22 Vcleft=Vcc-(Ic*Rcleft);// quiescent voltage of left
    collector in volts
23 disp("Amperes",It,"tail current=")
24 disp("Amperes",Ie,"emitter current=")
25 disp("Volts",Vcright,"right quiescent collector
    voltage=")
26 disp("Volts",Vcleft,"left quiescent collector
    voltage=")
27
28 // Result
29 // Tail current is 2.4 mAmperes
30 // Emitter current is 1.2 mAmperes
31 // Right hand side collector has a quiescent voltage
    of 8.4 Volts
32 // Left hand side collector has a quiescent voltage
    of 12 Volts

```

Scilab code Exa 17.4 example4

```

1 // calculate ac output voltage and input impedance
    of the diff amp
2 // Electronic Principles
3 // By Albert Malvino , David Bates
4 // Seventh Edition
5 // The McGraw-Hill Companies
6 // Example 17-4, page 631
7
8 clear; clc; close;
9

```

```

10 // Given data
11 Vee=15; // in volts from the figure
12 Vcc=15; // in volts from the figure
13 Re=7.5*10^3; // emitter resistance in ohms
14 Rc=5*10^3; // collector resistance in ohms
15 Vin=10^-3; // in volts
16 B=300; // given
17
18 // Calculations
19 It=Vee/Re; // tail current in amperes
20 Ie=It/2; // emitter current in amperes
21 re=25*10^-3/Ie; // ac emitter resistance in ohms
22 Av=Rc/re; // voltage gain
23 Vout=Av*Vin; // ac output voltage in volts
24 zin=2*B*re; // input impedance of either base in ohms
25 disp("Volts",Vout,"output voltage=")
26 disp("ohms",zin,"input impedance=")
27
28 // Result
29 // ac output voltage is 200 mVolts
30 // Input impedance of the differential amplifier is
    15 Kohms

```

Scilab code Exa 17.5 example5

```

1 // calculate ac output voltage and input impedance
  of the diff amp using second approximation
2 // Electronic Principles
3 // By Albert Malvino , David Bates
4 // Seventh Edition
5 // The McGraw-Hill Companies
6 // Example 17-5, page 632
7

```

```

8 clear; clc; close;
9
10 // Given data
11 Vee=15; // in volts from the figure
12 Vcc=15; // in volts from the figure
13 Re=7.5*10^3; // emitter resistance in ohms
14 Rc=5*10^3; // collector resistance in ohms
15 Vin=10^-3; // in volts
16 B=300; // given
17
18 // Calculations
19 It=(Vee-0.7)/Re; // tail current in amperes using
    second approximation
20 Ie=It/2; // emitter current in amperes
21 re=25*10^-3/Ie; // ac emitter resistance in ohms
22 Av=Rc/re; // voltage gain
23 Vout=Av*Vin; // ac output voltage in volts
24 zin=2*B*re; // input impedance of either base in ohms
25 disp("Volts",Vout,"output voltage=")
26 disp("ohms",zin,"input impedance=")
27
28 // Result
29 // ac output voltage is 191 mVolts
30 // Input impedance of the differential amplifier is
    15.7 Kohms

```

Scilab code Exa 17.8 example8

```

1 // calculate error output voltage
2 // Electronic Principles
3 // By Albert Malvino , David Bates
4 // Seventh Edition
5 // The McGraw-Hill Companies

```



```

6 // Example 17-8, page 639
7
8 clear; clc; close;
9
10 // Given data
11 Av=200;// voltage gain
12 Inbias=3*10^-6;// input bias current in amperes
13 Inoff=0.5*10^-6;// input offset current in amperes
14 Vinoff=10^-3;// input offset voltage in volts
15 Rb1=10^3;// in ohms
16 Rb2=0;// in ohms
17
18 // Calculations
19 V1err=(Rb1-Rb2)*Inbias;// unwanted dc error input in
    volts
20 V2err=(Rb1+Rb2)*Inoff/2;// unwanted dc error input
    in volts
21 V3err=Vinoff;// unwanted dc error input in volts
22 Verror=Av*(V1err+V2err+V3err);// output error
    voltage in volts
23 disp("Volts",Verror,"output error voltage=")
24
25 // Result
26 // Output error voltage is 850 mVolts

```

Scilab code Exa 17.9 example9

```

1 // calculate error output voltage
2 // Electronic Principles
3 // By Albert Malvino , David Bates
4 // Seventh Edition
5 // The McGraw-Hill Companies
6 // Example 17-9, page 640

```

```

7
8 clear; clc; close;
9
10 // Given data
11 Av=300; // voltage gain
12 Inbias=80*10^-9; // input bias current in amperes
13 Inoff=20*10^-9; // input offset current in amperes
14 Vinoff=5*10^-3; // input offset voltage in volts
15 Rb1=10^4; // in ohms
16 Rb2=10^4; // in ohms
17
18 // Calculations
19 V1err=(Rb1-Rb2)*Inbias; // unwanted dc error input in
    volts
20 V2err=(Rb1+Rb2)*Inoff/2; // unwanted dc error input
    in volts
21 V3err=Vinoff; // unwanted dc error input in volts
22 Verror=Av*(V1err+V2err+V3err); // output error
    voltage in volts
23 disp("Volts",Verror,"output error voltage=")
24
25 // Result
26 // Output error voltage is 1.56 Volts

```

Scilab code Exa 17.10 example10

```

1 // calculate common mode voltage gain and output
    voltage
2 // Electronic Principles
3 // By Albert Malvino , David Bates
4 // Seventh Edition
5 // The McGraw-Hill Companies
6 // Example 17-10, page 642

```

```

7
8 clear; clc; close;
9
10 // Given data
11 Rc=10^6; // collector resistance in ohms
12 Re=10^6; // emitter resistance in ohms
13 Vin=10^-3; // input voltage in volts
14
15 // Calculations
16 Avcm=Rc/(2*Re); // swamped voltage gain
17 Vout=Vin*Avcm; // output voltage in volts
18 disp("Volts",Vout,"output voltage=")
19
20 // Result
21 // Output voltage is 0.5 mVolts

```

Scilab code Exa 17.12 example12

```

1 // calculate output voltage
2 // Electronic Principles
3 // By Albert Malvino , David Bates
4 // Seventh Edition
5 // The McGraw-Hill Companies
6 // Example 17-12, page 644
7
8 clear; clc; close;
9
10 // Given data
11 Av=200000; // voltage gain
12 CMRRdb=90; // common mode rejection ratio in decibals
13 Vin=10^-6; // input voltage in volts

```

```

14
15 // Calculations
16 CMRR=10^(CMRRdb/20); // common mode rejection ratio
17 Avcm=Av/CMRR; // swamped voltage gain
18 Vout1=Vin*Av; // desired output voltage in volts
19 Vout2=Vin*Avcm; // common mode output voltage in
    volts
20 Vout=Vout1+Vout2; // total output voltage in volts
21 disp(" Volts",Vout," output voltage=")
22
23 // Result
24 // Output voltage is 6.32 microVolts

```

Scilab code Exa 17.13 example13

```

1 // calculate load voltage
2 // Electronic Principles
3 // By Albert Malvino , David Bates
4 // Seventh Edition
5 // The McGraw-Hill Companies
6 // Example 17-13, page 651
7
8 clear; clc; close;
9
10 // Given data
11 Vee=15; // in volts from the figure
12 Vcc=15; // in volts from the figure
13 Re=7.5*10^3; // emitter resistance in ohms
14 Rc=7.5*10^3; // collector resistance in ohms
15 Rl=15*10^3; // load resistance in ohms
16 Vin=10*10^-3; // input voltage in volts
17
18 // Calculations

```

```
19 It=Vee/Re;// tail current in amperes
20 Ie=It/2;// emitter current in amperes
21 re=(25*10^-3)/Ie;// ac emitter resistance in ohms
22 Av=Rc/re;// unloaded voltage gain
23 Vout=Av*Vin;// unloaded output voltage in volts
24 Rth=2*Rc;// thevenin resistance in ohms
25 Vl=Vout/2;// load voltage in volts as Rl=Rth
26 disp("Volts",Vl,"load voltage=")
27
28 // Result
29 // Load voltage is 1.5 Volts
```

Chapter 18

Operational Amplifiers

Scilab code Exa 18.4 example4

```
1 // find slew rate of op-amp
2 // Electronic Principles
3 // By Albert Malvino , David Bates
4 // Seventh Edition
5 // The McGraw-Hill Companies
6 // Example 18-4, page 673
7
8 clear; clc; close;
9
10 // Given data
11 dV=0.25; // voltage change in volts
12 dT=0.1*10^-6; // time duration in which the voltage
    change took place in seconds
13
14 // Calculations
15 Sr=dV/dT; // slew rate in volts/second
16 disp(Sr,"Slew rate=")
17
18 // Result
19 // slew rate of the op-amp is 2.5 Megavolts/second
```

Scilab code Exa 18.5 example5

```
1 // find power band width
2 // Electronic Principles
3 // By Albert Malvino , David Bates
4 // Seventh Edition
5 // The McGraw-Hill Companies
6 // Example 18-5, page 673
7
8 clear; clc; close;
9
10 // Given data
11 Sr=15*10^6; // slew rate in volts/second
12 Vp=10; // peak voltage in volts
13
14 // Calculations
15 fmax=Sr/(2*%pi*Vp); // power band width in hertz
16 disp("Hertz ",fmax,"power band width=")
17
18 // Result
19 // Power bandwidth is 239 kHzertz
```

Scilab code Exa 18.6 example6

```
1 // find power band width
2 // Electronic Principles
3 // By Albert Malvino , David Bates
4 // Seventh Edition
```

```

5 // The McGraw–Hill Companies
6 // Example 18–6, page 673
7
8 clear; clc; close;
9
10 // Given data
11 Vp=8; // peak voltage in volts
12 Sr1=0.5*10^6; // slew rate in volts/second
13 Sr2=5*10^6; // slew rate in volts/second
14 Sr3=50*10^6; // slew rate in volts/second
15
16 // Calculations
17 fmax1=Sr1/(2*%pi*Vp); // power band width in hertz
18 fmax2=Sr2/(2*%pi*Vp); // power band width in hertz
19 fmax3=Sr3/(2*%pi*Vp); // power band width in hertz
20 disp("Hertz ",fmax1,"power band width 1=")
21 disp("Hertz ",fmax2,"power band width 2=")
22 disp("Hertz ",fmax3,"power band width 3=")
23
24 // Result
25 // Power bandwidth when slew rate is 0.5 Volts/micro
    seconds is 10 kHzertz
26 // Power bandwidth when slew rate is 5 Volts/micro
    seconds is 100 kHzertz
27 // Power bandwidth when slew rate is 50 Volts/micro
    seconds is 1 MHertz

```

Scilab code Exa 18.7 example7

```

1 // find closed–loop voltage gain , bandwidth and
    output voltage
2 // Electronic Principles
3 // By Albert Malvino , David Bates

```



```

4 // Seventh Edition
5 // The McGraw-Hill Companies
6 // Example 18-7, page 678
7
8 clear; clc; close;
9
10 // Given data
11 R1=1.5*10^3; // in ohms from the given figure
12 Rf=75*10^3; // in ohms from the given figure
13 Vin=10^-2; // input voltage in mVpp
14 f1=10^3; // frequency in hertz
15 f2=10^6; // frequency in hertz
16 funity=10^6; // unity gain frequency in hertz
17
18 // Calculations
19 Avcl=-Rf/R1; // closed loop voltage gain
20 f2cl=funity/Avcl; // closed-loop bandwidth
21 Vout1=Avcl*Vin; // output voltage at 10^3 Hertz
22 Vout2=-Vin; // output voltage at 10^6 Hertz as it is
    unity gain frequency in hertz
23 disp(Avcl,"closed loop voltage gain=")
24 disp("Hertz",f2cl,"closed loop bandwidth=")
25 disp("Volts",Vout1,"output voltage 1=")
26 disp("Volts",Vout2,"output voltage 2=")
27
28 // Result
29 // Closed loop voltage gain is -50
30 // Closed loop bandwidth is 20 Khertz
31 // Output voltage is -500 mVpp at 1 KHertz
32 // Output voltage is -10 mVpp at 1000 KHertz

```

Scilab code Exa 18.8 example8

```

1 // find output voltage
2 // Electronic Principles
3 // By Albert Malvino , David Bates
4 // Seventh Edition
5 // The McGraw-Hill Companies
6 // Example 18-8, page 679
7
8 clear; clc; close;
9
10 // Given data
11 R1=1.5*10^3;// in ohms from the given figure
12 Rf=75*10^3;// in ohms from the given figure
13 Vin=0;// input voltage in mVpp
14 Inbias=80*10^-9;// input bias current in amperes
15 Inoff=20*10^-9;// input offset current in amperes
16 Vinoff=2*10^-3;// input offset voltage in volts
17 Rb1=0;// in ohms
18
19 // Calculations
20 Rb2=R1*Rf/(R1+Rf);// in ohms
21 V1err=(Rb1-Rb2)*Inbias;// unwanted dc error input in
   volts
22 V2err=(Rb1+Rb2)*Inoff/2;// unwanted dc error input
   in volts
23 V3err=Vinoff;// unwanted dc error input in volts
24 Avcl=-Rf/R1;// closed loop voltage gain
25 Verror=Avcl*(V1err+V2err+V3err);// output error
   voltage in volts;
26 Vout=Verror;// output voltage in volts
27 disp("Volts",Verror,"output error voltage=")
28
29 // Result
30 // Output voltage will be (+ or -) 94.9 mVolts

```

Scilab code Exa 18.9 example9

```
1 // find output voltage
2 // Electronic Principles
3 // By Albert Malvino , David Bates
4 // Seventh Edition
5 // The McGraw-Hill Companies
6 // Example 18-9, page 679
7
8 clear; clc; close;
9
10 // Given data
11 R1=1.5*10^3;// in ohms from the given figure
12 Rf=75*10^3;// in ohms from the given figure
13 Vin=0;// input voltage in mVpp
14 Inbias=500*10^-9;// input bias current in amperes
15 Inoff=200*10^-9;// input offset current in amperes
16 Vinoff=6*10^-3;// input offset voltage in volts
17 Rb1=0;// in ohms
18
19 // Calculations
20 Rb2=R1*Rf/(R1+Rf);// in ohms
21 V1err=(Rb1-Rb2)*Inbias;// unwanted dc error input in
    volts
22 V2err=(Rb1+Rb2)*Inoff/2;// unwanted dc error input
    in volts
23 V3err=Vinoff;// unwanted dc error input in volts
24 Avcl=-Rf/R1;// closed loop voltage gain
25 Verror=Avcl*(V1err+V2err+V3err);// output error
    voltage in volts;
26 Vout=Verror;// output voltage in volts
27 disp("Volts",Verror,"output error voltage=")
28
29 // Result
30 // Output voltage will be (+ or -) 270.5 mVolts
```

Scilab code Exa 18.10 example10

```
1 // find closed-loop voltage gain , bandwidth and
  output voltage
2 // Electronic Principles
3 // By Albert Malvino , David Bates
4 // Seventh Edition
5 // The McGraw-Hill Companies
6 // Example 18-10, page 683
7
8 clear; clc; close;
9
10 // Given data
11 R1=10^2;// in ohms from the given figure
12 Rf=3.9*10^3;// in ohms from the given figure
13 Vin=50*10^-3;// input voltage in mVpp
14 f=250*10^3;// frequency in hertz
15 funity=10^6;// unity gain frequency in hertz
16
17 // Calculations
18 Avcl=(Rf/R1)+1;// closed loop voltage gain
19 f2cl=funity/Avcl;// closed-loop bandwidth
20 // Avcl at 250 Khertz is equilaent to a voltage gain
  of 4
21 Vout=4*Vin;// output voltage at 250*10^3 Hertz
22 disp(Avcl,"closed loop voltage gain=")
23 disp(" Hertz",f2cl,"closed loop bandwidth=")
24 disp(" Volts",Vout,"output voltage=")
25
26 // Result
27 // Closed loop voltage gain is 40
28 // Closed loop bandwidth is 25 Khertz
```

29 // Output voltage is 200 mVpp at 250 KHertz

Scilab code Exa 18.11 example11

```
1 // find output error voltage
2 // Electronic Principles
3 // By Albert Malvino , David Bates
4 // Seventh Edition
5 // The McGraw-Hill Companies
6 // Example 18-11, page 684
7
8 clear; clc; close;
9
10 // Given data
11 R1=10^2;// in ohms from the given figure
12 Rf=3.9*10^3;// in ohms from the given figure
13 Inbias=500*10^-9;// input bias current in amperes
14 Inoff=200*10^-9;// input offset current in amperes
15 Vinoff=6*10^-3;// input offset voltage in volts
16 Rb1=0;// in ohms
17
18 // Calculations
19 Avcl=(Rf/R1)+1;// closed loop voltage gain
20 Rb2=R1*Rf/(R1+Rf);// in ohms
21 V1err=(Rb1-Rb2)*Inbias;// unwanted dc error input in
    volts
22 V2err=(Rb1+Rb2)*Inoff/2;// unwanted dc error input
    in volts
23 V3err=Vinoff;// unwanted dc error input in volts
24 Verror=Avcl*(V1err+V2err+V3err);// output error
    voltage in volts;
25 disp(" Volts",Verror,"output error voltage=")
26
```

```
27 // Result
28 // Output error voltage is 238 mVolts
```

Scilab code Exa 18.12 example12

```
1 // find ac output voltage
2 // Electronic Principles
3 // By Albert Malvino , David Bates
4 // Seventh Edition
5 // The McGraw-Hill Companies
6 // Example 18-12, page 687
7
8 clear; clc; close;
9
10 // Given data
11 Rf=100*10^3; // in ohms from the given figure
12 R1=20*10^3; // in ohms from the given figure
13 R2=10*10^3; // in ohms from the given figure
14 R3=50*10^3; // in ohms from the given figure
15 V1=100*10^-3; // voltage in Vpp from the given figure
16 V2=200*10^-3; // voltage in Vpp from the given figure
17 V3=300*10^-3; // voltage in Vpp from the given figure
18
19 // Calculations
20 Av1cl=-Rf/R1; // closed loop voltage gain
21 Av2cl=-Rf/R2; // closed loop voltage gain
22 Av3cl=-Rf/R3; // closed loop voltage gain
23 Vout=(Av1cl*V1)+(Av2cl*V2)+(Av3cl*V3); // output
    voltage in Vpp
24 disp("Vpp",Vout,"output voltage=")
25
26 // Result
27 // Output voltage is -3.1 Vpp
```

Scilab code Exa 18.13 example13

```
1 // find output voltage and bandwidth
2 // Electronic Principles
3 // By Albert Malvino , David Bates
4 // Seventh Edition
5 // The McGraw-Hill Companies
6 // Example 18-13, page 688
7
8 clear; clc; close;
9
10 // Given data
11 Vin=10*10^-3;// ac input source in Vpp
12 R=100*10^3;// internal resistance in ohms
13 Rl=1;// load resistance in ohms
14 funity=10^6;// unity gain frequency in hertz
15
16 // Calculations
17 Avcl=1;// closed loop voltage gain of a voltage
    follower
18 Vout=Avcl*Vin;// output voltage in volts
19 f2cl=funity/Avcl;// closed-loop bandwidth
20 disp("Hertz",f2cl,"closed loop bandwidth=")
21 disp(Vout,"output voltage=")
22
23 // Result
24 // Output voltage is 10 mVpp
25 // bandwidth is 1 MHertz
```

Chapter 19

Negative Feedback

Scilab code Exa 19.1 example1

```
1 // find feedback fraction ,ideal and exact closed-  
  loop voltage gain ,percent error  
2 // Electronic Principles  
3 // By Albert Malvino , David Bates  
4 // Seventh Edition  
5 // The McGraw-Hill Companies  
6 // Example 19-1, page 709  
7  
8 clear; clc; close;  
9  
10 // Given data  
11 R1=10^2; // in ohms from the given figure  
12 Rf=3.9*10^3; // in ohms from the given figure  
13 Avol=10^5; // Avol of 741C  
14  
15 // Calculations  
16 B=R1/(R1+Rf); // feedback fraction  
17 Aideal=1/B; // ideal closed loop voltage gain  
18 %error=100/(1+(Avol*B)); // percentage % in closed-  
  loop voltage gain  
19 Avexact=Avol/(1+(Avol*B)); // exact closed loop
```



```

    voltage gain
20 disp(" hertz",B," bandwidth=")
21 disp(Aideal," Ideal closed-loop voltage gain=")
22 disp(Avexact," exact closed-loop voltage gain=")
23 disp("%",%error," percentage error=")
24
25 // Result
26 // Bandwidth is 0.025
27 // Ideal closed-loop voltage gain is 40
28 // Exact closed-loop voltage gain is 39.984
29 // Percentage error is 0.04%

```

Scilab code Exa 19.2 example2

```

1 // find closed-loop input impedance
2 // Electronic Principles
3 // By Albert Malvino , David Bates
4 // Seventh Edition
5 // The McGraw-Hill Companies
6 // Example 19-2, page 713
7
8 clear; clc; close;
9
10 // Given data
11 R1=10^2;// in ohms from the given figure
12 Rf=3.9*10^3;// in ohms from the given figure
13 Avol=10^5;// Avol of 741C
14 Rin=2*10^6;// in ohms
15 Rcm=200*10^6;// in ohms
16
17 // Calculations
18 B=R1/(R1+Rf);// feedback fraction
19 zincl=(1+(Avol*B))*Rin;// closed-loop input

```

```

    impedance in ohms
20 // as zincl>100 Mega ohms
21 zincl=Rcm*zincl/(zincl+Rcm)
22 disp("ohms",zincl,"closed-loop input impedance=")
23
24 // Result
25 // closed-loop input impedance is 192 Mohms

```

Scilab code Exa 19.3 example3

```

1 // find closed-loop output impedance
2 // Electronic Principles
3 // By Albert Malvino , David Bates
4 // Seventh Edition
5 // The McGraw-Hill Companies
6 // Example 19-3, page 714
7
8 clear; clc; close;
9
10 // Given data
11 R1=10^2; // in ohms from the given figure
12 Rf=3.9*10^3; // in ohms from the given figure
13 Avol=10^5; // Avol of 741C
14 Rout=75; // in ohms
15 Rcm=200*10^6; // in ohms
16
17 // Calculations
18 B=R1/(R1+Rf); // feedback fraction
19 zoutcl=Rout/(1+(Avol*B)); // closed-loop output
    impedance in ohms
20 disp("ohms",zoutcl,"closed-loop output impedance=")
21
22 // Result

```

23 // closed-loop output impedance is 0.03 ohms

Scilab code Exa 19.4 example4

```
1 // find closed-loop total harmonic distortion
2 // Electronic Principles
3 // By Albert Malvino , David Bates
4 // Seventh Edition
5 // The McGraw-Hill Companies
6 // Example 19-4, page 714
7
8 clear; clc; close;
9
10 // Given data
11 R1=10^2; // in ohms from the given figure
12 Rf=3.9*10^3; // in ohms from the given figure
13 Avol=10^5; // Avol of 741C
14 THDo1=7.5; // open loop total harmonic distortion in
    %
15
16 // Calculations
17 B=R1/(R1+Rf); // feedback fraction
18 THDc1=THDo1/(1+(Avol*B)); // closed loop total
    harmonic distortion in %
19 disp("%",THDc1," closed-loop total harmonic
    distortion=")
20
21 // Result
22 // closed-loop total harmonic distortion is 0.003%
```

Scilab code Exa 19.6 example6

```
1 // find closed-loop input and output impedance
2 // Electronic Principles
3 // By Albert Malvino , David Bates
4 // Seventh Edition
5 // The McGraw-Hill Companies
6 // Example 19-6, page 717
7
8 clear; clc; close;
9
10 // Given data
11 Rf=5*10^3; // in ohms from the given figure
12 Avol=10^5; // Avol of 741C
13 Rout=75; // in ohms
14
15 // Calculations
16 zincl=Rf/(1+Avol); // closed-loop input impedance in
    ohms
17 zoutcl=Rout/(1+Avol); // closed-loop output impedance
    in ohms
18 disp("ohms",zincl,"closed-loop input impedance=")
19 disp("ohms",zoutcl,"closed-loop output impedance=")
20
21 // Result
22 // closed-loop input impedance is 0.05 ohms
23 // closed-loop output impedance is 0.00075 ohms
```

Scilab code Exa 19.9 example9

```
1 // find closed-loop bandwidth
2 // Electronic Principles
3 // By Albert Malvino , David Bates
4 // Seventh Edition
5 // The McGraw-Hill Companies
6 // Example 19-9, page 723
7
8 clear; clc; close;
9
10 // Given data
11 // LF411A
12 AvolB=1000-1; // given
13 f2ol=160; // open-loop bandwidth in hertz
14
15 // Calculations
16 f2cl=(1+AvolB)*f2ol; // closed-loop bandwidth in
    hertz
17 disp("hertz",f2cl,"closed-loop bandwidth")
18
19 // Result
20 // closed-loop bandwidth is 160 KHertz
```

Scilab code Exa 19.10 example10

```
1 // find closed-loop bandwidth
2 // Electronic Principles
3 // By Albert Malvino , David Bates
4 // Seventh Edition
5 // The McGraw-Hill Companies
6 // Example 19-10, page 723
7
```

```

8 clear; clc; close;
9
10 // Given data
11 // LM308
12 Avol=250000; // given
13 f2ol=1.2; // open-loop bandwidth in hertz
14 Avcl=50; // closed loop voltage gain
15
16 // Calculations
17 f2cl=(Avol/Avcl)*f2ol; // closed-loop bandwidth in
    hertz
18 disp(" hertz",f2cl," closed-loop bandwidth")
19
20 // Result
21 // closed-loop bandwidth is 6 KHertz

```

Scilab code Exa 19.11 example11

```

1 // find closed-loop bandwidth
2 // Electronic Principles
3 // By Albert Malvino , David Bates
4 // Seventh Edition
5 // The McGraw-Hill Companies
6 // Example 19-11, page 724
7
8 clear; clc; close;
9
10 // Given data
11 // LM12
12 Avol=50000; // given
13 f2ol=14; // open-loop bandwidth in hertz
14
15 // Calculations

```

```
16 f2c1=(1+Avol)*f2o1;// closed-loop bandwidth in hertz
17 disp(" hertz",f2c1,"closed-loop bandwidth")
18
19 // Result
20 // closed-loop bandwidth is 700 KHertz
```

Scilab code Exa 19.12 example12

```
1 // find closed-loop bandwidth
2 // Electronic Principles
3 // By Albert Malvino , David Bates
4 // Seventh Edition
5 // The McGraw-Hill Companies
6 // Example 19-12, page 724
7
8 clear; clc; close;
9
10 // Given data
11 // OP-07A
12 AvolB=2500-1;// given
13 f2o1=20;// open-loop bandwidth in hertz
14
15 // Calculations
16 f2c1=(1+AvolB)*f2o1;// closed-loop bandwidth in
    hertz
17 disp(" hertz",f2c1,"closed-loop bandwidth")
18
19 // Result
20 // closed-loop bandwidth is 50 KHertz
```

Scilab code Exa 19.13 example13

```
1 // find closed-loop bandwidth, peak voltage
2 // Electronic Principles
3 // By Albert Malvino , David Bates
4 // Seventh Edition
5 // The McGraw-Hill Companies
6 // Example 19-13, page 724
7
8 clear; clc; close;
9
10 // Given data
11 // LM741C
12 funity=10^6; // in hertz
13 Sr=0.5*10^6; // slew rate in Volts/second
14 Avcl=10; // closed-loop voltage gain
15
16 // Calculations
17 f2cl=funity/Avcl; // closed-loop bandwidth in hertz
18 Vpeak=Sr/(2*pi*f2cl); // peak voltage in volts
19 disp(" hertz", f2cl, " closed-loop bandwidth")
20 disp(" Volts", Vpeak, " peak voltage=")
21
22 // Result
23 // closed-loop bandwidth is 100 KHertz
24 // Peak voltage is 0.795 Volts
```

Chapter 20

Linear Op Amp Circuits

Scilab code Exa 20.2 example2

```
1 // find maximum,minimum voltage gain
2 // Electronic Principles
3 // By Albert Malvino , David Bates
4 // Seventh Edition
5 // The McGraw-Hill Companies
6 // Example 20-2, page 747
7
8 clear; clc; close;
9
10 // Given data
11 R1=1.2*10^3;// in ohms
12 R2=91*10^3;// in ohms
13
14 // Calculations
15 Avmin=-R2/R1;// minimum voltage gain
16 Avmax=0;// maximum voltage gain is 0
17 disp(Avmin,"minimum voltage gain=")
18 disp(Avmax,"maximum voltage gain=")
19
20 // Result
21 // Minimum voltage gain is -75.8
```

22 // Maximum voltage gain is 0

Scilab code Exa 20.3 example3

```
1 // find maximum positive voltage gain and value of
  other fixed resistance
2 // Electronic Principles
3 // By Albert Malvino , David Bates
4 // Seventh Edition
5 // The McGraw-Hill Companies
6 // Example 20-3, page 747
7
8 clear; clc; close;
9
10 // Given data
11 nR=7.5*10^3; // in ohms
12 R=1.5*10^3; // in ohms
13
14 // Calculations
15 n=nR/R; // obvious
16 Av=n; // maximum positive voltage gain
17 R2=nR/(n-1); // other fixed resistance in hms
18 disp(Av,"maximum voltage gain=")
19 disp("ohms",R2,"resistance=")
20
21 // Result
22 // Maximum voltage gain is 5
23 // Other resistance is 1.875 Kohms
```

Scilab code Exa 20.5 example5

```
1 // find voltage gain of each channel
2 // Electronic Principles
3 // By Albert Malvino , David Bates
4 // Seventh Edition
5 // The McGraw-Hill Companies
6 // Example 20-5, page 759
7
8 clear; clc; close;
9
10 // Given data
11 R1=1*10^3; // in ohms
12 R2=2*10^3; // in ohms
13 R3=3*10^3; // in ohms
14 R4=4*10^3; // in ohms
15 R5=5*10^3; // in ohms
16 Rf=6*10^3; // in ohms
17
18 // Calculations
19 R12=R1*R2/(R1+R2); // R1||R2
20 R45=R4*R5/(R4+R5); // R4||R5
21 R35=R3*R5/(R3+R5); // R3||R5
22 Av1=-Rf/R1; // voltage gain of channel
23 Av2=-Rf/R2; // voltage gain of channel
24 Av3=((Rf/R12)+1)*(R45/(R3+R45)); // voltage gain of
    channel
25 Av4=((Rf/R12)+1)*(R35/(R4+R35)); // voltage gain of
    channel
26 disp(Av1," voltage gain 1=")
27 disp(Av2," voltage gain 2=")
28 disp(Av3," voltage gain 3=")
29 disp(Av4," voltage gain 4=")
30
31 // Results
32 // Voltage gain of channel 1 is -6
33 // Voltage gain of channel 2 is -3
34 // Voltage gain of channel 3 is 4.26
```

35 // Voltage gain of channel 4 is 3.19

Scilab code Exa 20.6 example6

```
1 // find decimal equivalent of binary input and
  output voltage of the converter
2 // Electronic Principles
3 // By Albert Malvino , David Bates
4 // Seventh Edition
5 // The McGraw-Hill Companies
6 // Example 20-6, page 762
7
8 clear; clc; close;
9
10 // Given data
11 D0=1; // binary input
12 D1=0; // binary input
13 D2=0; // binary input
14 D3=1; // binary input
15 Vref=5; // in volts
16
17 // Calculations
18 BIN=(D0*2^0)+(D1*2^1)+(D2*2^2)+(D3*2^3); // decimal
  equivalent of binary input
19 Vout=-(BIN*2*Vref/(2^4)); // output voltage in volts
20 disp(BIN,"decimal equivalent of binary input=")
21 disp("Volts",Vout,"output voltage=")
22
23 // Result
24 // decimal equivalent of binary input 1001 is 9
25 // Output voltage of the convertor is -5.625 Volts
```

Scilab code Exa 20.7 example7

```
1 // find closed loop output impedance, short loaded
   current and voltage gain of the circuit
2 // Electronic Principles
3 // By Albert Malvino , David Bates
4 // Seventh Edition
5 // The McGraw-Hill Companies
6 // Example 20-7, page 764
7
8 clear; clc; close;
9
10 // Given data
11 R1=10^3; // in ohms
12 R2=51*10^3; // in ohms
13 Avol=100000; // Avol of 741C
14 zoutol=75; // open-loop output impedance in ohms
15 Bdc=125; // current gain
16 Isc=25*10^-3; // short-load current in amperes
17
18 // Calculations
19 Av=-R2/R1; // voltage gain
20 B=R1/(R1+R2); // feedback fraction
21 zoutcl=zoutol/(1+(Avol*B)); // closed-loop output
   impedance in ohms
22 Imax=Bdc*Isc; // boosted value of short loaded
   current in amperes
23 disp("ohms",zoutcl,"Closed loop output impedance=")
24 disp(Av,"Voltage gain=")
25 disp("amperes",Imax,"Short-load current=")
26
27 // Result
```

```
28 // Closed loop output impedance is 0.039 ohms
29 // Voltage gain is -51
30 // Short-load current is 3.13 Amperes
```

Scilab code Exa 20.8 example8

```
1 // find output current and maximum load resistance
2 // Electronic Principles
3 // By Albert Malvino , David Bates
4 // Seventh Edition
5 // The McGraw-Hill Companies
6 // Example 20-8, page 768
7
8 clear; clc; close;
9
10 // Given data
11 R=10*10^3; // in ohms
12 Vin=10; // input voltage in volts
13 Vcc=15; // in volts
14
15 // Calculations
16 iout=Vin/R; // output current in amperes
17 Rlmax=R*((Vcc/Vin)-1); // maximum load resistance in
    ohms
18 disp("Amperes",iout,"output current=")
19 disp("ohms",Rlmax,"Maximum load resistance=")
20
21 // Result
22 // Output current is 1 mAmpere
23 // Maximum load resistance is 5 Kohms
```

Scilab code Exa 20.9 example9

```
1 // find output current and maximum load resistance
2 // Electronic Principles
3 // By Albert Malvino , David Bates
4 // Seventh Edition
5 // The McGraw-Hill Companies
6 // Example 20-9, page 768
7
8 clear; clc; close;
9
10 // Given data
11 R=15*10^3; // in ohms
12 Vin=3; // input voltage in volts
13 Vcc=15; // in volts
14
15 // Calculations
16 iout=-Vin/R; // output current in amperes
17 Rlmax=(R/2)*((Vcc/Vin)-1); // maximum load resistance
    in ohms
18 disp("Amperes",iout,"output current=")
19 disp("ohms",Rlmax,"Maximum load resistance=")
20
21 // Result
22 // Output current is -0.2 mAmperes
23 // Maximum load resistance is 30 Kohms
```

Scilab code Exa 20.10 example10

```

1 // find maximum,minimum voltage gain
2 // Electronic Principles
3 // By Albert Malvino , David Bates
4 // Seventh Edition
5 // The McGraw-Hill Companies
6 // Example 20-10, page 771
7
8 clear; clc; close;
9
10 // Given data
11 Rdsmin=50; // in ohms
12 Rdsmax=120*10^3; // in ohms
13 R1=1*10^3; // in ohms
14 R2=47*10^3; // in ohms
15 R3=100*10^3; // in ohms
16
17 // Calculations
18 Avmax=((R2/R1)+1)*(Rdsmax/(Rdsmax+R3)); // maximum
    voltage gain
19 Avmin=((R2/R1)+1)*(Rdsmin/(Rdsmin+R3)); // minimum
    voltage gain
20 disp(Avmin,"minimum voltage gain=")
21 disp(Avmax,"maximum voltage gain=")
22
23 // Result
24 // Minimum voltage gain is 0.024
25 // Maximum voltage gain is 26.2

```

Chapter 21

Active Filters

Scilab code Exa 21.1 example1

```
1 // find voltage gain ,cutoff frequency
2 // Electronic Principles
3 // By Albert Malvino , David Bates
4 // Seventh Edition
5 // The McGraw-Hill Companies
6 // Example 21-1, page 806
7
8 clear;clc; close;
9
10 // Given data
11 R1=10^3;// in ohms
12 R2=39*10^3;// in ohms
13 R3=12*10^3;// in ohms
14 C1=680*10^-12;// capacitance in faraday
15
16 // Calculations
17 Av=(R2/R1)+1;// voltage gain
18 fc=1/(2*%pi*R3*C1);// cutoff frequency in hertz
19 disp(Av," Voltage gain=")
20 disp(" Hertz",fc," cutoff frequency=")
21
```

```
22 // Result
23 // voltage gain is 40
24 // cutoff frequency is 19.5 KHertz
```

Scilab code Exa 21.2 example2

```
1 // find voltage gain ,cutoff frequency
2 // Electronic Principles
3 // By Albert Malvino , David Bates
4 // Seventh Edition
5 // The McGraw-Hill Companies
6 // Example 21-2, page 807
7
8 clear;clc; close;
9
10 // Given data
11 R1=220;// in ohms
12 R2=43*10^3;// in ohms
13 C1=100*10^-12;// capacitance in faraday
14
15 // Calculations
16 Av=-R2/R1;// voltage gain
17 fc=1/(2*pi*R2*C1);// cutoff frequency in hertz
18 disp(Av," Voltage gain=")
19 disp(" Hertz",fc," cutoff frequency=")
20
21 // Result
22 // Voltage gain is -195
23 // Cutoff frequency is 37 KHertz
```

Scilab code Exa 21.3 example3

```
1 // find pole frequency ,Q,cutoff frequency
2 // Electronic Principles
3 // By Albert Malvino , David Bates
4 // Seventh Edition
5 // The McGraw-Hill Companies
6 // Example 21-3, page 811
7
8 clear;clc; close;
9
10 // Given data
11 C1=820*10^-12;// capacitance in faraday
12 C2=1.64*10^-9;// capacitance in faraday
13 R=30*10^3;// resistance in ohms
14
15 // Calculations
16 Q=((C2/C1)^0.5)/2;// q of the filter
17 fp=1/(2*pi*R*((C1*C2)^0.5));// peak frequency in
    hertz
18 fc=fp;// for Butterworth response cutoff frequency
    is equal to peak frequency
19 disp(Q,"Q of the filter=")
20 disp("hertz",fc,"cutoff frequency=")
21 disp("hertz",fp,"peak frequency=")
22
23 // Result
24 // Q of the filter is 0.707(Butterworth response)
25 // peak frequency is 4.58 kHz
26 // cutoff frequency is 4.58 kHz
```

Scilab code Exa 21.4 example4

```
1 // find pole frequency ,Q,cutoff frequency
2 // Electronic Principles
3 // By Albert Malvino , David Bates
4 // Seventh Edition
5 // The McGraw-Hill Companies
6 // Example 21-4, page 811
7
8 clear;clc; close;
9
10 // Given data
11 C1=330*10^-12;// capacitance in faraday
12 C2=440*10^-12;// capacitance in faraday
13 R=51*10^3;// resistance in ohms
14 Kc=0.786;// constant for Bessel response
15
16 // Calculations
17 Q=((C2/C1)^0.5)/2;// q of the filter
18 fp=1/(2*%pi*R*((C1*C2)^0.5));// peak frequency in
    hertz
19 fc=Kc*fp;// for Bessel's response cutoff frequency
    is Kc*peak frequency
20 disp(Q,"Q of the filter=")
21 disp("hertz",fc,"cutoff frequency=")
22 disp("hertz",fp,"peak frequency=")
23
24 // Result
25 // Q of the filter is 0.577(Bessel response)
26 // peak frequency is 8.19 kHz
27 // cutoff frequency is 6.44 kHz
```

Scilab code Exa 21.5 example5

```
1 // find pole frequency ,Q,cutoff frequency , 3-db
  frequencies
2 // Electronic Principles
3 // By Albert Malvino , David Bates
4 // Seventh Edition
5 // The McGraw-Hill Companies
6 // Example 21-5, page 812
7
8 clear;clc; close;
9
10 // Given data
11 C1=390*10^-12;// capacitance in faraday
12 C2=27*10^-9;// capacitance in faraday
13 R=22*10^3;// resistance in ohms
14 Ap=12.5;// in decibel
15 K0=0.99;// constant
16 Kc=1.38;// constant
17 K3=1.54;// constant
18
19 // Calculations
20 Q=((C2/C1)^0.5)/2;// q of the filter
21 fp=1/(2*%pi*R*((C1*C2)^0.5));// peak frequency in
  hertz
22 fc=Kc*fp;// cutoff frequency in hertz
23 f3db=K3*fp;// 3-db frequency in hertz
24 disp(Q,"Q of the filter=")
25 disp(" hertz",fc," cutoff frequency=")
26 disp(" hertz",fp," peak frequency=")
27 disp(" hertz",f3db," 3db frequency=")
28
```

```
29 // Result
30 // Q of the filter is 4.16
31 // peak frequency is 2.23 kHz
32 // cutoff frequency is 3.08 kHz
33 // 3-dB frequency is 3.43 kHz
```

Scilab code Exa 21.6 example6

```
1 // find pole frequency ,Q,cutoff frequency
2 // Electronic Principles
3 // By Albert Malvino , David Bates
4 // Seventh Edition
5 // The McGraw-Hill Companies
6 // Example 21-6, page 817
7
8 clear;clc; close;
9
10 // Given data
11 C=330*10^-12; // capacitance in faraday
12 R1=51*10^3; // resistance in ohms
13 R2=30*10^3; // resistance in ohms
14 R=47*10^3; // resistance in ohms
15
16 // Calculations
17 Av=(R2/R1)+1; // midband voltage gain
18 Q=1/(3-Av); // q of the filter
19 fp=1/(2*pi*R*C); // peak frequency in hertz
20 fc=fp; // for Butterworth response cutoff frequency
    is equal to peak frequency
21 disp(Q,"Q of the filter=")
22 disp(" hertz",fc," cutoff frequency=")
23 disp(" hertz",fp," peak frequency=")
24
```

```
25 // Result
26 // Q of the filter is 0.709
27 // peak frequency is 10.3 kHz
28 // cutoff frequency is 10.3 kHz
```

Scilab code Exa 21.7 example7

```
1 // find pole frequency ,Q,cutoff frequency
2 // Electronic Principles
3 // By Albert Malvino , David Bates
4 // Seventh Edition
5 // The McGraw-Hill Companies
6 // Example 21-7, page 817
7
8 clear;clc; close;
9
10 // Given data
11 C=100*10^-12;// capacitance in faraday
12 R1=56*10^3;// resistance in ohms
13 R2=15*10^3;// resistance in ohms
14 R=82*10^3;// resistance in ohms
15 Kc=0.786;// constant for Bessel response
16
17 // Calculations
18 Av=(R2/R1)+1;// midband voltage gain
19 Q=1/(3-Av);// q of the filter
20 fp=1/(2*pi*R*C);// peak frequency in hertz
21 fc=Kc*fp;// for Bessel's response cutoff frequency
    is Kc*peak frequency
22 disp(Q,"Q of the filter=")
23 disp(" hertz",fc," cutoff frequency=")
24 disp(" hertz",fp," peak frequency=")
25
```

```
26 // Result
27 // Q of the filter is 0.578
28 // peak frequency is 19.4 kHz
29 // cutoff frequency is 15.2 kHz
```

Scilab code Exa 21.9 example9

```
1 // find pole frequency ,Q,cutoff frequency
2 // Electronic Principles
3 // By Albert Malvino , David Bates
4 // Seventh Edition
5 // The McGraw-Hill Companies
6 // Example 21-9, page 820
7
8 clear;clc; close;
9
10 // Given data
11 C=4.7*10^-9;// capacitance in faraday
12 R1=24*10^3;// resistance in ohms
13 R2=12*10^3;// resistance in ohms
14
15 // Calculations
16 Q=((R1/R2)^0.5)/2;// q of the filter
17 fp=1/(2*pi*C*((R1*R2)^0.5));// peak frequency in
    hertz
18 fc=fp;// for Butterworth response cutoff frequency
    is equal to peak frequency
19 disp(Q,"Q of the filter=")
20 disp("hertz",fc,"cutoff frequency=")
21 disp("hertz",fp,"peak frequency=")
22
23 // Results
24 // Q of the filter is 0.707(Butterworth response)
```



```
25 // peak frequency is 2 kHzertz
26 // cutoff frequency is 2 kHzertz
```

Scilab code Exa 21.10 example10

```
1 // find pole frequency ,Q,resonant ,cutoff,3-db
  frequency
2 // Electronic Principles
3 // By Albert Malvino , David Bates
4 // Seventh Edition
5 // The McGraw-Hill Companies
6 // Example 21-10, page 821
7
8 clear;clc; close;
9
10 // Given data
11 C=10^-9;// capacitance in faraday
12 R1=10*10^3;// resistance in ohms
13 R2=15*10^3;// resistance in ohms
14 R=30*10^3;// resistance in ohms
15 K0=0.94;// constant
16 Kc=1.32;// constant
17 K3=1.48;// constant
18
19 // Calculations
20 Av=(R2/R1)+1;// midband voltage gain
21 Q=1/(3-Av);// q of the filter
22 fp=1/(2*%pi*R*C);// peak frequency in hertz
23 fc=fp/Kc;// cutoff frequency in hertz
24 f0=fp/K0;// resonant frequency in hertz
25 f3db=fp/K3;// 3-db frequency in hertz
26 disp(Q,"Q of the filter=")
27 disp("hertz",fc,"cutoff frequency=")
```

```

28 disp(" hertz",fp," peak frequency=")
29 disp(" hertz",f0," resonant frequency=")
30 disp(" hertz",f3db," 3db frequency=")
31
32 // Result
33 // Q is 2
34 // peak frequency is 5.31 kHzertz
35 // cutoff frequency is 4.02 kHzertz
36 // resonant frequency is 5.65 kHzertz
37 // 3-dB frequency is 3.59 kHzertz

```

Scilab code Exa 21.12 example12

```

1 // find voltage gain ,center frequency ,Q
2 // Electronic Principles
3 // By Albert Malvino , David Bates
4 // Seventh Edition
5 // The McGraw-Hill Companies
6 // Example 21-12, page 827
7
8 clear;clc; close;
9
10 // Given data
11 C=120*10^-9;// capacitance in faraday
12 R1=13*10^3;// resistance in ohms
13 R2=10*10^3;// resistance in ohms
14 R=22*10^3;// resistance in ohms
15
16 // Calculations
17 Av=(R2/R1)+1;// voltage gain
18 Q=0.5/(2-Av);// q of the filter
19 f0=1/(2*pi*R*C);// center frequency in hertz
20 disp(Q,"Q of the filter=")

```

```
21 disp(Av," Voltage gain=")
22 disp(" hertz",f0," resonant frequency=")
23
24 // Result
25 // Q is 2.17
26 // resonant frequency is 60.3 Hertz
27 // Voltage gain is 1.77
```

Scilab code Exa 21.13 example13

```
1 // find phase shift of output voltage
2 // Electronic Principles
3 // By Albert Malvino , David Bates
4 // Seventh Edition
5 // The McGraw-Hill Companies
6 // Example 21-13, page 833
7
8 clear;clc; close;
9
10 // Given data
11 C=100*10^-9;// capacitance in faraday
12 R=10^3;// resistance in ohms
13 f=10^3;// frequency in hertz
14
15 // Calculations
16 fo=1/(2*%pi*R*C);// cutoff frequency in hertz
17 angle=2*atan(fo/f)*180/%pi;// phase shift in degree
18 disp(" degrees",angle," phase shift=")
19
20 // Result
21 // Phase shift is 116 degrees
```

Chapter 22

Non Linear Op Amp Circuits

Scilab code Exa 22.4 example4

```
1 // find trip point , cutoff frequency
2 // Electronic Principles
3 // By Albert Malvino , David Bates
4 // Seventh Edition
5 // The McGraw-Hill Companies
6 // Example 22-4, page 854
7
8 clear;clc; close;
9
10 // Given data
11 Vcc=15; // in volts from the figure
12 C=10*10^-6; // capacitance in faraday
13 R1=200*10^3; // resistance in ohms
14 R2=100*10^3; // resistance in ohms
15
16 // Calculations
17 Vref=(R2/(R1+R2))*Vcc; // reference voltage in volts
18 R=R1*R2/(R1+R2); // equivalent resistance in ohms
19 fc=1/(2*pi*R*C); // cutoff frequency in hertz
20 disp(" hertz",fc," cutoff frequency=")
21 disp(" Volts",Vref," Trip point=")
```

```
22
23 // Result
24 // Trip point is 5 Volts
25 // cutoff frequency is 0.239 Hertz
```

Scilab code Exa 22.5 example5

```
1 // find duty cycle of output waveform
2 // Electronic Principles
3 // By Albert Malvino , David Bates
4 // Seventh Edition
5 // The McGraw-Hill Companies
6 // Example 22-5, page 855
7
8 clear;clc; close;
9
10 // Given data
11 Vp=10;// peak voltage in volts
12 Vcc=15;// in volts from the figure
13 C=10*10^-6;// capacitance in faraday
14 R1=200*10^3;// resistance in ohms
15 R2=100*10^3;// resistance in ohms
16
17 // Calculations
18 // input is a sine wave it is 10sin(angle)
19 Vref=(R2/(R1+R2))*Vcc;// reference voltage in volts
20 // output is a rectangular waveform whose trip point
   is 5 Volts
21 angle1=asin(Vref/Vp)*180/%pi;// angle where
   switching occurs
22 angle2=180-angle1;// other angle where switching
   occurs
23 angle=angle2-angle1;// conduction angle in degrees
```

```

24 D=angle*100/360; // duty cycle in %
25 disp("%" ,D,"duty cycle=")
26
27 // Result
28 // duty cycle is 33.3 %

```

Scilab code Exa 22.6 example6

```

1 // find trip points and hysteresis
2 // Electronic Principles
3 // By Albert Malvino , David Bates
4 // Seventh Edition
5 // The McGraw-Hill Companies
6 // Example 22-6, page 860
7
8 clear;clc; close;
9
10 // Given data
11 Vsat=13.5; // in volts
12 R1=1*10^3; // resistance in ohms
13 R2=47*10^3; // resistance in ohms
14
15 // Calculations
16 B=R1/(R1+R2); // feedback fraction
17 UTP=(R1/R2)*Vsat; // upper trip point in volts
18 LTP=-(R1/R2)*Vsat; // lower trip point in volts
19 H=UTP-LTP; // hysteresis in volts
20 disp(" Volts",UTP,"upper trip point=")
21 disp(" Volts",LTP,"lower trip point=")
22 disp(" Volts",H,"hysteresis=")
23
24 // Result
25 // Trip points are -0.287 and +0.287 Volts

```

26 // Hysteresis is 0.574 Volts

Scilab code Exa 22.7 example7

```
1 // find output voltage , closed loop time constant
2 // Electronic Principles
3 // By Albert Malvino , David Bates
4 // Seventh Edition
5 // The McGraw-Hill Companies
6 // Example 22-7, page 865
7
8 clear;clc; close;
9
10 // Given data
11 Avol=100000;// open loop voltage gain
12 Vin=8;// input voltage in volts
13 C=1*10^-6;// capacitance in faraday
14 R=2*10^3;// resistance in ohms
15 T=10^-3;// in seconds
16
17 // Calculations
18 t=R*C*(1+Avol);// closed loop time constant in
    seconds
19 V=(T*Vin)/(R*C);// magnitude of negative output
    voltage at end of pulse in volts
20 disp("seconds",t,"time constant=")
21 disp("Volts",V,"output voltage=")
22
23 // Result
24 // Closed loop time constant is 200 seconds
25 // Output voltage at end of pulse is -4 volts
```

Scilab code Exa 22.8 example8

```
1 // find output voltage
2 // Electronic Principles
3 // By Albert Malvino , David Bates
4 // Seventh Edition
5 // The McGraw-Hill Companies
6 // Example 22-8, page 868
7
8 clear;clc; close;
9
10 // Given data
11 fin=10^3;// frequency in hertz '
12 Vp=5;// peak voltage in volts
13 C=10*10^-6;// capacitance in faraday
14 R=10^3;// resistance in ohms
15
16 // Calculations
17 Vout=Vp/(2*fin*R*C);// output voltage in Vpp
18 disp("Volts",Vout,"output voltage=")
19
20 // Result
21 // Output voltage is 0.25 Vpp
```

Scilab code Exa 22.10 example10

```
1 // find frequency of output signal
2 // Electronic Principles
```

```

3 // By Albert Malvino , David Bates
4 // Seventh Edition
5 // The McGraw-Hill Companies
6 // Example 22-10, page 871
7
8 clear;clc; close;
9
10 // Given data
11 R1=18*10^3;// resistance in ohms
12 R2=2*10^3;// resistance in ohms
13 R=10^3;// resistance in ohms
14 C=0.1*10^-6;// capacitance in faraday
15
16 // Calculations
17 B=R1/(R1+R2);// feedback fraction
18 T=2*R*C*log((1+B)/(1-B));// time period of output
    signal
19 f=1/T;// frequency of output signal
20 disp(" hertz",f," Frequency=")
21
22 // Result
23 // Frequency of output signal is 1.7 KHertz

```

Scilab code Exa 22.12 example12

```

1 // find frequency and peak-to-peak voltage
2 // Electronic Principles
3 // By Albert Malvino , David Bates
4 // Seventh Edition
5 // The McGraw-Hill Companies
6 // Example 22-12, page 873
7
8 clear;clc; close;

```

```

9
10 // Given data
11 Vsat=13; // in volts
12 R1=1*10^3; // resistance in ohms
13 R2=100*10^3; // resistance in ohms
14 R3=10*10^3; // resistance in ohms
15 R4=100*10^3; // resistance in ohms
16 C=10*10^-6; // capacitance in faraday
17
18 // Calculations
19 UTP=(R1/R2)*Vsat; // upper trip point in volts
20 H=2*UTP; // hysteresis in volts
21 Vout=H; // peak to peak voltage in volts
22 f=R2/(4*R1*R3*C); // frequency in hertz
23 disp(" hertz",f," Frequency=")
24 disp(" Volts",Vout," output voltage=")
25
26 // Result
27 // Peak-to-peak output is 0.26 Volts
28 // frequency is 250 Hertz

```

Chapter 23

Oscillators

Scilab code Exa 23.1 example1

```
1 // find minimum and maximum frequency
2 // Electronic Principles
3 // By Albert Malvino , David Bates
4 // Seventh Edition
5 // The McGraw-Hill Companies
6 // Example 23-1, page 897
7
8 clear;clc; close;
9
10 // Given data
11 C=0.01*10^-6;// capacitance in faraday
12 Rmin=1*10^3;// resistance in ohms
13 Rmax=101*10^3;// resistance in ohms
14
15 // Calculations
16 fcmin=1/(2*pi*Rmax*C);// cutoff frequency in hertz
17 fcmax=1/(2*pi*Rmin*C);// cutoff frequency in hertz
18 disp("hertz",fcmax,"Maximum frequency of
    oscillation=")
19 disp("hertz",fcmin,"Minimum frequency of
    oscillation=")
```

```
20
21 // Result
22 // Minimum frequency of oscillation is 158 Hertz
23 // Maximum frequency of oscillation is 15.9 KHertz
```

Scilab code Exa 23.2 example2

```
1 // find output voltage of oscillator
2 // Electronic Principles
3 // By Albert Malvino , David Bates
4 // Seventh Edition
5 // The McGraw-Hill Companies
6 // Example 23-2 , page 897
7
8 clear;clc; close;
9
10 // Given data
11 R=10^3;// lamp resistance in ohms
12 V=2;// lamp voltage in volts
13 Rb=2*10^3;// feedback resistance in ohms
14
15 // Calculations
16 I=V/R;// lamp current in amperes
17 Vout=I*(R+Rb);// output voltage in volts
18 disp(" Volts",Vout,"output voltage=")
19
20 // Result
21 // Output voltage of the oscillator is 6vrms
```

Scilab code Exa 23.4 example4

```
1 // find frequency of oscillation
2 // Electronic Principles
3 // By Albert Malvino , David Bates
4 // Seventh Edition
5 // The McGraw-Hill Companies
6 // Example 23-4, page 908
7
8 clear;clc; close;
9
10 // Given data
11 C1=0.001*10^-6; // capacitance in faraday
12 C2=0.01*10^-6; // capacitance in faraday
13 C3=50*10^-12; // capacitance in faraday
14 L=15*10^-6; // inductance in henry
15
16 // Calculations
17 C=1/((1/C1)+(1/C2)+(1/C3)); // equivalent capacitance
    in faraday
18 fr=1/(2*pi*(L*C)^0.5); // frequency of oscillation
    in hertz
19 disp("hertz",fr,"frequency of osscillation=")
20
21 // Result
22 // frequency of oscillation is 5.81 MHertz
```

Scilab code Exa 23.5 example5

```
1 // find series and parallel resonant frequencies of
    crystal
2 // Electronic Principles
3 // By Albert Malvino , David Bates
```

```

4 // Seventh Edition
5 // The McGraw-Hill Companies
6 // Example 23-5, page 912
7
8 clear;clc; close;
9
10 // Given data
11 L=3;// inductance in henry
12 Cm=10*10^-12;// capacitance in faraday
13 Cs=0.05*10^-12;// capacitance in faraday
14 R=2*10^3;// resistance in ohms
15
16 // Calculations
17 fs=1/(2*%pi*(L*Cm)^0.5);// series resonant frequency
    in hertz
18 Cp=Cm*Cs/(Cm+Cs);// equivalent parallel capacitance
19 fp=1/(2*%pi*(L*Cp)^0.5);// parallel resonant
    frequency in hertz
20 disp("hertz",fs,"Series resonant frequency=")
21 disp("hertz",fp,"parallel resonant frequency=")
22
23 // Result
24 // Series resonant frequency of the crystal is 411
    Khertz
25 // Parallel resonant frequency of the crystal is 412
    Khertz

```

Scilab code Exa 23.6 example6

```

1 // find minimum trigger voltage ,maximum capacitor
    voltage ,width of output pulse
2 // Electronic Principles
3 // By Albert Malvino , David Bates

```

```

4 // Seventh Edition
5 // The McGraw-Hill Companies
6 // Example 23-6, page 918
7
8 clear;clc; close;
9
10 // Given data
11 C=0.47*10^-6; // capacitance in faraday
12 R=33*10^3; // resistance in ohms
13 Vcc=12; // in volts
14
15 // Calculations
16 UTP=2*Vcc/3; // upper trip point in volts
17 LTP=Vcc/3; // lower trip point in volts
18 W=1.1*R*C; // pulse width
19 disp("Volts",UTP,"Maximum trigger voltage=")
20 disp("Volts",LTP,"Minimum trigger voltage=")
21 disp("seconds",W,"pulse width=")
22
23 // Result
24 // Minimum trigger voltage is 4 Volts
25 // Maximum capacitor voltage is 8 Volts
26 // Pulse width is 17.1 mSeconds

```

Scilab code Exa 23.7 example7

```

1 // find width of output pulse
2 // Electronic Principles
3 // By Albert Malvino , David Bates
4 // Seventh Edition
5 // The McGraw-Hill Companies
6 // Example 23-7, page 919
7

```



```

8 clear;clc; close;
9
10 // Given data
11 C=470*10^-6;// capacitance in faraday
12 R=10*10^6;// resistance in ohms
13
14 // Calculations
15 W=1.1*R*C;// pulse width
16 disp("seconds",W,"pulse width=")
17
18 // Result
19 // Pulse width is 1.44 hrs

```

Scilab code Exa 23.8 example8

```

1 // find frequency of output and duty cycle
2 // Electronic Principles
3 // By Albert Malvino , David Bates
4 // Seventh Edition
5 // The McGraw-Hill Companies
6 // Example 23-8, page 922
7
8 clear;clc; close;
9
10 // Given data
11 C=47*10^-9;// capacitance in faraday
12 R1=75*10^3;// resistance in ohms
13 R2=30*10^3;// resistance in ohms
14
15 // Calculations
16 f=1.44/((R1+2*R2)*C);// frequency in hertz
17 D=(R1+R2)/(R1+(2*R2));// duty cycle
18 disp("hertz",f,"frequency in hertz=")

```

```

19 disp("%",D,"duty cycle")
20
21 // Result
22 // Frequency of output signal is 227 hertz
23 // duty cycle is 0.778

```

Scilab code Exa 23.10 example10

```

1 // find period of output pulses ,minimum and maximum
   pulse width, quiescent pulse width
2 // Electronic Principles
3 // By Albert Malvino , David Bates
4 // Seventh Edition
5 // The McGraw–Hill Companies
6 // Example 23–10, page 927
7
8 clear;clc; close;
9
10 // Given data
11 C=0.01*10^-6;// capacitance in faraday
12 R=9.1*10^3;// resistance in ohms
13 Vcc=12;// in volts
14 f=2.5*10^3;// frequency in hertz
15 Vmod=2;// peak voltage
16
17 // Calculations
18 T=1/f;// period of output pulses
19 UTP=2*Vcc/3;// upper trip point in volts
20 UTPmin=UTP-Vmod;// minimum upper trip point in volts
21 UTPmax=UTP+Vmod;// maximum upper trip point in volts
22 W=1.1*R*C;// quiescent pulse width
23 Wmin=-R*C*log(1-(UTPmin/Vcc));// minimum pulse width
24 Wmax=-R*C*log(1-(UTPmax/Vcc));// maximum pulse width

```

```

25 disp("seconds",T,"period of output cycle=")
26 disp("Volts",UTPmin,"Minium UTP=")
27 disp("Volts",UTPmax,"Maxium UTP=")
28 disp("seconds",W,"Quiescent pulse width=")
29 disp("seconds",Wmin,"minimum pulse width=")
30 disp("seconds",Wmax,"maximum pulse width=")
31
32 // Result
33 // Period of output pulses is 400 Microseconds
34 // Quiescent pulse width is 100 Micro seconds
35 // Minimum UTP is 6 Volts
36 // Maximum UTP is 10 Volts
37 // Minimum pulse width is 63.1 Microseconds
38 // Maximum pulse width is 163 Microseconds

```

Scilab code Exa 23.12 example12

```

1 // find slope of output ramp,its peak value ,duration
2 // Electronic Principles
3 // By Albert Malvino , David Bates
4 // Seventh Edition
5 // The McGraw-Hill Companies
6 // Example 23-12, page 929
7
8 clear;clc; close;
9
10 // Given data
11 C=100*10^-9;// capacitance in faraday
12 Ic=10^-3;// collector cuurent in amperes
13 Vcc=15;// in volts
14 f=2.5*10^3;// frequency in hertz
15
16 // Calculations

```

```
17 S=Ic/C;// slope in Volts/second
18 V=2*Vcc/3;// peak value of ramp
19 T=2*Vcc/(3*S);// duration of ramp in seconds
20 disp(S,"slope of output ramp=")
21 disp("Volts",V,"peak value=")
22 disp("seconds",T,"duration of the ramp=")
23
24 // Result
25 // slope of output ramp is 10^4 Volts/Second
26 // Peak value is 10 Volts
27 // duration of the ramp is 10^-2 second
```

Chapter 24

Regulated Power Supplies

Scilab code Exa 24.1 example1

```
1 // find output,load,collector current
2 // Electronic Principles
3 // By Albert Malvino , David Bates
4 // Seventh Edition
5 // The McGraw-Hill Companies
6 // Example 24-1, page 954
7
8 clear; clc; close;
9
10 // Given data
11 Vin=15;// input voltage
12 Rs=10;// in ohms
13 Vz=9.1;// in volts
14 Vbe=0.8;// in volts
15 Rl=40;// in ohms
16
17 // Calculations
18 Vout=Vz+Vbe;// output voltage in volts
19 Is=(Vin-Vout)/Rs;// current through series resistor
    in amperes
20 Il=Vout/Rl;// load current in amperes
```

```

21 Ic=Is-I1;// collector current in ampers
22 disp(" Volts",Vout," output voltage=")
23 disp(" amperes",I1,"load current=")
24 disp(" amperes",Ic," collector current=")
25
26 // Results
27 // Output voltage is 9.9
28 // Load current is 248 mAmperes
29 // Collector current is 262 mAmperes

```

Scilab code Exa 24.2 example2

```

1 // find output voltage ,load ,collector current
2 // Electronic Principles
3 // By Albert Malvino , David Bates
4 // Seventh Edition
5 // The McGraw–Hill Companies
6 // Example 24–2, page 954
7
8 clear; clc; close;
9
10 // Given data
11 Vin=15;// input voltage
12 Rs=10;// in ohms
13 Vz=6.2;// in volts
14 Vbe=0.81;// in volts
15 R1=40;// in ohms
16 R1=750;// in ohms
17 R2=250 ;// in ohms
18
19 // Calculations
20 Vout=((R1+R2)/R1)*(Vz+Vbe);// output voltage in
    volts

```

```

21 Is=(Vin-Vout)/Rs;// current through series resistor
    in amperes
22 Il=Vout/Rl;// load current in amperes
23 Ic=Is-Il;// collector current in ampers
24 disp(" Volts",Vout,"output voltage=")
25 disp(" amperes",Il,"load current=")
26 disp(" amperes",Ic,"collector current=")
27
28 // Results
29 // Output voltage is 9.35
30 // Load current is 234 mAmperes
31 // Collector current is 331 mAmperes

```

Scilab code Exa 24.3 example3

```

1 // find efficiency and power dissipated
2 // Electronic Principles
3 // By Albert Malvino , David Bates
4 // Seventh Edition
5 // The McGraw-Hill Companies
6 // Example 24-3, page 955
7
8 clear; clc; close;
9
10 // Given data
11 Vin=15;// input voltage
12 Rs=10;// in ohms
13 Vz=6.2;// in volts
14 Vbe=0.81;// in volts
15 Rl=40;// in ohms
16 R1=750;// in ohms
17 R2=250 ;// in ohms
18

```

```

19 // Calculations
20 Vout=((R1+R2)/R1)*(Vz+Vbe); // output voltage in
    volts
21 Is=(Vin-Vout)/Rs; // current through series resistor
    in amperes
22 Il=Vout/Rl; // load current in amperes
23 Ic=Is-Il; // collector current in amperes
24 Pout=Vout*Il; // load power in watts
25 Iin=Is; // as I3 is very low input current in amperes
26 Pin=Vin*Iin; // input power in watts
27 E=(Pout/Pin)*100; // efficiency in %
28 Preg=Pin-Pout; // power dissipated by regulator in
    watts
29 disp("%",E," efficiency=")
30 disp("watts",Preg," power dissipated=")
31
32 // Results
33 // Efficiency is 25.8 %
34 // Power dissipated by regulator is 6.29 watts

```

Scilab code Exa 24.4 example4

```

1 // find output voltage ,input ,load ,collector current
2 // Electronic Principles
3 // By Albert Malvino , David Bates
4 // Seventh Edition
5 // The McGraw-Hill Companies
6 // Example 24-4, page 955
7
8 clear; clc; close;
9
10 // Given data
11 Vin=15; // input voltage

```



```

12 Rs=10; // in ohms
13 Vz=6.8; // in volts
14 Rl=40; // in ohms
15 R1=7.5*10^3; // in ohms
16 R2=2.5*10^3 ; // in ohms
17
18 // Calculations
19 Vout=((R1+R2)/R1)*Vz; // output voltage in volts
20 Is=(Vin-Vout)/Rs; // current through series resistor
    in amperes
21 Iin=Is; // as I3 is very low input current in amperes
22 Il=Vout/Rl; // load current in amperes
23 Ic=Is-Il; // collector current in amperes
24 disp(" Volts",Vout," output voltage=")
25 disp(" amperes",Iin," input current=")
26 disp(" amperes",Il," load current=")
27 disp(" amperes",Ic," collector current=")
28
29 // Results
30 // Output voltage is 9.07 Volts
31 // Input current is 593 mAmperes
32 // Load current is 227 mAmperes
33 // Collector current is 366 mAmperes

```

Scilab code Exa 24.6 example6

```

1 // find load regulation and line regulation
2 // Electronic Principles
3 // By Albert Malvino , David Bates
4 // Seventh Edition
5 // The McGraw-Hill Companies
6 // Example 24-6, page 956
7

```

```

8 clear; clc; close;
9
10 // Given data
11 Vn1=9.91; // in volts
12 Vf1=9.81; // in volts
13 Vh1=9.94; // in volts
14 V11=9.79 ; // in volts
15
16 // Calculations
17 ld=((Vn1-Vf1)/Vf1)*100 ; // load regulation in %
18 ln=((Vh1-V11)/V11)*100; // loan regulation in %
19 disp("%" ,ld," load regulation=")
20 disp("%" ,ln," line regulation=")
21
22 // Results
23 // load regulation is 1.02%
24 // line regulation is 1.53%

```

Scilab code Exa 24.7 example7

```

1 // find output voltage ,power dissipation
2 // Electronic Principles
3 // By Albert Malvino , David Bates
4 // Seventh Edition
5 // The McGraw-Hill Companies
6 // Example 24-7, page 962
7
8 clear; clc; close;
9
10 // Given data
11 Vin=15; // input voltage
12 Vz=6.2; // in volts
13 Vbe=0.7; // in volts

```

```

14 R1=40; // in ohms
15 R1=3*10^3; // in ohms
16 R2=1*10^3 ; // in ohms
17
18 // Calculations
19 Vout=((R1+R2)/R1)*(Vz+Vbe); // output voltage in
    volts
20 Ic=Vout/R1; // transistor current is equal to load
    current
21 Pd=(Vin-Vout)*Ic; // power dissipation in watts
22 disp(" Volts",Vout," output voltage=")
23 disp(" Watts",Pd," power dissipation=")
24
25 // Results
26 // Output voltage is 9.2 Volts
27 // power dissipation is 1.33 Watts

```

Scilab code Exa 24.8 example8

```

1 // find efficiency
2 // Electronic Principles
3 // By Albert Malvino , David Bates
4 // Seventh Edition
5 // The McGraw-Hill Companies
6 // Example 24-8, page 963
7
8 clear; clc; close;
9
10 // Given data
11 Vin=15; // input voltage
12 Vz=6.2; // in volts
13 Vbe=0.7; // in volts
14 R1=40; // in ohms

```

```

15 R1=3*10^3; // in ohms
16 R2=1*10^3 ; // in ohms
17
18 // Calculations
19 Vout=((R1+R2)/R1)*(Vz+Vbe); // output voltage in
    volts
20 I1=Vout/R1; // load current in amperes
21 Ic=I1; // transistor current is equal to load current
22 Pout=Vout*I1; // load power in watts
23 Pin=Vin*Ic; // input power in watts
24 E=(Pout/Pin)*100; // efficiency in %
25 disp("%" ,E," efficiency=")
26
27 // Results
28 // Efficiency is 61.3 %

```

Scilab code Exa 24.10 example10

```

1 // find load regulation and line regulation
2 // Electronic Principles
3 // By Albert Malvino , David Bates
4 // Seventh Edition
5 // The McGraw-Hill Companies
6 // Example 24-10, page 964
7
8 clear; clc; close;
9
10 // Given data
11 Vn1=10.16; // in volts
12 Vf1=10.15; // in volts
13 Vh1=10.16; // in volts
14 Vll=10.07; // in volts
15

```

```

16 // Calculations
17 ld=((Vn1-Vf1)/Vf1)*100 ;// load regulation in %
18 ln=((Vh1-Vl1)/Vl1)*100; // loan regulation in %
19 disp("%" ,ld,"load regulation=")
20 disp("%" ,ln,"line regulation=")
21
22 // Results
23 // load regulation is 0.0985%
24 // line regulation is 0.894%

```

Scilab code Exa 24.13 example13

```

1 // find output voltage
2 // Electronic Principles
3 // By Albert Malvino , David Bates
4 // Seventh Edition
5 // The McGraw-Hill Companies
6 // Example 24-13, page 972
7
8 clear; clc; close;
9
10 // Given data
11 R1=2*10^3; // in ohms
12 R2=22*10^3 ; // in ohms
13
14 // Calculations
15 Vout=((R1+R2)/R1)*1.25; // output voltage in volts
16 disp(" Volts" ,Vout,"output voltage=")
17
18 // Results
19 // Output voltage is 15 Volts

```

Scilab code Exa 24.15 example15

```
1 // find output voltage
2 // Electronic Principles
3 // By Albert Malvino , David Bates
4 // Seventh Edition
5 // The McGraw-Hill Companies
6 // Example 24-15, page 984
7
8 clear; clc; close;
9
10 // Given data
11 R1=2.21*10^3; // in ohms
12 R2=2.8*10^3 ; // in ohms
13 Vref=2.21; // in volts
14
15 // Calculations
16 Vout=((R1+R2)/R1)*Vref; // output voltage in volts
17 disp(" Volts",Vout," output voltage=")
18
19 // Results
20 // Output voltage is 5.01 Volts
```

Scilab code Exa 24.16 example16

```
1 // find output voltage
2 // Electronic Principles
3 // By Albert Malvino , David Bates
```

```
4 // Seventh Edition
5 // The McGraw-Hill Companies
6 // Example 24-16, page 984
7
8 clear; clc; close;
9
10 // Given data
11 R1=1*10^3; // in ohms
12 R2=5.79*10^3 ; // in ohms
13 Vref=2.21; // in volts
14
15 // Calculations
16 Vout=((R1+R2)/R1)*Vref; // output voltage in volts
17 disp(" Volts",Vout," output voltage=")
18
19 // Results
20 // Output voltage is 15 Volts
```
