# Scilab Textbook Companion for Grob's Basic Electronics by M. E. Schultz[1]

Created by
Shaikh Bilal Anees
Degree in Electronics & Telecommunication
Electronics Engineering
A.I.K.T.C
College Teacher
Banda Nawaz
Cross-Checked by
Chaitanya Potti

May 31, 2016

[1]Funded by a grant from the National Mission on Education through ICT, http://spoken-tutorial.org/NMEICT-Intro. This Textbook Companion and Scilab codes written in it can be downloaded from the "Textbook Companion Project" section at the website http://scilab.in

# Book Description

**Title:** Grob's Basic Electronics

**Author:** M. E. Schultz

**Publisher:** McGraw-Hill

**Edition:** 11

**Year:** 2010

**ISBN:** 9780073510859

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

**Exa** Example (Solved example)

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

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

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

# Contents

# List of Scilab Codes

# Chapter 1

# Chapter Introduction to Powers of 10

**Scilab code Exa 0.1** Example 1

```
// Grob's Basic Electronics 11e
// Chapter No. I
// Example No. I_1
clc; clear;
// Express the following numbers in scientifi c
   notation:(a) 3900 (b) 0.0000056.

disp ('To express 3900 in scientific notation, write
    the number as a number between 1 and 10, which
   is 3.9 in this case, times a power of 10.')
disp ('Therefore 3900 = 3.9*10^3 in scientific')

disp ('To express 0.0000056 in scientific notation,
   write the number as a number between 1 and 10,
   which is 5.6 in this case, times a power of 10.')
disp ('Therefore 0.0000056 = 5.6*10^-6 in scientific
   ')
```

**Scilab code Exa 0.2** Example 2

```
// Grob's Basic Electronics 11e
// Chapter No. I
// Example No. I_2
clc; clear;
// Express the following numbers in scientific
   notation: (a) 235,000 (b) 364,000,000 (c)
   0.000756 (d) 0.00000000000016.

disp('To express 235,000 in scientific notation,
   write the number as a number between 1 and 10,
   which is 2.35 in this case, times a power of 10.'
   )
disp('Therefore 235,000 = 2.35*10^5 in scientific')

disp('To express 364,000,000 in scientific notation
   , write the number as a number between 1 and 10,
   which is 3.64 in this case, times a power of 10.'
   )
disp('Therefore 364,000,000 = 3.64*10^8 in
   scientific')

disp('To express 0.000756 in scientific notation,
   write the number as a number between 1 and 10,
   which is 7.56 in this case, times a power of 10.'
   )
disp('Therefore 0.000756 = 7.56*10^-4 in scientific
   ')

disp('To express 0.00000000000016 in scientific
   notation, write the number as a number between 1
   and 10, which is 1.6 in this case, times a power
   of 10.')
```

```
disp ('Therefore 0.00000000000016 = 1.6*10^-13 in scientific')
```

**Scilab code Exa 0.3** Example 3

```
// Grob's Basic Electronics 11e
// Chapter No. I
// Example No. I_3
clc; clear;
// Convert the following numbers written in scientific notation into decimal notation: (a) 4.75*10^2 (b) 6.8*10^-5.

disp ('To convert 4.75*10^2 into decimal notation, the decimal point must be shifted 2 places to the right.')
disp ('Therefore 4.75*10^2 = 475 in decimal')

disp ('To convert 6.8*10^-5 into decimal notation, the decimal point must be shifted 5 places to the left.')
disp ('Therefore 6.8*10^-5 = 0.000068 in decimal')
```

**Scilab code Exa 0.4** Example 4

```
// Grob's Basic Electronics 11e
// Chapter No. I
// Example No. I_4
clc; clear;
// Express the following numbers in engineering notation: (a) 27,000 (b) 0.00047.

```

```
disp('To express the number 27,000 in engineering notation, it must be written as a number between 1 and 1000 times a power of 10 which is a multiple of 3.')
disp('Therefore 27000 = 27*10^3 in engineering')

disp('To express the number 0.00047 in engineering notation, it must be written as a number between 1 and 1000 times a power of 10 which is a multiple of 3.')
disp('Therefore 0.00047 = 470*10^-6 in engineering')
```

**Scilab code Exa 0.5** Example 5

```
// Grob's Basic Electronics 11e
// Chapter No. I
// Example No. I_5
clc; clear;
// Express the resistance of 1,000,000-Ohms using the appropriate metric prefix from Table I  2 .

disp('First, express 1,000,000-Ohms in engineering notation: 1,000,000-Ohms = 1.0*10^6-Ohms')
disp('Next, replace 10^6 with its corresponding metric prefix. i.e mega (M)')
disp('Therefore 1,000,000-Ohms = 1.0*10^6-Ohms = 1-MOhms')
```

**Scilab code Exa 0.6** Example 6

```
// Grob's Basic Electronics 11e
// Chapter No. I
```

```
// Example No. I_6
clc; clear;
// Express the voltage value of 0.015-V using the
   appropriate metric prefix from Table I  2 .

disp ('First , express 0.015-V in engineering
   notation: 0.015-V = 0.015-V')
disp ('Next , replace 10^-3 with its corresponding
   metric prefix. i.e milli (m)')
disp ('Therefore 0.015-V = 0.015-V = 15-mV')
```

**Scilab code Exa 0.7** Example 7

```
// Grob's Basic Electronics 11e
// Chapter No. I
// Example No. I_7
clc; clear;
// Express the power value of 250-W using the
   appropriate metric prefix from Table I  2 .

disp ('In this case, it is not necessary to use any
   of the metric prefixes listed in Table I  2 . The
    reason is that 250-W cannot be expressed as a
   number between 1 and 1000 times a power of 10
   which is a multiple of 3.')
disp ('250 W cannot be expressed in engineering
   notation. The closest we can come is 0.25*10^3-W,
    which is not representative of engineering
   notation. Although 10^3 can be replaced with the
   metric prefix kilo (k)')
disp ('It is usually preferable to express the power
    as 250-W and not as 0.25-kW.')
```

**Scilab code Exa 0.8** Example 8

```
// Grob's Basic Electronics 11e
// Chapter No. I
// Example No. I_8
clc; clear;
// Make the following conversions: (a) convert 25 mA to uA (b) convert 2700 kOhms to MOhms.

disp('To convert 25 mA to uA, recall that the metric prefix milli (m) corresponds to 10^3 and that metric prefix micro (u) corresponds to 10^6. Since 10^6 is less than 10^3 by a factor of 1000 (10^3), the numerical part of the expression must be increased by a factor of 1000 (10^3).')
disp('Therefore, 25 mA = 25*10^-3 A = 25,000*10^-6 A = 25,000 uA.')

disp('To convert 2700 kOhms to MOhms, recall that the metric prefix kilo (k) corresponds to 10^3 and that the metric prefix mega (M) corresponds to 10^6. Since 10^6 is larger than 10^3 by a factor of 1000 (10^3), the numerical part of the expression must be decreased by a factor of 1000 (10^3).')
disp('2700 kOhms = 2700*10^3 Ohms = 2.7*10^6 Ohms = 2.7 MOhms.')
```

**Scilab code Exa 0.9** Example 9

```
// Grob's Basic Electronics 11e
// Chapter No. I
// Example No. I_9
clc; clear;
// Add 170*10^3 and 23*10^4. Express the final
```

```
answer in scientific notation.

// Given data

A = 170*10^3;        // Variable 1
B = 23*10^4;         // Variable 2

C = A+B;
disp (C,'The addition of 170*10^3 and 23*10^4 is')
disp ('i.e 4.0*10^5')
```

**Scilab code Exa 0.10** Example 10

```
// Grob's Basic Electronics 11e
// Chapter No. I
// Example No. I_10
clc; clear;
// Substract 250*10^3 and 1.5*10^6. Express the
   final answer in scientific notation.

// Given data

A = 1.5*10^6;        // Variable 1
B = 250*10^3;        // Variable 2

C = A-B;
disp (C,'The substraction of 250*10^3 and 1.5*10^6
   is')
disp ('i.e 1.25*10^6')
```

**Scilab code Exa 0.11** Example 11

```
// Grob's Basic Electronics 11e
```

```
// Chapter No. I
// Example No. I_11
clc; clear;
// Multiply 3*10^6 by 150*10^2. Express the final
   answer in scientific notation.

// Given data

A = 3*10^6;          // Variable 1
B = 150*10^2;        // Variable 2

C = A*B;
disp (C,'The multiplication of 3*10^6 by 150*10^2 is
   ')
disp ('i.e 4.5*10^10')
```

**Scilab code Exa 0.12** Example 12

```
// Grob's Basic Electronics 11e
// Chapter No. I
// Example No. I_12
clc; clear;
// Divide 5.0*10^7 by 2.0*10^4. Express the final
   answer in scientific notation.

// Given data

A = 5.0*10^7;        // Variable 1
B = 2.0*10^4;        // Variable 2

C = A/B;
disp (C,'The division of 5.0*10^7 by 2.0*10^4 is')
disp ('i.e 2.5*10^3')
```

**Scilab code Exa 0.13** Example 13

```
// Grob's Basic Electronics 11e
// Chapter No. I
// Example No. I_13
clc; clear;
// Find the reciprocals for the following powers of
   10: (a) 10^5 (b) 10^-3.

// Given data

A = 10^5;         // Variable 1
B = 10^-3;        // Variable 2

C = 1/A;
disp (C,'The reciprocal of 10^5 is')
disp ('i.e 10^-5')

D = 1/B;
disp (D,'The reciprocal of 10-3 is')
disp ('i.e 10^3')
```

**Scilab code Exa 0.14** Example 14

```
// Grob's Basic Electronics 11e
// Chapter No. I
// Example No. I_14
clc; clear;
// Square 3.0*10^4. Express the answer in scientific
    notation.

// Given data
```

```
A = 3.0*10^4;         // Variable 1

B = A*A;
disp (B,'The square of 3.0*10^4 is')
disp ('i.e 9.0*10^8')
```

**Scilab code Exa 0.15** Example 15

```
// Grob's Basic Electronics 11e
// Chapter No. I
// Example No. I_15
clc; clear;
// Find the squareroot of 4*10^6. Express the answer
    in scientific notation.

// Given data

A = 4*10^6;         // Variable 1

B = sqrt(A);
disp (B,'The squareroot of 4*10^6 is')
disp ('i.e 2*10^3')
```

**Scilab code Exa 0.16** Example 16

```
// Grob's Basic Electronics 11e
// Chapter No. I
// Example No. I_16
clc; clear;
// Find the squareroot of 90*10^5. Express the
    answer in scientific notation.

```

```
// Given data

A = 90*10^5;        // Variable 1

B = sqrt(A);
disp (B,'The squareroot of 90*10^5 is')
disp ('i.e 3.0*10^3')
```

**Scilab code Exa 0.17** Example 17

```
// Grob's Basic Electronics 11e
// Chapter No. I
// Example No. I_17
clc; clear;
// Show the keystrokes for multiplying 40*10^-3 by
   5*10^6.

// Given data

A = 40*10^-3;        // Variable 1
B = 5*10^6;          // Variable 2

C = A*B;
disp (C,'The multiplication of 40*10^-3 by 5*10^6 is
   ')
disp ('i.e 200.000*10^03 OR 200E03')
```

# Chapter 2

# Chapter 01 Electricity

**Scilab code Exa 1.1** Example 18

```
// Grob's Basic Electronics 11e
// Chapter No. 01
// Example No. 1_1
clc; clear;
// A neutral dielectric has added to it 1.25*10^18
   electrons. What is its charge in coulombs?

// Given data

ec = 1.25*10^18;         // Electron charge
   =1.25*10^18 electrons

disp ("This number of electrons is double the charge
    of 1 C.")
disp ('Therefore, -Q = 2 Columbs')
```

**Scilab code Exa 1.2** Example 19

```
// Grob's Basic Electronics 11e
// Chapter No. 01
// Example No. 1_2
clc; clear;
// A dielectric has a positive charge of 12.5*10^18
   protons. What is its charge in coulombs?

// Given data

ec = 12.5*10^18;          // Electron charge
   =12.5*10^18 electrons

disp ("This number of electrons is double the charge
    of 1 C and posotive.")
disp ('Therefore, +Q = 2 Columbs')
```

**Scilab code Exa 1.3** Example 20

```
// Grob's Basic Electronics 11e
// Chapter No. 01
// Example No. 1_3
clc; clear;
// A dielectric with +Q of 2 C has 12.5*10^18
   electrons added. What is its charge then?

// Given data

ec = 12.5*10^18;          // Electron charge
   =12.5*10^18 electrons

disp ("The 2-C of negative charge added by the
   electron cancles the 2-C of positive charge,
   making the dielectric neutral.")
disp ('Therefore, Q = 0')
```

**Scilab code Exa 1.4** Example 21

```
// Grob's Basic Electronics 11e
// Chapter No. 01
// Example No. 1_4
clc; clear;
// A neutral dielectric has 12.5*10^18 electrons removed. What is its charge?

// Given data

ec = 12.5*10^18;        // Electron charge =12.5*10^18 electrons

disp ('The 2-C of electron charge removed allows an excess of 12.5*10^18 protons. Since the proton and electron have exactly the same amount of charge,')
disp ('now the dielectric has a positive charge of +Q = 2 Columbs.')
```

---

**Scilab code Exa 1.5** Example 22

```
// Grob's Basic Electronics 11e
// Chapter No. 01
// Example No. 1_5
clc; clear;
// What is the output voltage of a battery that expends 3.6 J of energy in moving 0.5C of charge?

// Given data

```

```
W = 3.6;            // Work=3.6 Jouls
Q = 0.5;            // Charge=0.5 Columb

V = W/Q;
disp (V,'The Output Voltage of a Battery in Volts')
```

**Scilab code Exa 1.6** Example 23

```
// Grob's Basic Electronics 11e
// Chapter No. 01
// Example No. 1_6
clc; clear;
//The charge of 12 C moves past a given point every
    second. How much is the intensity of charge flow?

// Given data

Q = 12;            // Charge=12 Columb
T = 1;              // Time=1 Sec i.e every second

I = Q/T;
disp (I,'The Intensity of Charge Flow in Amps')
```

**Scilab code Exa 1.7** Example 24

```
// Grob's Basic Electronics 11e
// Chapter No. 01
// Example No. 1_7
clc; clear;
// The charge of 5 C moves past a given point in 1 s
    . How much is the current?

// Given data
```

```
Q = 5;          // Charge=5 Columb
T = 1;            // Time=1 Sec

I = Q/T;
disp (I,'The Current in Amps')
```

**Scilab code Exa 1.8** Example 25

```
// Grob's Basic Electronics 11e
// Chapter No. 01
// Example No. 1_8
clc; clear;
// Calculate the resistance for the following
   conductance values: (a) 0.05 S (b) 0.1 S

// Given data

G1 = 0.05;        // G1=0.05 Siemins
G2 = 0.1;        // G1=0.1 Siemins

R1 = 1/G1;
disp (R1,'The Resistance for Conductance value 0.05
   S in Ohms')

R2 = 1/G2;
disp (R2,'The Resistance for Conductance value 0.1 S
    in Ohms')
```

**Scilab code Exa 1.9** Example 26

```
// Grob's Basic Electronics 11e
// Chapter No. 01
```

```
// Example No. 1_9
clc; clear;
//Calculate the conductance for the following
    resistance values: (a) 1 kOhms (b)5 kOhms

// Given data

R1 = 1*10^3;        // R1=1k Ohms
R2 = 5*10^3;         // R2=5k Ohms

G1 = 1/R1;
disp (G1,'The Conductance for Resistance value 1
   kOhms in Siemens')
disp ('OR 1 mS')

G2 = 1/R2;
disp (G2,'The Conductance for Resistance value 5
   kOhms in Siemens')
disp ('OR 200 uS')
```

# Chapter 3

# Chapter 02 Resistors

**Scilab code Exa 2.1** Example 27

```
// Grob's Basic Electronics 11e
// Chapter No. 02
// Example No. 2_1
clc; clear;
// What is the resistance indicated by the five-band
    color code in Fig. 2  10? Also, what ohmic
   range is permissible for the specified tolerance?

disp('The first stripe is orange for the number 3,
   the second stripe is blue for the number 6, and
   the third stripe is green for the number 5.
   Therefore, the first three digits of the
   resistance are 3, 6, and 5, respectively. The
   fourth stripe, which is the multiplier, is black,
    which means add no zeros. The fifth stripe,
   which indicates the resistor tolerance, is green
   for +-0.5%.')

disp('Therefore R = 365 Ohms +-0.5%. The
   permissible ohmic range is calculated as
   365*0.005 = +-1.825 Ohms, or 363.175 to 366.825
```

```
Ohms.')
```

**Scilab code Exa 2.2** Example 28

```
// Grob's Basic Electronics 11e
// Chapter No. 02
// Example No. 2_2
clc; clear;
// Determine the resistance of the chip resistor in
   Fig. 2 13.

disp('The first two digits are 5 and 6, giving 56 as
    the first two numbers in the resistance value.
   The third digit, 2, is the multiplier, which
   means add 2 zeros to 56 for,')

disp ('Resistance of 5600 Ohms or 5.6 kOhms.')
```

# Chapter 4

# Chapter 03 Ohms Law

**Scilab code Exa 3.1** Example 29

```
// Grob's Basic Electronics 11e
// Chapter No. 03
// Example No. 3_1
clc; clear;
// A heater with the resistance of 8 Ohms is
   connected across the 120-V power line. How much
   is current I?

// Given data

V = 120;          // Voltage of Power line=120 Volts
R = 8;            // Heater Resistance=8 Ohms

I = V/R;
disp (I,'The Current I in Amps')
```

**Scilab code Exa 3.2** Example 30

```
// Grob's Basic Electronics 11e
// Chapter No. 03
// Example No. 3_2
clc; clear;
// A small lightbulb with a resistance of 2400 Ohms
   is connected across the 120-V power line. How
   much is current I?

// Given data

V = 120;          // Voltage of Power line=120 Volts
R = 2400;         // Lightbulb Resistance=2400 Ohms

I = V/R;
disp (I,'The Current I in Amps')
```

**Scilab code Exa 3.3** Example 31

```
// Grob's Basic Electronics 11e
// Chapter No. 03
// Example No. 3_3
clc; clear;
// If a 12-Ohms resistor is carrying a current of
   2.5 A, how much is its voltage?

// Given data

I = 2.5;          // Current=2.5 Amps
R = 12;           // Resistance=12 Ohms

V = I*R;
disp (V,'The Voltage in Volts')
```

**Scilab code Exa 3.4** Example 32

```
// Grob's Basic Electronics 11e
// Chapter No. 03
// Example No. 3_4
clc; clear;
// How much is the resistance of a lightbulb if it
   draws 0.16 A from a 12-V battery?

// Given data

V = 12;            // Voltage of Battery=12 Volts
I = 0.16;          // Current drawn form Battery=0.16
   Amps

R = V/I
disp (R,'The Resistance in Ohms')
```

---

**Scilab code Exa 3.5** Example 33

```
// Grob's Basic Electronics 11e
// Chapter No. 03
// Example No. 3_5
clc; clear;
// The I of 8 mA flows through a 5-kOhms Resistor.
   How much is the IR voltage?

// Given data

I = 8*10^-3;          // Current flowing through
   Resistor=8m Amps
R = 5*10^3;           // Resistance=5k Ohms

V = I*R;
disp (V,'The Voltage in Volts')
```

**Scilab code Exa 3.6** Example 34

```
// Grob's Basic Electronics 11e
// Chapter No. 03
// Example No. 3_6
clc; clear;
// How much current is produced by 60 V across 12
    kOhms?

// Given data

V = 60;          // Voltage=60 Volts
R = 12*10^3;     // Resistance=12k Ohms

I = V/R;
disp (I,'The Current I in Amps')
disp ('i.e 5 mAmps')
```

**Scilab code Exa 3.7** Example 35

```
// Grob's Basic Electronics 11e
// Chapter No. 03
// Example No. 3_7
clc; clear;
// A toaster takes 10 A from the 120-V power line.
    How much power is used?

// Given data

V = 120;          // Voltage of Power line=120 Volts
I = 10;           // Current drawn from Powerline=10
    Amps
```

```

P = V*I;
disp (P,'The Power used in Watts')
disp ('OR 1.2 kW')
```

**Scilab code Exa 3.8** Example 36

```
// Grob's Basic Electronics 11e
// Chapter No. 03
// Example No. 3_8
clc; clear;
// How much current flows in the filament of a 300-W
    bulb connected to the 120-V power line?

// Given Data

V = 120;        // Voltage of Power line=120 Volts
P = 300;        // Power of Bulb=300 Watts

I = P/V;
disp (I,'The Current I in Amps')
```

**Scilab code Exa 3.9** Example 37

```
// Grob's Basic Electronics 11e
// Chapter No. 03
// Example No. 3_9
clc; clear;
// How much current flows in the filament of a 60-W
    bulb connected to the 120-V power line?

// Given Data

```

```
V = 120;          // Voltage of Power line=120 Volts
P = 60;           // Power of Bulb=60 Watts

I = P/V;
disp (I,'The Current I in Amps')
disp ('OR 500 mA')
```

**Scilab code Exa 3.10** Example 38

```
// Grob's Basic Electronics 11e
// Chapter No. 03
// Example No. 3_10
clear; clc;
// Asuming that the cost of electricity is 6 cent
   per kWh, how much will it cost to light a 100-W
   lightbulb for 30 days?

h = 24*30;     // Total hours = 24 hrs * 30 days

kWh = 0.1*h;     // 100W=0.1kW

Cost = kWh*0.06;     // 6 cent = $0.06

disp (Cost,'Cost in $')
```

**Scilab code Exa 3.11** Example 39

```
// Grob's Basic Electronics 11e
// Chapter No. 03
// Example No. 3_11
clc; clear;
// Calculate the power in a circuit where the source
    of 100 V produces 2 A in a 50 Ohms Resistor.
```

```
// Given data

I = 2;            // Current=2 Amps
R = 50;           // Resistance=50 Ohms
V = 100;          // Voltage Source=100 Volts

P = I*I*R;
disp (P,'The Power in Watts')
```

**Scilab code Exa 3.12** Example 40

```
// Grob's Basic Electronics 11e
// Chapter No. 03
// Example No. 3_12
clc; clear;
// Calculate the power in a circuit where the source
   of 100 V produces 4 A in a 25 Ohms Resistor.

// Given data

I = 4;            // Current=4 Amps
R = 25;           // Resistance=25 Ohms
V = 100;          // Voltage Source=100 Volts

P = I*I*R;
disp (P,'The Power in Watts')
```

**Scilab code Exa 3.13** Example 41

```
// Grob's Basic Electronics 11e
// Chapter No. 03
// Example No. 3_13
```

```
clc; clear;
// How much current is needed for a 600-W, 120-V
   toaster?

// Given data

V = 120;          // Applied Voltage=120 Volts
P = 600;          // Power of toaster=600 Watts

I = P/V;
disp (I,'The Current I in Amps')
```

**Scilab code Exa 3.14** Example 42

```
// Grob's Basic Electronics 11e
// Chapter No. 03
// Example No. 3_14
clc; clear;
// How much is the resistance of a 600-W, 120-V
   toaster?

// Given data

V = 120;          // Applied Voltage=120 Volts
P = 600;          // Power of toaster=600 Watts

R = (V*V)/P;
disp (R,'The Resistance in Ohms')
```

**Scilab code Exa 3.15** Example 43

```
// Grob's Basic Electronics 11e
// Chapter No. 03
```

```
// Example No. 3_15
clc; clear;
// How much current is needed for a 24 Ohms Resistor
    that dissipates 600 W?

// Given data

R = 24;          // Resistance=24 Ohms
P = 600;         // Power=600 Watts

I = sqrt(P/R);
disp (I,'The Current I in Amps')
```

**Scilab code Exa 3.16** Example 44

```
// Grob's Basic Electronics 11e
// Chapter No. 03
// Example No. 3_16
clc; clear;
// Determine the required resistance and appropriate
    wattage rating of a resistor to meet the
   following requirements: The resistor must have a
   30-V IR drop when its current is 20 mA. The
   resistors available have the following wattage
   ratings: 1  8 , 1  4 , 1  2 , 1, and 2 W.

// Given data

I = 20*10^-3;    // Current=20m Amps
V = 30;          // Voltage Drop=30 Volts

R = V/I;
disp (R,'The Resistor value in Ohms')
disp ('i.e 1.5 kOhms')

```

```
P = I*I*R;
disp (P,'The Power in Watts')
disp ('OR 600 mW')
```

**Scilab code Exa 3.17** Example 45

```
// Grob's Basic Electronics 11e
// Chapter No. 03
// Example No. 3_17
clc; clear;
//Determine the required resistance and appropriate
    wattage rating of a carbonfilm resistor to meet
    the following requirements: The resistor must
    have a 225-V IR drop when its current is 150 uA.
    The resistors available have the following
    wattage ratings: 1  8 , 1  4 , 1  2 , 1, and 2 W.

// Given data

I = 150*10^-6;    // Current=150 uAmps
V = 225;          // Voltage Drop=225 Volts

R = V/I;
disp (R,'The Resistor value in Ohms')
disp ('i.e 1.5 MOhms')

P = I*I*R;
disp (P,'The Power in Watts')
disp ('i.e 33.75 mW')
```

# Chapter 5

# Chapter 04 Series Circuits

**Scilab code Exa 4.1** Example 46

```
// Grob's Basic Electronics 11e
// Chapter No. 04
// Example No. 4_1
clc; clear;
// Two resistances R1 and R2 of 5 Ohms each and R3
   of 10 Ohms are in series. How much is Rt?

// Given data

R1 = 5;      // Resistor 1=5 Ohms
R2 = 5;      // Resistor 2=5 Ohms
R3 = 10;     // Resistor 3=10 Ohms

Rt = R1+R2+R3;
disp (Rt,'The Combined Series Resistance in Ohms')
```

**Scilab code Exa 4.2** Example 47

```
// Grob's Basic Electronics 11e
// Chapter No. 04
// Example No. 4_2
clc; clear;
//With 80 V applied across the series string, how much is the current in R3?

// Given data

Rt = 20;       // Total Resistance=20 Ohms
Vt = 80;       // Applied Voltage=80 Volts

I = Vt/Rt;
disp (I,'The Current in Resistor R3 connected in Series in Amps')
```

**Scilab code Exa 4.3** Example 48

```
// Grob's Basic Electronics 11e
// Chapter No. 04
// Example No. 4_3
clc; clear;
// Solve for Rt, I and the individual resistor voltage drops at R1, R2, R3.

// Given data

R1 = 10;       // Resistor 1=10 Ohms
R2 = 20;       // Resistor 2=20 Ohms
R3 = 30;       // Resistor 3=30 Ohms
Vt = 12;       // Applied Voltage=12 Volts

Rt = R1+R2+R3;
disp (Rt,'The combined series resistance in Ohms')

```

```
I = Vt/Rt;
disp (I,'The current in Amps')
disp ('i.e 200 mA')

V1 = I*R1
disp (V1,'The Voltage Drop of Resistor R1 in Volts')

V2 = I*R2
disp (V2,'The Voltage Drop of Resistor R2 in Volts')

V3 = I*R3
disp (V3,'The Voltage Drop of Resistor R3 in Volts')
```

**Scilab code Exa 4.4** Example 49

```
// Grob's Basic Electronics 11e
// Chapter No. 04
// Example No. 4_4
clc; clear;
// A voltage source produces an IR drop of 40 V across a 20 Ohms R1, 60 V across a 30 Ohms R2, and 180 V across a 90 Ohms R3, all in series. According to Kirchhoff s voltage law, how much is the applied voltage Vt ?

// Given data

V1 = 40;      // Voltage drop at R1=40 Volts
V2 = 60;      // Voltage drop at R2=60 Volts
V3 = 180;     // Voltage drop at R3=180 Volts

Vt = V1+V2+V3;
disp (Vt,'The Applied Voltage Vt in Volts')
```

**Scilab code Exa 4.5** Example 50

```
// Grob's Basic Electronics 11e
// Chapter No. 04
// Example No. 4_5
clc; clear;
// An applied Vt of 120 V produces IR drops across
   two series resistors R 1 and R 2 If the voltage
   drop across R1 is 40 V, how much is the voltage
   drop across R2?

// Given data

V1 = 40;      // Voltage drop at R1=40 Volts
Vt = 120;     // Applied Voltage=120 Volts

V2 = Vt-V1;
disp (V2,'The Voltage Drop across Resistor R2 in
   Volts')
```

**Scilab code Exa 4.6** Example 51

```
// Grob's Basic Electronics 11e
// Chapter No. 04
// Example No. 4_6
clc; clear;
// Assume that the series circuit in Fig. 4 20 has
    failed. A technician troubleshooting the circuit
    used a voltmeter to record the following
   resistor voltage drops. V1=0 V; V2=0 V; V3=24 V;
   V4=0 V. Based on these voltmeter readings, which
   component is defective and what type of defect is
```

```
   it? (Assume that only one component is defective
   .)

// Given data

R1 = 150;       // Resistor 1=150 Ohms
R2 = 120;       // Resistor 2=120 Ohms
R3 = 180;       // Resistor 3=180 Ohms
R4 = 150;       // Resistor 4=150 Ohms
Vt = 24;        // Applied Voltage=24 Volts

Rt = R1+R2+R3+R4;

I = Vt/Rt;

V1 = I*R1
disp (V1,'The Voltage Drop of Resistor R1 in Volts')

V2 = I*R2
disp (V2,'The Voltage Drop of Resistor R2 in Volts')

V3 = I*R3
disp (V3,'The Voltage Drop of Resistor R3 in Volts')

V4 = I*R4
disp (V4,'The Voltage Drop of Resistor R4 in Volts')

disp ('The Resistor R3 is defective since it is open
    circuit and drops all the voltage arround it')
```

**Scilab code Exa 4.7** Example 52

```
// Grob's Basic Electronics 11e
// Chapter No. 04
// Example No. 4_7
```

```
clc; clear;
// Assume that the series circuit has failed. A
   technician troubleshooting the circuit used a
   voltmeter to record the following resistor
   voltage drops: V1  8 V;V2  6.4 V;V3  9.6 V;V4  0
   V. Based on the voltmeter readings, which
   component is defective and what type of defect is
   it? (Assume that only one component is defective
   .)

// Given data

R1 = 150;      // Resistor 1=150 Ohms
R2 = 120;      // Resistor 2=120 Ohms
R3 = 180;      // Resistor 3=180 Ohms
R4 = 150;      // Resistor 4=150 Ohms
Vt = 24;       // Applied Voltage=24 Volts

disp ('Calculated from the Circuit')

Rt = R1+R2+R3+R4;

I = Vt/Rt;

V1 = I*R1
disp (V1,'The Voltage Drop of Resistor R1 in Volts')

V2 = I*R2
disp (V2,'The Voltage Drop of Resistor R2 in Volts')

V3 = I*R3
disp (V3,'The Voltage Drop of Resistor R3 in Volts')

V4 = I*R4
disp (V4,'The Voltage Drop of Resistor R4 in Volts')

disp ('The normal values for V1 , V2 , V3 , and V4
   are 6 V, 4.8 V, 7.2 V, and 6 V, respectively.
```

Comparing the calculated values with those measured reveals that V1 , V2 , and V3 have increased from their normal values. This indicates that the current has increased , which is why we have a larger voltage drop across these resistors. The measured value of 0 V for V4 shows a signifi cant drop from its normal value of 6 V. The only way this resistor can have 0 V, when all other resistors show an increase in voltage , is if R4 is shorted. Then V4=I*R4=I*0( Ohms)=0 V. ')

---

# Chapter 6

# Chapter 05 Parallel Circuits

**Scilab code Exa 5.1** Example 53

```
// Grob's Basic Electronics 11e
// Chapter No. 05
// Example No. 5_1
clc; clear;
// Solve for branch currents I1 and I2.

R1 = 1*10^3;     // Resistor 1=1*10^3 Ohms
R2 = 600;        // Resistor 2=600 Ohms
Va = 15;         // Applied Voltage=15 Volts

I1 = Va/R1;
disp (I1,'The Current Resistor R1 in Amps')
disp ('i.e 15 mAmps')

I2 = Va/R2;
disp (I2,'The Current Resistor R2 in Amps')
disp ('i.e 25 mAmps')
```

**Scilab code Exa 5.2** Example 54

```
// Grob's Basic Electronics 11e
// Chapter No. 05
// Example No. 5_2
clc; clear;
// An R1 of 20 Ohms, an R2 of 40 Ohms, and an R3 of
   60 Ohms are connected in parallel across the 120−
   V power line. Using Kirchhoff s current law,
   determine the total current It.

// Given data

R1 = 20;       // Resistor 1=20 Ohms
R2 = 40;       // Resistor 2=40 Ohms
R3 = 60;       // Resistor 3=60 Ohms
Va = 120;      // Applied Voltage=120 Volts

I1 = Va/R1;
I2 = Va/R2;
I3 = Va/R3;

It = I1+I2+I3
disp (It,'The Total Current in the Mainline in Amps'
   )
```

**Scilab code Exa 5.3** Example 55

```
// Grob's Basic Electronics 11e
// Chapter No. 05
// Example No. 5_3
clc; clear;
// Two branches R1 and R2 across the 120−V power
   line draw a total line current It of 15 A. The R1
    branch takes 10 A. How much is the current I2 in
    the R2 branch?

```

```
// Given data

I1 = 10;         // Current in R1 branch=10 Amps
It = 15;         // Total Current=15 Amps

I2 = It-I1;
disp (I2,'The Current in R2 branch in Amps')
```

**Scilab code Exa 5.4** Example 56

```
// Grob's Basic Electronics 11e
// Chapter No. 05
// Example No. 5_4
clc; clear;
// Three parallel branch currents are 0.1 A, 500 mA, and 800 A. Using Kirchhoff s current law, calculate It.


// Given data

I1 = 0.1;                // Branch Current 1=0.1 Amps
I2 = 0.5;                // Branch Current 2=500m Amps
I3 = 800*10^-6;          // Branch Current 3=800u Amps

It = I1+I2+I3;
disp (It,'The Total Current in Amps')
disp ('i.e 600.8 mAmps')
```

**Scilab code Exa 5.5** Example 57

```
// Grob's Basic Electronics 11e
// Chapter No. 05
```

```
// Example No. 5_5
clc; clear;
// Two branches, each with a 5-A current, are
   connected across a 90-V source. How much is the
   equivalent resistance Req?

// Given data

I1 = 5;        // Branch Current 1=5 Amps
I2 = 5;        // Branch Current 2=5 Amps
Va = 90;       // Applied Voltage=90 Volts

It = I1+I2;
Req = Va/It;
disp (Req,'The Equivalent Resistance Req in Ohms')
```

**Scilab code Exa 5.6** Example 58

```
// Grob's Basic Electronics 11e
// Chapter No. 05
// Example No. 5_6
clc; clear;
// What Rx in parallel with 40 Ohms will provide an
   Req of 24 Ohms?

// Given data

R = 40;           // Resistance=40 Ohms
Req = 24;         // Equivqlent Resistance=24 Ohms

Rx = (R*Req)/(R-Req);
disp (Rx,'The Value of Rx in Ohms')
```

**Scilab code Exa 5.7** Example 59

```
// Grob's Basic Electronics 11e
// Chapter No. 05
// Example No. 5_7
clc; clear;
// What R in parallel with 50 kOhms will provide an Req of 25 kOhms

// Given data

R1 = 50*10^3;          // R1=50k Ohms
Req = 25*10^3;         // Req=25k Ohms

R = (R1*Req)/(R1-Req);
disp (R,'The value of R in Ohms')
disp ('i.e 50 kOhms')
```

---

**Scilab code Exa 5.8** Example 60

```
// Grob's Basic Electronics 11e
// Chapter No. 05
// Example No. 5_8
clc; clear;
// In Fig. 5 18a, suppose that the ammeter M1 reads 16-A instead of 20-A as it should. What could be wrong with the circuit?

disp ('Notice that the current I3 is supposed to be 4-A. If R3 is open, this explains why M1 reads a current that is 4-A less than its normal value. To confi rm that R3 is open; open S1 and disconnect the top lead of R3 from point E. Next place an ammeter between the top of R3 and point E. Now, close S1. If I3 measures 0-A, you know
```

that R3 is open. If I3 measures 4–A, you know that one of the other branches is drawing less current than it should. In this case, the next step would be to measure each of the remaining branch currents to find the defective component.'
)

---

# Chapter 7

# Chapter 06 Series Parallel Circuits

**Scilab code Exa 6.1** Example 61

```
// Grob's Basic Electronics 11e
// Chapter No. 06
// Example No. 6_1
clc; clear;
// The Current in M1 reads 0 A with the standard
   resistor RS adjusted to 5642 Ohms. What is the
   value of the unknown resistor Rx?

// Given data

Rs = 5642;          // Standard Resistor=5642 Ohms
R1 = 1*10^3;        // Resistor 1=1k Ohms
R2 = 10*10^3;       // Resistor 2=10k Ohms

Rx = Rs*(R1/R2);
disp (Rx,'The Unknown Resistance Rx in Ohms')
```

**Scilab code Exa 6.2** Example 62

```
// Grob's Basic Electronics 11e
// Chapter No. 06
// Example No. 6_2
clc; clear;
// what is the maximum unknown resistance Rx that
   can be measured for the ratio arm values shown?

// Given data

Rsmax = 9999;        // Standard Resistor(max)=9999
   Ohms
R1 = 1*10^3;         // Resistor 1=1k Ohms
R2 = 10*10^3;         // Resistor 2=10k Ohms

Rxmax = Rsmax*(R1/R2);
disp (Rxmax,'The Unknown Resistance Rx(max) in Ohms'
   )
```

---

**Scilab code Exa 6.3** Example 63

```
// Grob's Basic Electronics 11e
// Chapter No. 06
// Example No. 6_3
clc; clear;
// Assume that the series-parallel circuit in Fig. 6
    15a has failed. A technician troubleshooting
   the circuit has measured the following voltages:
   V1 = 10.8 V; VAB = 9 V; V4 = 16.2 V. These
   voltage readings are shown in Fig. 6 15b. Based
    on the voltmeter readings shown, which component
    is defective and what type of defect does it
   have?

```

```
// Given data

V1 = 10.8;        // Voltage at R1=10.8 Volts
Vab = 9;          // Voltage at point (AB)=9 Volts
V4 = 16.2;        // Voltage at R4=16.2 Volts
R1 = 120;         // Resistor 1=120 Ohms

disp('If we consider the resistance between points
    A and B as a single resistance, the circuit can
    be analyzed as if it were a simple series circuit
    . Notice that V1 and V4 have decreased from their
     normal values of 12-V and 18-V, respectively,
    whereas the voltage VAB across R2 and R3 has
    increased from 6-V to 9-V.')
disp('Since the voltages V1 and V4 have decreased
    and the voltage VAB has increased, the defective
    component must be either R2 or R3 across points A
     and B.')

It = V1/R1;
Rab = Vab/It;
disp(Rab,'The Resistance R(AB) in Ohms')

disp('Notice that the value of RAB is the same as
    that of R2. This means, of course, that R3 must
    be open.')
disp('Another approach to finding which resistor is
     open would be to open the switch S1 and measure
    the resistance across points A and B. This
    measurement would show that the resistance RAB
    equals 100 Ohms, again indicating that the
    resistor R3 must be open.')
```

**Scilab code Exa 6.4** Example 64

```
// Grob's Basic Electronics 11e
// Chapter No. 06
// Example No. 6_4
clc; clear;
// Assume that the series-parallel circuit in Fig. 6 15a has failed. A technician troubleshooting the circuit has measured the following voltages: V1 = 14.4 V; VAB = 0 V; V4 = 21.6 V. These voltage readings are shown in Fig. 6 15c. Based on the voltmeter readings shown, which component is defective and what type of defect does it have?

// Given data

V1 = 14.4;        // Voltage at R1=14.4 Volts
Vab = 0;          // Voltage at point (AB)=0 Volts
V4 = 21.6;        // Voltage at R4=21.6 Volts
R1 = 120;         // Resistor 1=120 Ohms

disp ('Since the voltages V1 and V4 have both increased, and the voltage VAB has decreased, the defective component must be either R2 or R3 across points A and B. Because the voltage VAB is 0 V, either R2 or R3 must be shorted.')
disp ('But how can we find out which resistor is shorted? One way would be to measure the currents I2 and I3. The shorted component is the one with all the current.')
disp ('Another way to find out which resistor is shorted would be to open the switch S1 and measure the resistance across points A and B. Disconnect one lead of either R2 or R3 from point A while observing the ohmmeter. If removing the top lead of R3 from point A still shows a reading of 0 Ohms, then you know that R2 must be shorted. Similarly, if removing the top lead of R2 from point A (with R3 still connected at point A)
```

still produces a reading of 0 Ohms, then you know that R3 is shorted.')

---

# Chapter 8

# Chapter 07 Voltage and Current Dividers

**Scilab code Exa 7.1** Example 65

```
// Grob's Basic Electronics 11e
// Chapter No. 07
// Example No. 7_1
clc; clear;
// Three 50 Ohms resistors R1, R2 and R3 are in
   series across an applied voltage of 180 V. How
   much is the IR voltage drop across each resistor?

// Given data

R1 = 50*10^3;        // Resistor 1=50k Ohms
R2 = 50*10^3;        // Resistor 2=50k Ohms
R3 = 50*10^3;        // Resistor 3=50k Ohms
Vt = 180;            // Applied Voltage=180 Volts

R = R1               // R = R1 = R2 = R3
Rt = R1+R2+R3;
V = Vt*(R/Rt);
disp (V,'The Voltage Drop across each Resistor in
```

```
Volts')
```

# Chapter 9

# Chapter 08 Analog and Digital Multimeters

**Scilab code Exa 8.1** Example 66

```
// Grob's Basic Electronics 11e
// Chapter No. 08
// Example No. 8_1
clc; clear;
// A shunt extends the range of a 50−uA meter
   movement to 1 mA. How much is the current through
    the shunt at full−scale deflection?

// Given data

It = 1*10^-3;          // Total Current=1 mAmps
Im = 50*10^-6;         // Current (cause of meter
   movement)=50 uAmps

Is = It-Im;
disp (Is,'The Current through Shunt at Full Scale
   Deflection in Amps')
disp ('i.e 950 uAmps')
```

**Scilab code Exa 8.2** Example 67

```
// Grob's Basic Electronics 11e
// Chapter No. 08
// Example No. 8_2
clc; clear;
// A 50 uA meter movement has an Rm of 1000 Ohms.
   What Rs is needed to extend the range to 500 uA?

// Given data

It = 500*10^-6;      // Total Current=500u Amps
Im = 50*10^-6;       // Current (cause of meter
   movement)=50 uAmps
rm = 1000;           // Resistance of moving coil
   =1000 Ohms

Is = It-Im;
Vm = Im*rm;

Rs = Vm/Is;
disp (Rs,'The Shunt Resistance Rs needed to extend
   the range to 500 uA in Ohms')
```

# Chapter 10

# Chapter 09 Kirchhoffs Laws

**Scilab code Exa 9.1** Example 68

```
// Grob's Basic Electronics 11e
// Chapter No. 09
// Example No. 9_1
clc; clear;
// Apply Kirchhoff s current law to solve for the
   unknown current, I3.

// Given data

I1 = 2.5;      // Branch 1 Current=2.5 Amps
I2 = 8;        // Branch 2 Current=8 Amps
I4 = 6;        // Branch 3 Current=6 Amps
I5 = 9;        // Branch 4 Current=9 Amps

// I1+I2+I3-I4-I5 = 0 Sum of all currents at node is
    ZERO
// I1+I2+I3 = I4+I5 Total Incomming Current = Total
   Outgoing Current

I3 = I4+I5-I1-I2;
disp (I3,'The Branch 3 Current I3 in Amps')
```

**Scilab code Exa 9.2** Example 69

```
// Grob's Basic Electronics 11e
// Chapter No. 09
// Example No. 9_2
clc; clear;
// Apply Kirchhoff s voltage law to solve for the
   voltages V(AG) & V(BG).

// Given data

V1 = 18;         // Source Voltage 1=18 Volts
V2 = 18;         // Source Voltage 2=18 Volts
R1 = 120;        // Resistor 10=120 Ohms
R2 = 100;        // Resistor 2=100 Ohms
R3 = 180;        // Resistor 3=180 Ohms

Vt = V1+V2;
Rt = R1+R2+R3;

I = Vt/Rt;

VR1 = I*R1;
VR2 = I*R2;
VR3 = I*R3;

// V1+V2-VR1-VR2-VR3=0 Sum of all Voltages in loop
   is ZERO
// V1+V2 = VR1+VR2+VR3 Total Applied Voltage = Total
    Dropped Voltage in Resistors

Vt = VR1+VR2+VR3;

VAG = VR2+VR3-V2;
```

```
disp (VAG,'The Voltage V(AG) in Volts')

VBG = V1-VR1-VR2;
disp (VBG,'The Voltage V(BG) in Volts')
```

# Chapter 12

# Chapter 11 Conductors and Insulators

**Scilab code Exa 11.1** Example 70

```
// Grob's Basic Electronics 11e
// Chapter No. 11
// Example No. 11_1
clc; clear;
// What is the area in circular mils of a wire with
   a diameter of 0.005 in.?

// Given data

Din = 0.005;          // Diameter in Inches=0.005 in.
Dmil = 5;             // Diameter in Mils=5 mil.

// 0.005 in. = 5 mil
// Therefore: Din == Dmil

A = Dmil*Dmil;
disp (A,'The Circular Area in cmils')
```

**Scilab code Exa 11.2** Example 71

```
// Grob's Basic Electronics 11e
// Chapter No. 11
// Example No. 11_2
clc; clear;
// A stranded wire is made up of 16 individual strands of No. 27 gage wire. What is its equivalent gage size in solid wire?

// Given data

N = 16;          // No. of strands=16
A27 = 201.5      // Circular area of No. 27 Guage wire=201.5 cmils

A = N*A27;
disp (A,'The Total Area in cmils')

disp ('The Circular Area of 3224 cmils corresponds very closely to the cmil area of No. 15 gage wire. Therefore, 16 strands of No. 27 gage wire is roughly equivalent to No. 15 gage solid wire.')
```

**Scilab code Exa 11.3** Example 72

```
// Grob's Basic Electronics 11e
// Chapter No. 11
// Example No. 11_3
clc; clear;
// How much is the resistance of 100 ft of No. 20 gage copper wire?
```

```

// Given data

roh = 10.4;           // roh or specific resistance
    =10.4 (for Copper)
l = 100;              // Lenght=100 feet
A = 1022;             // Area of No. 20 Gage=1022 cmil

R = roh*(l/A);
disp (R,'The Resistance of 100 ft of No. 20 gage
    Copper Wire in Ohms')
disp ('i.e 1.02 Ohms')
```

**Scilab code Exa 11.4** Example 73

```
// Grob's Basic Electronics 11e
// Chapter No. 11
// Example No. 11_4
clc; clear;
// How much is the resistance of 100 ft of No. 23
    gage copper wire?

// Given data

roh = 10.4;           // roh or specific resistance
    =10.4 (for Copper)
l = 100;              // Lenght=100 feet
A = 509.5;             // Area of No. 23 Gage=509.5
    cmil

R = roh*(l/A);
disp (R,'The Resistance of 100 ft of No. 20 gage
    Copper Wire in Ohms')
```

**Scilab code Exa 11.5** Example 74

```
// Grob's Basic Electronics 11e
// Chapter No. 11
// Example No. 11_5
clc; clear;
// How much is the resistance of a slab of germanium 0.2 cm long with a crosssectional area of 1 sqcm ?

// Given data

roh = 55;          // roh or specific resistance=55 (for Germanium)
l = 0.2*10^-2;     // Lenght=100 feet
A = 1*10^-2;       // Area=1 sqcm

R = roh*(l/A);
disp (R,'The Resistance of a Slab of Germanium in Ohms')
```

**Scilab code Exa 11.6** Example 75

```
// Grob's Basic Electronics 11e
// Chapter No. 11
// Example No. 11_6
clc; clear;
// A tungsten wire has a 14-Ohms R at 20 C. Calculate its resistance at 120 C.

// Given data

```

```
Tmax = 120;           // Temp(max)=120 degree Centigrates
Tmin = 20;            // Temp(min)=20 degree Centigrates
Ro = 14;              // Wire Resistance=14 Ohms
alpha = 0.005;        // Aplha=0.005 (for Tungsten)

delta = Tmax-Tmin;

Rt = Ro+Ro*(alpha*delta);
disp (Rt,'The Resistance at 120 C in Ohms')
```

# Chapter 13

# Chapter 12 Battries

**Scilab code Exa 12.1** Example 76

```
// Grob's Basic Electronics 11e
// Chapter No. 12
// Example No. 12_1
clc; clear;
// Calculate ri if the output of a generator drops
   from 100 V with zero load current to 80 V when Il
    is 2 A.

// Given data

Vo0 = 100;      // Vo at zero load current=100 Volts
Vo1 = 80;       // Vo at 2 A load current=80 Volts
Il = 2;         // Load current=2 Amps

Ri = (Vo0-Vo1)/Il;
disp (Ri,'The Resistance ri in Ohms')
```

# Chapter 14

# Chapter 13 Magnetism

**Scilab code Exa 13.1** Example 77

```
// Grob's Basic Electronics 11e
// Chapter No. 13
// Example No. 13_1
clc; clear;
// Make the following conversions: (a) 25,000 Mx to
   Wb; (b) 0.005 Wb to Mx.

// Given data

A = 25000;          // A=25000 Maxwell
B = 0.005;          // B=0.005 Wabers
C = 1*10^8;         // Conversion Factor

Wb = A*(1/C);
disp (Wb,'The 25000 Maxwell in Wabers is')
disp ('i.e 250*10^-6 Wb or 250 uWb')

Mx = B*C;
disp (Mx,'The 0.005 Wabers in Maxwell is')
disp ('i.e 5.0*10^5 Mx')
```

**Scilab code Exa 13.2** Example 78

```
// Grob's Basic Electronics 11e
// Chapter No. 13
// Example No. 13_2
clc; clear;
// With a flux of 10,000 Mx through a perpendicular
   area of 5 sqcm, what is the flux density in gauss
   ?

// Given data

A = 5;       // Area=5 sqcm
flux = 10000; // Total Flux=10000 Mx

B = flux/A;
disp (B,'The Flux Density in Guass (G)')
```

---

**Scilab code Exa 13.3** Example 79

```
// Grob's Basic Electronics 11e
// Chapter No. 13
// Example No. 13_3
clc; clear;
// With a flux of 400 uWb through an area of 0.0005
   sqm, what is the flux density B in tesla units?

// Given data

A = 0.0005;          // Area=0.0005 sqm
flux = 400*10^-6;    // Total Flux=400 uWb

```

```
B = flux/A;
disp (B,'The Flux Density in Tesla (T)')
```

**Scilab code Exa 13.4** Example 80

```
// Grob's Basic Electronics 11e
// Chapter No. 13
// Example No. 13_4
clc; clear;
// Make the following conversions: (a) 0.003 T to G;
    (b) 15,000 G to T.

// Given data

A = 0.003;           // A=0.003 Tesla
B = 15000;           // B=15000 Guass
C = 1*10^4;          // Conversion Factor

G = A*C;
disp (G,'The 0.003 Tesla in Guass is')

T = B*(1/C);
disp (T,'The 15,000 Guass in Tesla is')
```

# Chapter 15

# Chapter 14 Electromagnetism

**Scilab code Exa 14.1** Example 81

```
// Grob's Basic Electronics 11e
// Chapter No. 14
// Example No. 14_1
clc; clear;
// Calculate the ampere-turns of mmf for a coil with
    2000 turns and a 5-mA current.

// Given data

I = 5*10^-3;          // Current=5 mAmps
N = 2000;             // No. of Turns=2000

mmf = I*N;
disp (mmf,'The Amps-Turn (A.t) of Magneto-Motive
   Force (mmf) in A.t')
```

---

**Scilab code Exa 14.2** Example 82

```
// Grob's Basic Electronics 11e
// Chapter No. 14
// Example No. 14_2
clc; clear;
// A coil with 4 A is to provide a magnetizing force
    of 600 A t. How many turns are necessary?

// Given data

I = 4;          // Current=4 Amps
mmf = 600;      // Magnetizing Force=600 A.t

N = mmf/I;
disp (N,'The Turns necessary are')
```

**Scilab code Exa 14.3** Example 83

```
// Grob's Basic Electronics 11e
// Chapter No. 14
// Example No. 14_3
clc; clear;
// A coil with 400 turns must provide 800 A t of
   magnetizing force. How much current is necessary?

// Given data

mmf = 800;      // Magnetizing Force=800 A.t
N = 400;        // No. of Turns=400

I = mmf/N;
disp (I,'The Current necessary in Amps')
```

**Scilab code Exa 14.4** Example 84

```
// Grob's Basic Electronics 11e
// Chapter No. 14
// Example No. 14_4
clc; clear;
// The wire in a solenoid of 250 turns has a
   resistance of 3 Ohms. (a)How much is the current
   when the coil is connected to a 6-V battery? (b)
   Calculate the ampereturns of mmf.

// Given data

V = 6;              // Voltage=6 Volts
R = 3;              // Resistance=3 Ohms
N = 250;            // No. of Turns=250

I = V/R;
disp (I,'The Current necessary when a wire is
   connected to 6-V Battery in Amps')

mmf = I*N;
disp (mmf,'The Amps-Turn (A.t) of Magneto-Motive
   Force (mmf) in A.t')
```

**Scilab code Exa 14.5** Example 85

```
// Grob's Basic Electronics 11e
// Chapter No. 14
// Example No. 14_5
clc; clear;
// A magnetic material has a ur of 500. Calculate
   the absolute u as B/H (a) in CGS units and (b) in
    SI units.

// Given data

```

```
ur = 500;           // ur=500
uoa = 1;            // uo for CGS Units=1
uob = 1.26*10^-6;  // uo for SI Units=1.26 u

ua = ur*uoa;
disp (ua,'The Absolute u as B/H in CGS in (G/Oe)')

ub = ur*uob;
disp (ub,'The Absolute u as B/H in SI in (T/(A.t/m))
   ')
disp ('i.e 630*10^-6 T/(A.t/m)')
```

**Scilab code Exa 14.6** Example 86

```
// Grob's Basic Electronics 11e
// Chapter No. 14
// Example No. 14_6
clc; clear;
// u = 630*10^-6 in SI units, calculate the flux
   density B that will be produced by the field
   intensity H equal to 1000 A.t/m.

// Given data

u = 630*10^-6;        // u=630 micro T/(A.t/m)
H = 1000;             // H=1000 A.t/m

B = u*H;
disp (B,'The Flux density in Tesla')
```

# Chapter 16

# Chapter 15 Alternating Voltage and Current

**Scilab code Exa 15.1** Example 87

```
// Grob's Basic Electronics 11e
// Chapter No. 15
// Example No. 15_1
clc; clear;
// A sine wave of voltage varies from zero to a
   maximum of 100 V. How much is the voltage at the
   instant of 30   of the cycle? 45  ? 90  ? 270  ?

// Given data

Vm = 100;        // Vm=100 Volts
t1 = 30;         // Theta 1=30  .
t2 = 45;         // Theta 2=45  .
t3 = 90;         // Theta 3=90  .
t4 = 270;        // Theta 4=270  .

v1 = Vm*sind(t1);
disp (v1,'The Voltage at 30   in Volts')

```

```
v2 = Vm*sind(t2);
disp (v2,'The Voltage at 45   in Volts')

v3 = Vm*sind(t3);
disp (v3,'The Voltage at 90   in Volts')

v4 = Vm*sind(t4);
disp (v4,'The Voltage at 270   in Volts')
```

**Scilab code Exa 15.2** Example 88

```
// Grob's Basic Electronics 11e
// Chapter No. 15
// Example No. 15_2
clc; clear;
// An alternating current varies through one
   complete cycle in 1     1000 s. Calculate the
   period and frequency.

// Given data

tc = 1/1000;         // One Complete Cycle=1     1000
    sec.

T = tc;
disp (T,'The Time period in Seconds')
disp ('i.e 1/1000 sec')

f = 1/tc;
disp (f,'The Frequency in Hertz')
disp ('OR 1 kHz')
```

**Scilab code Exa 15.3** Example 89

```
// Grob's Basic Electronics 11e
// Chapter No. 15
// Example No. 15_3
clc; clear;
// Calculate the period for the two frequencies of 1
   MHz and 2 MHz.Calculate the period for the two
   frequencies of 1 MHz and 2 MHz.

// Given data

f1 = 1*10^6;          // Freq=1 MHz
f2 = 2*10^6;          // Freq=2 MHz

t1 = 1/f1;
disp (t1,'The Time period in Seconds of 1 MHz freq.'
   )
disp ('i.e 1*10^-6 sec = 1 usec')

t2 = 1/f2;
disp (t2,'The Time period in Seconds of 2 MHz freq.'
   )
disp ('i.e 0.5*10^-6 sec = 0.5 usec')
```

**Scilab code Exa 15.4** Example 90

```
// Grob's Basic Electronics 11e
// Chapter No. 15
// Example No. 15_4
clc; clear;
// Calculate lamda for a radio wave witf f of 30 GHz
   .

// Given data

c = 3*10^10;       // Speed of light=3*10^10 cm/s
```

```
f = 30*10^9;          // Freq=30 GHz

l = c/f;
disp (l,'The Lamda or Wavelenght in cm')
```

**Scilab code Exa 15.5** Example 91

```
// Grob's Basic Electronics 11e
// Chapter No. 15
// Example No. 15_5
clc; clear;
// The length of a TV antenna is lamda/2 for radio
   waves with f of 60 MHz. What is the antenna
   length in centimeters and feet?

// Given data

c = 3*10^10;      // Speed of light=3*10^10 cm/s
f = 60*10^6;      // Freq=60 MHz
in = 2.54;        // 2.54 cm = 1 in
ft = 12;          // 12 in = 1 ft

l1 = c/f;
l = l1/2;
disp (l,'The Height in cm')

li = l/in
lf = li/ft;
disp (lf,'The Height in feet')
```

**Scilab code Exa 15.6** Example 92

```
// Grob's Basic Electronics 11e
```

```
// Chapter No. 15
// Example No. 15_6
clc; clear;
// For the 6-m band used in amateur radio, what is
   the corresponding frequency?

// Given data

v = 3*10^10;      // Speed of light=3*10^10 cm/s
l = 6*10^2;       // lamda=6 meter

f = v/l
disp (f,'The Frequency in Hertz')
disp ('i.e 50*10^6 Hz OR 50 MHz')
```

**Scilab code Exa 15.7** Example 93

```
// Grob's Basic Electronics 11e
// Chapter No. 15
// Example No. 15_7
clc;clear;
// What is the wavelength of the sound waves
   produced by a loudspeaker at a frequency of 100
   Hz?

// Given data

c = 1130;    // Speed of light=1130 ft/s
f = 100;     // Freq=100 Hz

l = c/f;
disp (l,'The Lamda or Wavelenght in ft')
```

**Scilab code Exa 15.8** Example 94

```
// Grob's Basic Electronics 11e
// Chapter No. 15
// Example No. 15_8
clc; clear;
// For ultrasonic waves at a frequency of 34.44 kHz,
    calculate the wavelength in feet and in
   centimeters.

// Given data

c = 1130;    // Speed of light=1130 ft/s
f = 34.44*10^3;     // Freq=100 Hz
in = 2.54;         // 2.54 cm = 1 in
ft = 12;           // 12 in = 1 ft

l = c/f;
disp (l,'The Lamda or Wavelenght in ft')

a = l*ft;

l1 = a*in;
disp (l1,'The Lamda or Wavelenght in cm')
disp ('appox 1 cm')
```

# Chapter 17

# Chapter 16 Capacitance

**Scilab code Exa 16.1** Example 95

```
// Grob's Basic Electronics 11e
// Chapter No. 16
// Example No. 16_1
clc; clear;
// How much charge is stored in a 2 uF capacitor
   connected across a 50-V supply?

// Given data

V = 50;          // Voltage=50 Volts
C = 2*10^-6;     // Capacitor=2 uFarad

Q = C*V;
disp (Q,'The Charge Stored in Columb')
disp ('i.e 100*10^-6 Columbs')
```

---

**Scilab code Exa 16.2** Example 96

```
// Grob's Basic Electronics 11e
// Chapter No. 16
// Example No. 16_2
clc; clear;
// How much charge is stored in a 40 uF capacitor
   connected across a 50-V supply?

// Given data

V = 50;          // Voltage=50 Volts
C = 40*10^-6;    // Capacitor=2 uFarad

Q = C*V;
disp (Q,'The Charge Stored in Columb')
disp ('i.e 2000*10^-6 Columbs')
```

**Scilab code Exa 16.3** Example 97

```
// Grob's Basic Electronics 11e
// Chapter No. 16
// Example No. 16_3
clc; clear;
// A constant current of 2 uA charges a capacitor
   for 20 s. How much charge is stored? Remember I=Q
   /t or Q=I*t.

// Given data

I = 2*10^-6;          // Current=2 uAmps
t = 20;               // Time=20 Sec

Q = I*t
disp (Q,'The Charge Stored in Columb')
disp ('i.e 40*10^-6 Columbs OR 40 uColumb')
```

**Scilab code Exa 16.4** Example 98

```
// Grob's Basic Electronics 11e
// Chapter No. 16
// Example No. 16_4
clc; clear;
// The voltage across the charged capacitor is 20 V.
    Calculate C.

//Given data

V = 20;           // Voltage=20 Volts
Q = 40*10^-6;     // Charge=40 uColumb

C = Q/V
disp (C,'The Capacitance in Farad')
disp ('i.e 2 uF')
```

---

**Scilab code Exa 16.5** Example 99

```
// Grob's Basic Electronics 11e
// Chapter No. 16
// Example No. 16_5
clc; clear;
// A constant current of 5 mA charges a 10 uF
   capacitor for 1 s. How much is the voltage across
    the capacitor?

// Given data

I = 5*10^-3;          // Current=5 mAmps
t = 1;                // Time=1 Sec
```

```
C = 10*10^-6;         // Cap=10 uFarad

Q = I*t;

V = Q/C;
disp (V,'The Voltage across Capacitor in Volts')
```

**Scilab code Exa 16.6** Example 100

```
// Grob's Basic Electronics 11e
// Chapter No. 16
// Example No. 16_6
clc; clear;
// Calculate C for two plates, each with an area 2
   sqm, separated by 1 cm with a dielectric of air.

// Given data

c = 8.85*10^-12;      // Constant=8.85 p
A = 2;                // Area=2 sqm
d = 1*10^-2;          // Distance=1 cm
K = 1                 // Permeability=1

C = K*c*(A/d);
disp (C,'The Capacitance in Farad')
disp ('i.e 1700*10^-12 F OR 1770 pF')
```

**Scilab code Exa 16.7** Example 101

```
// Grob's Basic Electronics 11e
// Chapter No. 16
// Example No. 16_7
clc; clear;
```

```
// Determine the value of cpacitance for the film
   capacitors in Fig. 16-12a and b

disp ('In Fig. 16 12a , the first two numbers are
   5 and 6, respectively , for 56 as the first two
   digits in the numerical value of the capacitance.
    The third number, 3, indicates a multiplier of
   1000, or 56*1000 = 56,000 pF. The letter J
   indicates a capacitor tolerance of +-5%.')
disp ('In Fig. 16 12b , the first two numbers are
   4 and 7, respectively , for 47 as the first two
   digits in the numerical value of the capacitance.
    The third number, 9, indicates a fractional
   multiplier of 0.1, or 47*0.1 = 4.7 pF. The letter
    C indicates a capacitor tolerance of +-0.25 pF.'
   )
```

**Scilab code Exa 16.8** Example 102

```
// Grob's Basic Electronics 11e
// Chapter No. 16
// Example No. 16_8
clc; clear;
// In Fig. 16 14 , determine (a) the capacitance
   value and tolerance; (b) the temperature-range
   identification information.

disp ('(a) Since the capacitance is expressed as a
   decimal fraction , its value is in microfarads. In
    this case , C = 0.047 uF. The letter Z, to the
   right of 0.047, indicates a capacitor tolerance
   of +80%, -20%. Notice that the actual capacitance
    value can be as much as 80% above its coded
   value but only 20% below its coded value.')

```

```
disp ('(b) The alphanumeric code, Z5V, printed below
    the capacitance value, provides additional
   capacitor information. The letter Z and number 5
   indicate the low and high temperatures of +10 C
   and +85 C , respectively. The letter V indicates
   that the maximum capacitance change over the
   specified temperature range (10 C to 85 C ) is
   +22%, +82%. For temperature changes less than the
    range indicated, the percent change in
   capacitance will be less than that indicated.')
```

**Scilab code Exa 16.9** Example 103

```
// Grob's Basic Electronics 11e
// Chapter No. 16
// Example No. 16_9
clc; clear;
// Determine the capacitance and tolerance for the
   capacitor in Fig. 16  15.

disp ('The dots in the top row are read from left to
    right in the direction of the arrow. In the
   bottom row, they are read in the reverse order
   from right to left. The first dot at the left in
   the top row is black, indicating a mica capacitor
   . The next two color dots are blue and red, for
   62 as the first two digits in the numerical value
    of the capacitance. The next dot, at the far
   right in the bottom row, is red, indicating a
   multiplier of 100. Therefore, C = 62*100 = 6200
   pF. The next dot is gold, indicating a capacitor
   tolerance of +-5%.')
```

**Scilab code Exa 16.10** Example 104

```
// Grob's Basic Electronics 11e
// Chapter No. 16
// Example No. 16_10
clc; clear;
// For the tantalum capacitor shown in Fig. 16 21 ,
    determine the capacitance C in both pF and uF
   units. Also, determine the voltage rating and
   tolerance.

disp ('Moving from top to bottom, the first two
   color bands are yellow and violet, which
   represent the digits 4 and 7, respectively. The
   third color band is blue, indicating a multiplier
    of 1,000,000. Therefore the capacitance C is
   47*1,000,000 = 47,000,000 pF, or 47 uF. The blue
   color at the left indicates a voltage rating of
   35 V. And, finally, the silver dot at the very
   top indicates a tolerance of +-10%.')
```

---

**Scilab code Exa 16.11** Example 105

```
// Grob's Basic Electronics 11e
// Chapter No. 16
// Example No. 16_11
clc; clear;
// The high-voltage circuit for a color picture tube
    can have 30 kV across 500 pF of C . Calculate
   the stored energy.

// Given data

V = 30*10^3;          // Voltage=30 kVolts
C = 500*10^-12;       // Cap=500 pFarad
```

```
E = 0.5*C*V*V
disp (E,'The Energy Stored in Joules')
```

**Scilab code Exa 16.12** Example 106

```
// Grob's Basic Electronics 11e
// Chapter No. 16
// Example No. 16_12
clc; clear;
//Suppose a film capacitor, coded 393J, is being
   measured using the meter shown in Fig. 16 25.
   If the meter reads 37.6 on the 200-nF range, (a)
   What is the capacitance value in picofarad units?
    (b) Is the measured capacitance value within its
    specified tolerance?

disp ('The capacitor code, 393J, corresponds to a
   capacitance value of 39,000 pF +-5%.')
disp ('(a) A reading of 37.6 on the 200-nF range
   corresponds to a capacitance of 37.6 nF. To
   convert 37.6 nF to picofarad units, move the
   decimal point three places to the right. This
   gives an answer of 37,600 pF.')
disp ('(b) The acceptable capacitance range is
   calculated as follows: 39,000 pF * 0.05 = +-1950
   pF. Therefore, the measured value of capacitance
   can range anywhere from 37,050 pF to 40,950 pF
   and still be considered within tolerance.')

disp('Note that in nanofarad units, this corresponds
    to a range of 37.05 to 40.95 nF. Since the
   measured value of 37.6 nF falls within this range
   , the measured capacitance value is within
   tolerance.')
```

# Chapter 18

# Chapter 17 Capacitive Reactance

**Scilab code Exa 17.1** Example 107

```
// Grob's Basic Electronics 11e
// Chapter No. 17
// Example No. 17_1
clc; clear;
// How much is Xc for (a) 0.1 uF of C at 1400 Hz? (b
   ) 1 uF of C at the same frequency?

// Given data

f = 1400;             // Frequency=1400 Hz
C1 = 0.1*10^-6;       // Cap1=0.1 uF
C2 = 1*10^-6;         // Cap2=1 uF

Xc1 = 1/(2*%pi*f*C1);
disp (Xc1,'The Capacitive Reactance in Ohms')
disp ('appox 1140 Ohms')

Xc2 = 1/(2*%pi*f*C2);
disp (Xc2,'The Capacitive Reactance in Ohms')
```

```
disp ('appox 114 Ohms')
```

**Scilab code Exa 17.2** Example 108

```
// Grob's Basic Electronics 11e
// Chapter No. 17
// Example No. 17_2
clc; clear;
//How much is the Xc of a 47-pF value of C at (a) 1
   MHz? (b) 10 MHz?

// Given data

f1 = 1*10^6;    // Frequency1=1 MHz
f2 = 10*10^6;   // Frequency2=10 MHz
C = 47*10^-12; // Cap=47 pF

// For 1 MHz

Xc1 = 1/(2*%pi*f1*C);
disp (Xc1,'The Capacitive Reactance in Ohms')
disp ('appox 3388 Ohms')

// For 10 MHz

Xc2 = 1/(2*%pi*f2*C);
disp (Xc2,'The Capacitive Reactance in Ohms')
```

**Scilab code Exa 17.3** Example 109

```
// Grob's Basic Electronics 11e
// Chapter No. 17
// Example No. 17_3
```

```
clc; clear;
// What C is needed for Xc of 100 Ohms at 3.4 MHz?

// Given data

f = 3.4*10^6;    // Frequency=3.4 MHz
Xc = 100; // Capacitive Reactance=100 Ohms

C = 1/(2*%pi*f*Xc);
disp (C,'The Capacitance in Farads')
disp ('appox 468 pF')
```

**Scilab code Exa 17.4** Example 110

```
// Grob's Basic Electronics 11e
// Chapter No. 17
// Example No. 17_4
clc; clear;
// At what frequency will a 10 uF capacitor have Xc
   equal to 100 Ohms?

// Given data

Xc = 100; // Capacitive Reactance=100 Ohms
C = 10*10^-6; // Cap=10 uF

f = 1/(2*%pi*C*Xc);
disp (f,'The Frequency in Hertz')
disp ('appox 159 Hz')
```

**Scilab code Exa 17.5** Example 111

```
// Grob's Basic Electronics 11e
```

```
// Chapter No. 17
// Example No. 17_5
clc; clear;
// Calculate the instantaneous value of charging
   current ic produced by a 6 uF C when its
   potential difference is increased by 50 V in 1 s.

// Given data

C = 6*10^-6;      // Cap=6 uF
dv = 50;          // differential voltage increased by
    50 Volts
dt = 1;           // differectial time is 1 sec

ic = C*(dv/dt);
disp (ic,'The Instantaneous Value of Charging
   Current ic produced in Amps')
disp ('i.e 300 uAmps')
```

**Scilab code Exa 17.6** Example 112

```
// Grob's Basic Electronics 11e
// Chapter No. 17
// Example No. 17_6
clc; clear;
// Calculate the instantaneous value of charging
   current ic produced by a 6 uF C when its
   potential difference is decreased by 50 V in 1 s.

// Given data

C = 6*10^-6;      // Cap=6 uF
dv = -50;          // differential voltage decreased
   by 50 Volts
dt = 1;           // differectial time is 1 sec
```

```

ic = C*(dv/dt);
disp (ic,'The Instantaneous Value of Discharging
   Current ic produced in Amps')
disp ('i.e -300 uAmps')
```

**Scilab code Exa 17.7** Example 113

```
// Grob's Basic Electronics 11e
// Chapter No. 17
// Example No. 17_7
clc; clear;
// Calculate ic produced by a 250-pF capacitor for a
    change of 50 V in 1 us.

// Given data

C = 250*10^-12;       // Cap=250 pF
dv = 50;              // differential voltage increased
    by 50 Volts
dt = 1*10^-6;         // differectial time is 1 usec

ic = C*(dv/dt);
disp (ic,'The Instantaneous Value of ic produced in
   Amps')
disp ('12500 uAmps or 12.5 mAmps')
```

# Chapter 19

# Chapter 18 Capacitive Circuits

**Scilab code Exa 18.1** Example 114

```
// Grob's Basic Electronics 11e
// Chapter No. 18
// Example No. 18_1
clear; clc;
// If a R=30ohms and Xc=40ohms are in series with
   100V applied, find the following: Zt, I, Vr, Vc
   and Theta z. What is the phase angle between Vc
   and Vr with respect to I? Prove that the sum of
   the series voltage drop equals the applied
   voltage Vt

// Given data

R = 30;      // Resistance=30 Ohms
Xc = 40;     // Capacitive Reactance=40 Ohms
Vt = 100;    // Applied Voltage=100 Volts

R1 = R*R;
Xc1 = Xc*Xc;

Zt = sqrt(R1+Xc1);
```

```
disp (Zt,'Zt in Ohms');

I = (Vt/Zt);
disp (I, 'I in Ampers');

Vr = I*R;
disp (Vr, 'Voltage Across Resistor in Volts');

Vc = I*Xc;
disp (Vc, 'Voltage Across Capacitive Reactance in
    Volts');

Oz = atand(-(Xc/R))
disp (Oz, 'Theta z is');

//Prove that the sum of the series voltage drop
    equals the applied voltage Vt

Vt = sqrt((Vr*Vr)+(Vc*Vc));
disp (Vt, 'Sum of Voltage Drop is Equal to Applied
    Voltage of 100V in Volts');
```

**Scilab code Exa 18.2** Example 115

```
// Grob's Basic Electronics 11e
// Chapter No. 18
// Example No. 18_2
clc; clear;
// A 30-mA Ir is in parallel with another branch
    current of 40 mA for Ic. The applied voltage Va
    is 72 V. Calculate It, Zeq and Theta I.

// Given data

Ir = 30*10^-3;  // Current Ir=30 mA
```

```
Ic = 40*10^-3;   // Current Ic=40 mA
Va = 72;         // Applied Voltage=72 Volts

A = Ir*Ir;
B = Ic*Ic;

It = sqrt(A+B);
disp (It,'The Total Current in Amps')
disp ('i.e 50 mAmps')

Zeq = Va/It;
disp (Zeq,'The Equivqlent Impedence in Ohms')
disp ('i.e 1.44 kOhms')

Oi = atand (Ic/Ir);
disp (Oi,'The Value of Theta I in degrees')
```

# Chapter 20

# Chapter 19 Inductance

**Scilab code Exa 19.1** Example 116

```
// Grob's Basic Electronics 11e
// Chapter No. 19
// Example No. 19_1
clc; clear;
// The current in an inductor changes from 12 to 16
   A in 1s. How much is the di/dt rate of current
   change in amperes per second?

// Given data

di = 4;      // Differential current=16-12=4 Amps
dt = 1;      // Differential time=1 sec

A = di/dt;
disp (A,'The di/dt Rate of Current change in A/s')
```

**Scilab code Exa 19.2** Example 117

```
// Grob's Basic Electronics 11e
// Chapter No. 19
// Example No. 19_2
clc; clear;
// The current in an inductor changes by 50 mA in 2
   us. How much is the di/dt rate of current change
   in amperes per second?

// Given data

di = 50*10^-3;     // Differential current=50 mAmps
dt = 2*10^-6;      // Differential time=2 usec

A = di/dt;
disp (A,'The di/dt Rate of Current change in A/s')
```

**Scilab code Exa 19.3** Example 118

```
// Grob's Basic Electronics 11e
// Chapter No. 19
// Example No. 19_3
clc; clear;
// How much is the inductance of a coil that induces
    40 V when its current changes at the rate of 4 A
   /s?

// Given data

Vl = 40;     // Induced voltage=40 Volts
R = 4        // Current changing rate=di/dt=4 A/s

L = Vl/R;
disp (L,'The Value of Inductance in Henry')
```

**Scilab code Exa 19.4** Example 119

```
// Grob's Basic Electronics 11e
// Chapter No. 19
// Example No. 19_4
clc; clear;
// How much is the inductance of a coil that induces
    1000 V when its current changes at the rate of
   50 mA in 2us?

// Given data

Vl = 1000;        // Induced voltage=1000 Volts
di = 50*10^-3;    // differential current=50 mAmps
dt = 2*10^-6;     // differential time=2 usec

A = di/dt;

L = Vl/A;
disp (L,'The Value of Inductance in Henry')
disp ('OR 40 mH')
```

**Scilab code Exa 19.5** Example 120

```
// Grob's Basic Electronics 11e
// Chapter No. 19
// Example No. 19_5
clc; clear;
// How much is the self-induced voltage across a 4-H
    inductance produced by a current change of 12 A/
   s?

```

```
// Given data

L = 4;     // Inductor=4 H
R = 12;    // current change=di/dt=12 A/s

Vl = L*R;
disp (Vl,'The Value of Self-Induced Voltage in Volts')
```

**Scilab code Exa 19.6** Example 121

```
// Grob's Basic Electronics 11e
// Chapter No. 19
// Example No. 19_6
clc; clear;
// The current through a 200-mH L changes from 0 to 100 mA in 2 us. How much is Vl ?

// Given data

L = 200*10^-3;        // Inductor=200 mH
di = 100*10^-3;       // differential current=100 mAmps
dt = 2*10^-6;         // differectial time=2 usec

A = di/dt;

Vl = L*A;
disp (Vl,'The Value of Self-Induced Voltage in Volts')
disp ('OR 10 kVolts')
```

**Scilab code Exa 19.7** Example 122

```
// Grob's Basic Electronics 11e
// Chapter No. 19
// Example No. 19_7
clc; clear;
// A coil L1 produces 80 uWb of magnetic flux. Of this total flux, 60 uWb arelinked with L2. How much is k between L1 and L2?

// Given data

lf1 = 80*10^-6; // Magnetic flux of coil L1=80 uWb
lf2 = 60*10^-6; // Magnetic flux of coil L2=60 uWb

k = lf2/lf1;
disp (k,'The Coefficient of Coupling k between Coil L1 and Coil L2 is')
```

**Scilab code Exa 19.8** Example 123

```
// Grob's Basic Electronics 11e
// Chapter No. 19
// Example No. 19_8
clc; clear;
// A 10-H inductance L1 on an iron core produces 4 Wb of magnetic flux. Another coil L2 is on the same core. How much is k between L1 and L2?

// Given data

lf1 = 4; // Magnetic flux of coil L1=4 Wb
lf2 = 4; // Magnetic flux of coil L2=4 Wb

k = lf2/lf1;
disp (k,'The Coefficient of Coupling k between Coil L1 and Coil L2 is')
```

**Scilab code Exa 19.9** Example 124

```
// Grob's Basic Electronics 11e
// Chapter No. 19
// Example No. 19_9
clc; clear;
// Two 400-mH coils L1 and L2 have a coefficient of
   coupling k equal to 0.2. Calculate Lm.

// Given data

L1 = 400*10^-3; // L1=400 mH
L2 = 400*10^-3; // L2=400 mH
k = 0.2;        // Coupling coefficient=0.2

Lm = k*sqrt(L1*L2);
disp (Lm,'The mutual inductance in Henry')
disp ('i.e 80*10^-3 H OR 80 mH')
```

**Scilab code Exa 19.10** Example 125

```
// Grob's Basic Electronics 11e
// Chapter No. 19
// Example No. 19_10
clc; clear;
// If the two coils had a mutual inductance LM of 40
    mH, how much would k be?

// Given data

L1 = 400*10^-3; // Coil Inductance 1=400 mH
```

```
L2 = 400*10^-3; // Coil Inductance 2=400 mH
Lm = 40*10^-3;  // Mutual inductance=40 mH

lt = sqrt(L1*L2);

k = Lm/lt;
disp (k,'The Coupling Coefficient k is')
```

**Scilab code Exa 19.11** Example 126

```
// Grob's Basic Electronics 11e
// Chapter No. 19
// Example No. 19_11
clc; clear;
// A power transformer has 100 turns for Np and 600
   turns for Ns. What is the turns ratio? How much
   is the secondary voltage Vs if the primary
   voltage Vp is 120 V?

// Given data

np = 100;        // Turns in primary coil=100
ns = 600;        // Turns in secondary coil=600
vp = 120;        // Primary voltage=120 Volts

Tr = np/ns;
disp (Tr,'The Turns Ratio is')
disp ('OR 1:6')

vs = vp*(ns/np);
disp (vs,'The Secondary Voltage in Volts')
```

**Scilab code Exa 19.12** Example 127

```
// Grob's Basic Electronics 11e
// Chapter No. 19
// Example No. 19_12
clc; clear;
// A power transformer has 100 turns for Np and 5 turns for Ns. What is the turns ratio? How much is the secondary voltage Vs with a primary voltage of 120 V?

// Given data

np = 100;        // Turns in primary coil=100
ns = 5;          // Turns in secondary coil=5
vp = 120;        // Primary voltage=120 Volts

Tr = np/ns;
disp (Tr,'The Turns Ratio 20:1 or')

vs = vp*(ns/np);
disp (vs,'The Secondary Voltage in Volts')
```

**Scilab code Exa 19.13** Example 128

```
// Grob's Basic Electronics 11e
// Chapter No. 19
// Example No. 19_13
clc; clear;
// A transformer with a 1:6 turns ratio has 720 V across 7200 Ohms in the secondary. (a) How much is Is? (b) Calculate the value of Ip.

// Given data

vs = 720;        // Secondary voltage=720 Volts
Rl = 7200;       // Secondary load=7200 Ohms
```

```
tr = 1/6;        // Turns ratio=1:6

Is = vs/Rl;
disp (Is,'The Secondary Current in Amps')

Ip = Is/tr;
disp (Ip,'The Primary Current in Amps')
```

**Scilab code Exa 19.14** Example 129

```
// Grob's Basic Electronics 11e
// Chapter No. 19
// Example No. 19_14
clc; clear;
// A transformer with a 20:1 voltage step-down ratio has 6 V across 0.6  in the secondary. (a) How much is Is? (b) How much is Ip?

// Given data

vs = 6;          // Secondary voltage=6 Volts
Rl = 0.6;        // Secondary load=0.6 Ohms
tr = 20/1;       // Turns ratio=20:1

Is = vs/Rl;
disp (Is,'The Secondary Current in Amps')

Ip = Is/tr;
disp (Ip,'The Primary Current in Amps')
```

**Scilab code Exa 19.15** Example 130

```
// Grob's Basic Electronics 11e
```

```
// Chapter No. 19
// Example No. 19_15
clc; clear;
// Calculate the primary current I P if the
   secondary current Is equals its rated value of 2
   A.

// Given data

vs = 25.2;        // Secondary voltage=25.2 Volts
vp = 120;         // Primary voltage=120 Volts
Is = 2;           // Secondary current=2 Amps

Ip = Is*(vs/vp);
disp (Ip,'The Primary current in Amps')
disp ('OR 420 mAmps')
```

**Scilab code Exa 19.16** Example 131

```
// Grob's Basic Electronics 11e
// Chapter No. 19
// Example No. 19_16
clc; clear;
// Determine the Primary Impedence Zo

// Method 1
// Given data

Vp = 32;     // Primary Voltage = 32 Volts
Rl = 8;      // Load Resistance = 8 Ohms
TR = 4;      // Turns Ratio Np/Ns = 4/1

Vs = Vp/TR;

Is = Vs/Rl;
```

```
Ip = ((Vs/Vp)*Is);

Zp = Vp/Ip;
disp (Zp,'Primary Impedence in Ohms by Method 1');

// Method 2

Zp = TR*TR*Rl;
disp (Zp,'Primary Impedence in Ohms by Method 2');
```

**Scilab code Exa 19.17** Example 132

```
// Grob's Basic Electronics 11e
// Chapter No. 19
// Example No. 19_17
clc; clear;
// Calculate the turns ratio Np/Ns that will produce
   a reflected primary impedance Zp of (a) 75 Ohms;
   (b) 600 Ohms.

// Given data

Zs = 300;    // Secondary impedence=300 Ohms
Zp1 = 75;    // Primary impedence=75 Ohms
Zp2 = 600;   // Primary impedence=600 Ohms

tra = sqrt (Zp1/Zs);
disp (tra,'The Turns ratio Np/Ns is')
disp ('OR 1/2')

trb = sqrt (Zp2/Zs);
disp (trb,'The Turns ratio Np/Ns is 1.414/1 or')
```

**Scilab code Exa 19.18** Example 133

```
// Grob's Basic Electronics 11e
// Chapter No. 19
// Example No. 19_18
clc; clear;
// Inductance L1 is 5 mH and L2 is 10 mH. How much
   is Lt?

// Given data

l1 = 5*10^-3;    // Inductor 1=5 mH
l2 = 10*10^-3;   // Inductor 2=10 mH

Lt = l1+l2;
disp (Lt,'The Total Inductance in Henry')
disp ('i.e 15 mH')
```

---

**Scilab code Exa 19.19** Example 134

```
// Grob's Basic Electronics 11e
// Chapter No. 19
// Example No. 19_19
clc; clear;
// Inductances L1 and L2 are each 8 mH. How much is
   Leq?

// Given data

l1 = 8*10^-3;    // Inductor 1=8 mH
l2 = 8*10^-3;    // Inductor 2=8 mH

```

```
a = 1/l1;
b = 1/l2;

Leq = 1/(a+b);
disp(Leq,'The Equivalent Inductance in Henry')
disp ('i.e 4 mH')
```

**Scilab code Exa 19.20** Example 135

```
// Grob's Basic Electronics 11e
// Chapter No. 19
// Example No. 19_20
clc; clear;
// Two series coils, each with an L of 250 uH, have a total inductance of 550 uH connected series-aiding and 450 uH series-opposing. (a) How much is the mutual inductance Lm between the two coils? (b) How much is the coupling coefficient k?

// Given data

l1 = 250*10^-6;      // Coil Inductance 1=250 uH
l2 = 250*10^-6;      // Coil Inductance 2=250 uH
Lts = 550*10^-6;     // Inductance series-aiding=550 uH
Lto = 450*10^-6;     // Inductance series-opposing=450 uH

Lm = (Lts-Lto)/4
disp (Lm,'The Mutual Inductance in Henry')
disp ('i.e 25 uH')

lt = sqrt(l1*l2);

k = Lm/lt;
```

```
disp (k,'The Coupling coefficient k is')
```

**Scilab code Exa 19.21** Example 136

```
// Grob's Basic Electronics 11e
// Chapter No. 19
// Example No. 19_21
clc; clear;
// A current of 1.2 A flows in a coil with an
   inductance of 0.4 H. How much energy is stored in
    the magnetic field?

// Given data

l1 = 0.4;      // Coil Inductance l=0.4 H
I = 1.2;       // Current=1.2 Amps

E = (l1*I*I)/2;
disp (E,'The Energy Stored in the Magnetic Field in
   Joules')
```

# Chapter 21

# Chapter 20 Inductive Reactance

**Scilab code Exa 20.1** Example 137

```
// Grob's Basic Electronics 11e
// Chapter No. 20
// Example No. 20_1
clc; clear;
// How much is Xl of a 6-mH L at 41.67 kHz?

// Given data

f = 41.67*10^3;       // Frequency=41.67 kHz
L = 6*10^-3;          // Inductor=6 mH

Xl = 2*%pi*f*L;
disp (Xl,'The Inductive Reactance in Ohms')
```

**Scilab code Exa 20.2** Example 138

```
// Grob's Basic Electronics 11e
// Chapter No. 20
// Example No. 20_2
clc; clear;
// Calculate the Xl of (a) a 10-H L at 60 Hz and (b)
    a 5-H L at 60 Hz.

// Given  data

f = 60;      // Frequency=60 Hz
L1 = 10;     // Inductor 1=10 H
L2 = 5;      // Inductor 2=5 H
pi = 3.14

Xl1 = 2*pi*f*L1;
disp (Xl1,'The Inductive Reactance in Ohms')

Xl2 = 2*pi*f*L2;
disp (Xl2,'The Inductive Reactance in Ohms')
```

**Scilab code Exa 20.3** Example 139

```
// Grob's Basic Electronics 11e
// Chapter No. 20
// Example No. 20_3
clc; clear;
// Calculate the Xl of a 250-uH coil at (a) 1 MHz
   and (b) 10 MHz.

// Given data

f1 = 1*10^6;     // Frequency1=1 MHz
f2 = 10*10^6;    // Frequency2=10 MHz
L = 250*10^-6;   // Inductor=250 uH
pi = 3.14;
```

```
// For 1 Mhz

Xl1 = 2*pi*f1*L;
disp (Xl1,'The Inductive Reactance in Ohms')

// For 10 Mhz

Xl2 = 2*pi*f2*L;
disp (Xl2,'The Inductive Reactance in Ohms')
```

**Scilab code Exa 20.4** Example 140

```
// Grob's Basic Electronics 11e
// Chapter No. 20
// Example No. 20_4
clc; clear;
// A coil with negligible resistance has 62.8 V
   across it with 0.01 A of current. How much is Xl?

// Given data

Vl = 62.8;        // Voltage across coil=62.8 Volts
Il = 0.01;        // Current in coil=0.01 Amps

Xl = Vl/Il;
disp (Xl,'The Inductive Reactance in Ohms')
```

**Scilab code Exa 20.5** Example 141

```
// Grob's Basic Electronics 11e
// Chapter No. 20
// Example No. 20_5
```

```
clc; clear;
// Calculate L of the coil when the frequency is
   1000 Hz.

// Given data

Xl = 6280;        // Inductive reactance=6280 Ohms
f = 1000;         // Frequency=1000 Hz
pi = 3.14;

L = Xl/(2*pi*f);
disp (L,'The value of Inductor in Henry')
```

**Scilab code Exa 20.6** Example 142

```
// Grob's Basic Electronics 11e
// Chapter No. 20
// Example No. 20_6
clc; clear;
// Calculate L of a coil that has 15,700 Ohms of Xl
   at 12 MHz.

// Given data

Xl = 15700;     // Inductive reactance=15700 Ohms
f = 12*10^6;    // Frequency=12 MHz
pi = 3.14;

L = Xl/(2*pi*f);
disp (L,'The value of Inductor in Henry')
disp ('i.e Appox 208.8*10^-6 OR 208.8 uH')
```

**Scilab code Exa 20.7** Example 143

```
// Grob's Basic Electronics 11e
// Chapter No. 20
// Example No. 20_7
clc; clear;
// At what frequency will an inductance of 1 H have
   a reactance of 1000 ?

// Given data

Xl = 1000;      // Inductive reactance=1000 Ohms
L = 1;          // Inductor=1 H

f = Xl/(2*%pi*L);
disp (f,'The Frequency in Hertz')
```

# Chapter 22

# Chapter 21 Inductive Circuits

**Scilab code Exa 21.1** Example 144

```
// Grob's Basic Electronics 11e
// Chapter No. 21
// Example No. 21_1
clc; clear
// If a R=30 ohms and Xl=40 ohms are in series with
   100V applied, find the following: Zt, I, Vr, Vl
   and Theta z. What is the phase angle between Vl
   and Vr with respect to I? Prove that the sum of
   the series voltage drop equals the applied
   voltage Vt

// Given data

R = 30;      // Resistance=30 Ohms
Xl = 40;     // Inductive reactance=40 Ohms
Vt = 100;    // Applied voltage=100 Volts


R1 = R*R;
Xl1 = Xl*Xl;

```

```
Zt = sqrt(R1+Xl1);
disp (Zt,'Zt in ohms');

I = (Vt/Zt);
disp (I, 'I in Ampers');

Vr = I*R;
disp (Vr, 'Vr in Volts');

Vl = I*Xl;
disp (Vl, 'Vl in Volts');

Oz = atand(Xl/R);
disp (Oz, 'Theta z in degree');

//Prove that the sum of the series voltage drop
   equals the applied voltage Vt

Vt = sqrt((Vr*Vr)+(Vl*Vl));
disp (Vt, 'Sum of Voltage Drop is Equal to Applied
   Voltage 100V');
```

**Scilab code Exa 21.2** Example 145

```
// Grob's Basic Electronics 11e
// Chapter No. 21
// Example No. 21_2
clc; clear;
// What is the total Z of a 600-Ohms R in parallel
   with a 300 Ohms Xl? Assume 600 V for the applied
   voltage.

// Given data

R = 600;     // Resistance=600 Ohms
```

```
Xl = 300;    // Inductive reactance=300 Ohms
V = 600;     // Applied voltage=600 Volts

Ir = V/R;
Il = V/Xl;
A = Ir*Ir;
B = Il*Il;
It = sqrt(A+B);

Zeq = V/It;
disp(Zeq,'The Total Impedence in Ohms')
```

**Scilab code Exa 21.3** Example 146

```
// Grob's Basic Electronics 11e
// Chapter No. 21
// Example No. 21_3
clc; clear;
// An air-core coil has an Xl of 700 Ohms and an Re
   of 2 Ohms. Calculate the value of Q for this coil
   .

// Given data

Xl = 700;    // Inductive reactance=700 Ohms
Re = 2;      // AC effective resistance=2 Ohms

Q = Xl/Re;
disp (Q,'The Q of Coil is')
```

**Scilab code Exa 21.4** Example 147

```
// Grob's Basic Electronics 11e
```

```
// Chapter No. 21
// Example No. 21_4
clc; clear;
// A 200 uH coil has a Q of 40 at 0.5 MHz. Find Re.

// Given data

L = 200*10^-6;   // L of coil=200 uHenry
Q = 40;          // Q=40
f = 0.5*10^6;    // Frequency=0.5 MHz
pi = 3.14;

Xl = 2*pi*L*f;

Re = Xl/Q;
disp (Re,'The AC Effective Resistance in Ohms')
```

# Chapter 23

# Chapter 22 RC and LR Time Constants

**Scilab code Exa 22.1** Example 148

```
// Grob's Basic Electronics 11e
// Chapter No. 22
// Example No. 22_1
clc; clear;
// What is the time constant of a 20-H coil having
   100 Ohms of series resistance?

// Given data

L = 20;      // Inductor=20 Henry
R = 100;     // Resistor=100 Ohms

T = L/R;
disp (T,'The Time Constant in Seconds')
```

**Scilab code Exa 22.2** Example 149

```
// Grob's Basic Electronics 11e
// Chapter No. 22
// Example No. 22_2
clc; clear;
// An applied dc voltage of 10 V will produce a steady-state current of 100 mA in the 100-Ohms coil. How much is the current after 0.2 s? After 1 s?

// Given data

L = 20;          // Inductor=20 Henry
R = 100;         // Resistor=100 Ohms
I = 100*10^-3;   // Steady-state current=100 mAmps

disp ('Since 0.2 sec is one time constant, I is 63% of 100 mA')
I1 = 0.63*I;
disp (I1,'The current at 0.2 sec time constant')

disp ('After 1 sec the current reaches its steady state value of 100 mAmps ')
```

**Scilab code Exa 22.3** Example 150

```
// Grob's Basic Electronics 11e
// Chapter No. 22
// Example No. 22_3
clc; clear;
// If a 1-M Ohms R is added in series with the coil, how much will the time constant be for the higher resistance RL circuit?

// Given data

```

```
L = 20;          // Inductor=20 Henry
R = 1*10^6;      // Resistor=1 MOhms

T = L/R;
disp (T,'The Time Constant in Seconds')
disp ('i.e 20 us')
```

**Scilab code Exa 22.4** Example 151

```
// Grob's Basic Electronics 11e
// Chapter No. 22
// Example No. 22_4
clc; clear;
// What is the time constant of a 0.01-uF capacitor
   in series with a 1-M Ohmsresistance?

// Given data

C = 0.01*10^-6;       // Capacitor=0.01 uFarad
R = 1*10^6;           // Resistor=1 MOhms

T = C*R;
disp (T,'The Time Constant in Seconds')
```

**Scilab code Exa 22.5** Example 152

```
// Grob's Basic Electronics 11e
// Chapter No. 22
// Example No. 22_5
clc; clear;
// With a dc voltage of 300 V applied, how much is
   the voltage across C in Example 22  4 after 0.01
```

```
   s of charging? After 0.05 s? After 2 hours?
   After 2 days?

// Given data

C = 0.01*10^-6;      // Capacitor=0.01 uFarad
R = 1*10^6;          // Resistor=1 MOhms
V = 300;             // Applied DC=300 Volts

T = C*R;
disp (T,'The Time Constant in Seconds')

disp ('Since 0.01 sec is one time constant, the
   voltage across C then is 63% of 300 V,')

T1 = 0.63*V;
disp (T1,'The Capacitor voltage at 0.01 Sec in Volts
   ')

T2 = V
disp (V,'After 5 time constants or 0.05 Sec
   Capacitor voltage in volts ')

disp ('After 2 hours or 2 days the C will be still
   charged to 300 V if the supply is still connected
   ')
```

**Scilab code Exa 22.6** Example 153

```
// Grob's Basic Electronics 11e
// Chapter No. 22
// Example No. 22_6
clc; clear;
// If the capacitor is allowed to charge to 300 V
   and then discharged, how much is the capacitor
```

```
    voltage 0.01 s after the start of discharge? The
    series resistance is the same on discharge as on
    charge.

// Given data

C = 0.01*10^-6;       // Capacitor=0.01 uFarad
R = 1*10^6;           // Resistor=1 MOhms
V = 300;              // Applied DC=300 Volts

disp ('In one time constant, C discharges to 37% of
    its initial voltage')

V1 = 0.37*V;
disp (V1,'The Capacitor voltage after 0.01 sec start
     of discharge in volts')
```

**Scilab code Exa 22.7** Example 154

```
// Grob's Basic Electronics 11e
// Chapter No. 22
// Example No. 22_7
clc; clear;
// Assume the capacitor is discharging after being
    charged to 200 V. How much will the voltage
    across C be 0.01 s after the beginning of
    discharge? The series resistance is the same on
    discharge as on charge.

// Given data

C = 0.01*10^-6;       // Capacitor=0.01 uFarad
R = 1*10^6;           // Resistor=1 MOhms
V = 200;              // Capacitor voltage=200 Volts

```

```
disp ('In one time constant, C discharges to 37% of
    its initial voltage')

V1 = 0.37*V;
disp (V1,'The Capacitor voltage after 0.01 sec start
    of discharge in volts')
```

**Scilab code Exa 22.8** Example 155

```
// Grob's Basic Electronics 11e
// Chapter No. 22
// Example No. 22_8
clc; clear;
// If a 1-M Ohms resistance is added in series with
    the capacitor 0.01-uF and resistor 1-M Ohms in,
    how much will the time constant be?

// Given data

C = 0.01*10^-6;        // Capacitor=0.01 uFarad
R = 2*10^6;            // Resistor= 2 MOhms

T = C*R;
disp (T,'The Time Constant in Seconds')
```

**Scilab code Exa 22.9** Example 156

```
// Grob's Basic Electronics 11e
// Chapter No. 22
// Example No. 22_9
clc; clear;
// An RC circuit has a time constant of 3 s. The
    capacitor is charged to 40 V. Then C is
```

```
   discharged. After 6 s of discharge, how much is Vr?

// Given data

RC = 3;      // RC time constant=3 Sec
t = 6;       // Discharge time=6 Sec
Vc = 40;     // Capacitor voltage=40 Volts

A = t/RC;    // constant factor
B = log10(Vc);

Vr = 10^(B-(A*0.434));
disp (Vr,'The Value of Vr in Volts')
```

---

**Scilab code Exa 22.10** Example 157

```
// Grob's Basic Electronics 11e
// Chapter No. 22
// Example No. 22_10
clc; clear;
// An RC circuit has an R of 10 k Ohms and a C of
   0.05 uF. The applied voltage for charging is 36 V
   . (a) Calculate the time constant. (b) How long
   will it take C to charge to 24 V?

C = 0.05*10^-6;      // Capacitor=0.05 uFarad
R = 10*10^3;         // Resistor=10 kOhms
V = 36;              // Applied voltage=36 Volts
v = 12;              // Voltage drops from 36 to 12
   Volts
A = 2.3;             // Specific factor

T = C*R;
disp (T,'The Time Constant in Seconds')
```

```
disp ('i.e 0.5*10^-3 Sec OR 0.5 mSec')

t = A*T*log10(V/v);
disp (t,'Time required to charge Capacitor upto 24
    Volts in Seconds')
disp ('i.e appox 0.549*10^-3 Sec OR 0.549 mSec')
```

# Chapter 24

# Chapter 23 Alternating Current Circuits

**Scilab code Exa 23.1** Example 158

```
// Grob's Basic Electronics 11e
// Chapter No. 23
// Example No. 23_1
clc; clear;
// A 27-Ohms R is in series with 54 Ohms of Xl and
   27 Ohms of Xc. The applied voltage Vt is 50 mV.
   Calculate ZT, I, and Theta z.

// Given data

R = 27;          // Resistance=27 Ohms
Xl = 54;         // Inductive reactance=54 Ohms
Vt = 50*10^-3;   // Applied voltage=100 Volts
Xc = 27;         // Capacitive reactance=27 Ohms

nXl = Xl-Xc;     // Net Inductive reactance
R1 = R*R;
nXl1 = nXl*nXl;

```

```
Zt = sqrt(R1+nX11);
disp (Zt,'Total Impedence Zt in Ohms')

I = (Vt/Zt);
disp (I, 'Current I in Ampers')
disp ('i.e 1.31 mAmps')

Oz = atand(Xc/R);
disp (Oz, 'Theta z in Degree')
```

**Scilab code Exa 23.2** Example 159

```
// Grob's Basic Electronics 11e
// Chapter No. 23
// Example No. 23_2
clc; clear;
// The following branch currents are supplied from a 50-mV source: Ir=1.8 mA; Il=2.8 mA; Ic=1 mA. Calculate It, Zeq, and Theta I.

// Given data

Va = 50*10^-3;        // Applied voltage=50m Volts
Ir = 1.8*10^-3;       // Ir=1.8 mAmps
Il = 2.8*10^-3;       // Ir=2.8 mAmps
Ic = 1*10^-3;         // Ic=1 mAmps

nI = Il-Ic;           // net current
Ir1 = Ir*Ir;
nI1 = nI*nI;

It = sqrt(Ir1+nI1);
disp (It,'The Total Current It in Amps')
disp ('i.e 2.55 mAmps')

```

```
Zeq = Va/It;
disp (Zeq,'The Equivqlent Impedence Zeq in Ohms')
disp ('Appox 19.61 Ohms')

Oz = atand(-(nI/Ir));
disp (Oz, 'Theta z in Degree');
```

# Chapter 26

# Chapter 25 Resonance

**Scilab code Exa 25.1** Example 160

```
// Grob's Basic Electronics 11e
// Chapter No. 25
// Example No. 25_1
clc; clear;
// Calculate the resonant frequency for an 8-H
   inductance and a 20-uF capacitance.

// Given data

L = 8;                  // L=8 Henry
C = 20*10^-6;           // C=20 uFarad

fr = 1/(2*%pi*sqrt(L*C));
disp (fr,'The resonant frequency in Hertz')
disp ('Appox 12.6 Hertz')
```

**Scilab code Exa 25.2** Example 161

```
// Grob's Basic Electronics 11e
// Chapter No. 25
// Example No. 25_2
clc; clear;
// Calculate the resonant frequency for a 2-uH
   inductance and a 3-pF capacitance.

// Given data

L = 2*10^-6;        // Inductor=2 uHenry
C = 3*10^-12;       // Capacitor=3 pFarad
pi = 3.14;

fr = 1/(2*pi*sqrt(L*C));
disp (fr,'The resonant frequency in Hertz')
disp ('i.e 65 MHz')
```

**Scilab code Exa 25.3** Example 162

```
// Grob's Basic Electronics 11e
// Chapter No. 25
// Example No. 25_3
clc; clear;
// What value of C resonates with a 239-uH L at 1000
    kHz?

// Given data

L = 239*10^-6;       // Inductor=239 uHenry
fr = 1000*10^3;      // Resonant frequency=1000
   kHertz

A = %pi*%pi;           // pi square
B = fr*fr;           // Resonant frequency square

```

```
C = 1/(4*A*B*L);
disp (C,'The value of Capacitor in Farads')
disp ('i.e 106 pF')
```

**Scilab code Exa 25.4** Example 163

```
// Grob's Basic Electronics 11e
// Chapter No. 25
// Example No. 25_4
clc; clear;
// What value of L resonates with a 106-pF C at 1000
    kHz, equal to 1 MHz?

// Given data

C = 106*10^-12;      // Capacitor=106 pFarad
fr = 1*10^6;         // Resonant frequency=1 MHertz

A = %pi*%pi;            // pi square
B = fr*fr;           // Resonant frequency square

C = 1/(4*A*B*C);
disp (C,'The value of Inductor in Henry')
disp ('i.e 239 uF')
```

**Scilab code Exa 25.5** Example 164

```
// Grob's Basic Electronics 11e
// Chapter No. 25
// Example No. 25_5
clc;clear;
```

```
// A series circuit resonant at 0.4 MHz develops 100
    mV across a 250-uH L with a 2-mV input.
   Calculate Q .

// Given data

Vo = 100*10^-3;       // Output voltage=100 mVolts
Vi = 2*10^-3;         // Input voltage=2 mVolts
L = 250*10^-6;        // Inductor=250 uHenry
f = 0.4*10^6;         // Frequency=0.4 MHertz

Q = Vo/Vi;
disp (Q,'The Magnification factor Q is')
```

**Scilab code Exa 25.6** Example 165

```
// Grob's Basic Electronics 11e
// Chapter No. 25
// Example No. 25_6
clc; clear;
// What is the ac resistance of the coil in A series
    circuit resonant at 0.4 MHz develops 100 mV
   across a 250-uH L with a 2-mV input.

// Given data

Vo = 100*10^-3;       // Output voltage=100 mVolts
Vi = 2*10^-3;         // Input voltage=2 mVolts
L = 250*10^-6;        // Inductor=250 uHenry
f = 0.4*10^6;         // Frequency=0.4 MHertz
pi = 3.14;

Q = Vo/Vi;
Xl = 2*pi*f*L;

```

```
rs = Xl/Q;
disp (rs,'The Ac Resistance of Coil in Ohms')
```

**Scilab code Exa 25.7** Example 166

```
// Grob's Basic Electronics 11e
// Chapter No. 25
// Example No. 25_7
clc; clear;
// In Fig. 25 9 , assume that with a 4-mVac input
   signal for VT, the voltage across R1 is 2 mV when
    R1 is 225-kOhms. Determine Zeq and Q.

// Given data

vin = 4*10^-3;        // Input AC signal=4 mVac
R1 = 225*10^3;        // Resistance1=225 kOhms
vR1 = 2*10^-3;        // Voltage across Resistor1=2
   mVac
xl = 1.5*10^3;        // Inductive Reactance=1.5 kOhms

disp ('Because they divide Vt equally')

Zeq = R1;
disp (Zeq,'The Equivalent Impedence in Ohms')
disp ('i.e 225 kOhms')

Q = Zeq/xl;
disp (Q,'The Q is')
```

**Scilab code Exa 25.8** Example 167

```
// Grob's Basic Electronics 11e
```

```
// Chapter No. 25
// Example No. 25_8
clc; clear;
// A parallel LC circuit tuned to 200 kHz with a
   350-uH L has a measured ZEQ of 17,600. Calculate
   Q.

// Given data

L = 350*10^-6;        // Inductor=350 uHenry
f = 200*10^3;         // Frequency=200 kHertz
Zeq = 17600;          // Equivalent Impedence=17600
   Ohms

Xl = 2*%pi*f*L;

Q = Zeq/Xl;
disp (Q,'The Magnification factor Q is')
```

**Scilab code Exa 25.9** Example 168

```
// Grob's Basic Electronics 11e
// Chapter No. 25
// Example No. 25_9
clc; clear;
// An LC circuit resonant at 2000 kHz has a Q of
   100. Find the total bandwidth delta f and the
   edge frequencies f1 and f2.

// Given data

fr = 2000*10^3;           // Resonant frequency=2000
   kHertz
Q = 100;                  // Magnification factor=100

```

```
Bw = fr/Q;
disp (Bw,'The Bandwidth BW or Delta f in Hertz')
disp ('i.e 20 kHz')

f1 = fr-Bw/2;
disp (f1,'The Edge Frequency f1 in Hertz')
disp ('i.e 1990 kHz')

f2 = fr+Bw/2;
disp (f2,'The Edge Frequency f2 in Hertz')
disp ('i.e 2010 kHz')
```

**Scilab code Exa 25.10** Example 169

```
// Grob's Basic Electronics 11e
// Chapter No. 25
// Example No. 25_10
clc; clear;
// An LC circuit resonant at 6000 kHz has a Q of
   100. Find the total bandwidth delta f and the
   edge frequencies f1 and f2.

// Given data

fr = 6000*10^3;          // Resonant frequency=6000
   kHertz
Q = 100;                 // Magnification factor=100

Bw = fr/Q;
disp (Bw,'The Bandwidth BW or Delta f in Hertz')
disp ('i.e 60 kHz')

f1 = fr-Bw/2;
disp (f1,'The Edge Frequency f1 in Hertz')
disp ('i.e 5970 kHz')
```

```
f2 = fr+Bw/2;
disp (f2,'The Edge Frequency f2 in Hertz')
disp ('i.e 6030 kHz')
```

# Chapter 27

# Chapter 26 Filters

**Scilab code Exa 26.1** Example 170

```
// Grob's Basic Electronics 11e
// Chapter No. 26
// Example No. 26_1
clc; clear;
// Calculate (a)the cutoff frequency fc; (b)Vout at
    fc; (c)Theta at fc (Assume Vin = 10 Vpp for all
    frequencies)

// Given data

R = 10*10^3;          // Resistor=10 kOhms
C = 0.01*10^-6;       // Capacitor=0.01 uFarad
Vin = 10;             // Input Voltage=10Vpp
pi = 3.14

// To calculate fc

fc = 1/(2*pi*R*C);
disp (fc,'The Cutoff Frequency in Hertz')
disp ('i.e 1.592 kHz')

```

```
// To calculate Vout at fc

Xc = 1/(2*pi*fc*C);

Zt = sqrt((R*R)+(Xc*Xc));

Vout = Vin*(Xc/Zt);
disp (Vout,'The Output Voltage in Vpp' );

// To calculate Theta

Theta = atand(-(R/Xc));
disp (Theta,'The Phase angle (Theta z) in Degree');
```

**Scilab code Exa 26.2** Example 171

```
// Grob's Basic Electronics 11e
// Chapter No. 26
// Example No. 26_2
clc; clear;
// Calculate (a)the cutoff frequency fc; (b)Vout at
   1 kHz; (c)Theta at 1 kHz (Assume Vin = 10 Vpp for
    all frequencies)

// Given data

R = 1*10^3;          // Resistor=1 kOhms
L = 50*10^-3         // Inductor=50 mHenry
Vin = 10;            // Input Voltage=10Vpp
f = 1*10^3;          // Frequency=1 kHz
// To calculate fc

fc = R/(2*%pi*L);
disp (fc,'The Cutoff Frequency in Hertz')
disp ('i.e 3.183 kHz')
```

```

// To calculate Vout at fc

Xl = 2*%pi*f*L;

Zt = sqrt((R*R)+(Xl*Xl));

Vout = Vin*(R/Zt);
disp (Vout,'The Output Voltage in Vpp');
disp ('Appox 9.52 Volts(p-p)')

// To calculate Theta

Theta = atand(-(Xl/R));
disp (Theta,'The Phase angle (Theta z) in Degree');
```

**Scilab code Exa 26.3** Example 172

```
// Grob's Basic Electronics 11e
// Chapter No. 26
// Example No. 26_3
clc; clear;
// Calculate the cutoff frequency for (a) the RC
    high-pass filter; (b) the RL high-pass filter

// Given data

R = 1.5*10^3;         // Resistor=1.5 kOhms
L = 100*10^-3         // Inductor=100 mHenry
C = 0.01*10^-6;       // Capacitor=0.01 uFarad

// To calculate fc for RC high-pass filter

fc = 1/(2*%pi*R*C);
disp (fc,'The Cutoff Frequency for RC High-Pass
```

```
    Filter in Hertz')
disp ('i.e 10.61 kHz')

// To calculate fc for RL high-pass filter

fc1 = R/(2*%pi*L);
disp (fc1,'The Cutoff Frequency for RL High-Pass
    Filter in Hertz')
disp ('Appox 2.39 kHz')
```

**Scilab code Exa 26.4** Example 173

```
// Grob's Basic Electronics 11e
// Chapter No. 26
// Example No. 26_4
clc; clear;
// Calculate the cutoff frequencies fc1 and fc2.

//Given data

R1 = 1*10^3;          // Resistor 1=1 kOhms
C1 = 1*10^-6;         // Capacitor 1=1 uFarad
R2 = 100*10^3;        // Resistor 2=100 kOhms
C2 = 0.001*10^-6;     // Capacitor 2=0.001 uFarad

// To calculate fc1 for RC high-pass filter

fc1 = 1/(2*%pi*R1*C1);
disp (fc1,'The Cutoff Frequency for RC High-Pass
    filter in Hertz');
disp ('i.e 159 Hz')

// To calculate fc2 for RC high-pass filter

fc2 = 1/(2*%pi*R2*C2);
```

```
disp (fc2,'The Cutoff Frequency for RC High-Pass
    filter in Hertz');
disp ('i.e 1.59 kHz')
```

**Scilab code Exa 26.5** Example 174

```
// Grob's Basic Electronics 11e
// Chapter No. 26
// Example No. 26_5
clc; clear;
// Calculate the notch frequency fn if R1 is 1 kOhms
     and C1 is 0.01 uF. Also, calculate the required
    values for 2R1 and 2C1 in the low-pass filter.

// Given data

R1 = 1*10^3;          // Resistor 1=1 kOhms
C1 = 0.01*10^-6;      // Capacitor 1=0.01 uFarad
pi = 3.14;

// To calculate Notch frequency fn for RC low-pass
    filter

fn = 1/(4*pi*R1*C1);
disp (fn,'The Notch Frequency for RC Low-Pass filter
     in Hertz');
disp ('i.e 7.96 kHz')

A = 2*R1;
disp (A,'The Required Value of 2R1 in Ohms')
disp ('i.e 2 kOhms')

B = 2*C1;
disp (B,'The Required Value of 2C1 in Ohms')
disp ('0.02 uF')
```

**Scilab code Exa 26.6** Example 175

```
// Grob's Basic Electronics 11e
// Chapter No. 26
// Example No. 26_6
clc; clear;
// A certain amplifier has an input power of 1 W and
    an output power of 100 W. Calculate the dB power
   gain of the amplifier.

// Given data

Pi = 1;      // Input power=1 Watts
Po = 100;    // Output power=100 Watts

N = 10*log10(Po/Pi);
disp (N,'The Power Gain of Amplifier in dB')
```

**Scilab code Exa 26.7** Example 176

```
// Grob's Basic Electronics 11e
// Chapter No. 26
// Example No. 26_7
clc; clear;
// The input power to a filter is 100 mW, and the
   output power is 5 mW. Calculate the attenuation,
   in decibels, offered by the filter.

// Given data

Pi = 100*10^-3;     // Input power=1 Watts
```

```
Po = 5*10^-3;        // Output power=100 Watts

N = 10*log10(Po/Pi);
disp (N,'The Attenuation offered by the Filter in dB')
```

**Scilab code Exa 26.8** Example 177

```
// Grob's Basic Electronics 11e
// Chapter No. 26
// Example No. 26_8
clc; clear;
// Calculate the attenuation, in decibels, at the following frequencies: (a) 0 Hz; (b) 1.592 kHz; (c) 15.92 kHz. (Assume that Vin is 10 V p-p at all frequencies.)

// Given data

f1 = 0;                       // Frequency 1=0 Hz
f2 = 1.592*10^3;              // Frequency 2=1.592 kHz (cutoff frequency)
f3 = 15.92*10^3;              // Frequency 3=15.92 kHz
Vi = 10;                      // Voltage input=10 Volts(p-p)
R = 10*10^3;                  // Resistor 1=10 kOhms
C = 0.01*10^-6;               // Capacitor 1=0.01 uFarad
pi = 3.14;

Vo1 = Vi;
Vo2 = 0.707*Vi;

// At 0 Hz

N1 = 20*log10(Vo1/Vi);
```

```
disp (N1,'The Attenuation at 0 Hz in dB')

//At 1.592 kHz (cutoff frequency)

N2 = 20*log10(Vo2/Vi);
disp (N2,'The Attenuation at 1.592 kHz in dB')

// At 15.92 kHz

Xc = 1/(2*%pi*f3*C);

A = R*R;
B = Xc*Xc;

Zt = sqrt (A+B);

N3 = 20*log10(Xc/Zt);
disp (N3,'The Attenuation at 15.92 kHz in dB')
```

**Scilab code Exa 26.9** Example 178

```
// Grob's Basic Electronics 11e
// Chapter No. 26
// Example No. 26_9
clc; clear;
// From the graph in Fig. 26 23b, what is the
   attenuation in decibels at (a) 100 Hz; (b) 10 kHz
   ; (c) 50 kHz?

disp ('At F = 100 Hz, N(dB) = 0 dB, as indicated by
   point A on the graph.')
disp ('At F = 10 kHz, N(dB) = −16 dB, as indicated
   by point B on the graph.')
disp ('At F = 50 kHz, N(dB) = −30 dB, as indicated
   by point C on the graph.')
```

# Chapter 28

# Chapter 27 Diodes and Diode Applications

**Scilab code Exa 27.1** Example 179

```
// Grob's Basic Electronics 11e
// Chapter No. 27
// Example No. 27_1
clc; clear;
// For the diode curve, calculate the dc resistance, RF, at points A and B.

// Given data

Vf1 = 0.65;          // Forward votage 1=0.65 Volts
If1 = 11*10^-3       // Forward current 1=11 mAmps
Vf2 = 0.7;           // Forward votage 2=0.7 Volts
If2 = 22.5*10^-3     // Forward current 2=22.5 mAmps

Rf1 = Vf1/If1;
disp (Rf1,'The Forward Resistance at Point A in Ohms')
disp ('Appox 59.1 Ohms')

```

```
Rf2 = Vf2/If2;
disp (Rf2,'The Forward Resistance at Point B in Ohms
    ')
```

**Scilab code Exa 27.2** Example 180

```
// Grob's Basic Electronics 11e
// Chapter No. 27
// Example No. 27_2
clc; clear;
// A silicon diode has a forward voltage drop of 1.1
     V for a forward diode current, If, of 1 A.
    Calculate the bulk resistance, Rb.

// Given data

Vf1 = 1.1;  // Forward votage 1=1.1 Volts
If1 = 1     // Forward current 1=1 Amps
Vf2 = 0.7;  // Fwd. vltg. 2=0.7 Volts (min working
    vltg of diode is 0.7 V)
If2 = 0     // Forward current=0 Amps

delV = Vf1-Vf2;     // diff. between max. min.
    Voltages
delI = If1-If2;     // diff. between max. min.
    Currents

Rb = delV/delI;
disp (Rb,'The Bulk Resistance in Ohms')
```

**Scilab code Exa 27.3** Example 181

```
// Grob's Basic Electronics 11e
```

```
// Chapter No. 27
// Example No. 27_3
clc; clear;
// Solve for the load voltage and current using the
   first, second, and third diode approximations.

// Given data

Rl = 100;        // Load resistance=100 Ohms
Rb = 2.5;        // Resistance=2.5 Ohms
Vin = 10;        // Input voltage=10 Volts
Vb = 0.7;        // Voltage=0.7 Volts


// Using first approximation

Vl1 = Vin
disp (Vl1,'The Load Voltage of First Approximation
   in Volts(dc)')

Il1 = Vl1/Rl;
disp (Il1,'The Load Current of First Approximation
   in Amps')
disp ('i.e 100 mAmps')

// Using second approximation

Vl2 = Vin-Vb
disp (Vl2,'The Load Voltage of Second Approximation
   in Volts')

Il2 = Vl2/Rl;
disp (Il2,'The Load Current of Second Approximation
   in Amps')
disp ('i.e 93 mAmps')

// Using third approximation

```

```
Il3 = (Vin-Vb)/(Rl+Rb);
disp (Il3,'The Load Current of Third Approximation
    in Amps')
disp ('i.e 90.73 mAmps')

Vl3 = Il3*Rl;
disp (Vl3,'The Load Voltage of Third Approximation
    in Volts')
```

**Scilab code Exa 27.4** Example 182

```
// Grob's Basic Electronics 11e
// Chapter No. 27
// Example No. 27_4
clc; clear;
// If the turns ratio Np:Ns is 3:1, calculate the
    following: Vs, Vdc, Il, Idiode, PIV for D1, and
    fout.

// Given data

Vp = 120;          // Primary voltage=120 Vac
A = 3/1;           // Turns ratio Np:Ns=3:1
B = 1/3;           // Turns ratio Ns:Np=1:3
Rl = 100;          // Load resistance=100 Ohms
fi = 60;           // Input frequency=60

Vs = B*Vp;
disp (Vs,'The Secondary Voltage in Volts(ac)')

Vspk = (Vs*1.414);

C = Vspk-0.7;

Vdc = 0.318*C;
```

```
disp (Vdc,'The DC Voltage in Volts')

Il = Vdc/Rl;
disp (Il,'The Load Current in Amps');

Idiode = Il;
disp (Idiode,'The DC Diode Current in Amps')

PIV = Vspk;
disp (PIV,'The PIV for Diode-1 in Volts')

fo =fi;
disp (fo,'The Output Frequency in Hertz')
```

**Scilab code Exa 27.5** Example 183

```
// Grob's Basic Electronics 11e
// Chapter No. 27
// Example No. 27_5
clc; clear;
// If the turns ratio Np:Ns is 3:1, calculate the
   following: Vdc, Il, Idiode, PIV for D1, and fout.

// Given data

Vp = 120;        // Primary voltage=120 Vac
A = 3/1;         // Turns ratio Np:Ns = 3:1
B = 1/3;         // Turns ratio Ns:Np = 1:3
Rl = 100;        // Load resistance=100 Ohms

Vs = B*Vp;
Vspk = 1.414*(Vs/2);
Vopk = Vspk-0.7;

Vdc = 0.636*Vopk;
```

```
disp (Vdc,'The DC Voltage in Volts')

Il = Vdc/Rl;
disp (Il,'The Load Current in Amps')
disp ('i.e 175.4 mAmps')

Idiode = Il/2;
disp (Idiode,'The DC Diode Current in Amps')
disp ('i.e 87.7 mAmps')

C = (Vspk*2)-0.7;

PIV = C;
disp (PIV,'The PIV for Diode-1 in Volts')

f =120;
disp (f,'The Output Frequency in Hertz')
```

**Scilab code Exa 27.6** Example 184

```
// Grob's Basic Electronics 11e
// Chapter No. 27
// Example No. 27_6
clc; clear;
// If the turns ratio Np:Ns is 3:1, calculate the following: Vdc, Il, Idiode, PIV for each diode, and fout.

// Given data

Vp = 120;       // Primary voltage=120 Vac
A = 3/1;        // Turns ratio Np:Ns = 3:1
B = 1/3;        // Turns ratio Ns:Np = 1:3
Rl = 100;       // Load resistance=100 Ohms

```

```
Vs = B*Vp;
Vspk = 1.414*(Vs);
Vopk = Vspk-1.4;

Vdc = 0.636*Vopk;
disp (Vdc,'The DC Voltage in Volts')

Il = Vdc/Rl;
disp (Il,'The Load Current in Amps')
disp ('i.e 350.8 mAmps')

Idiode = Il/2;
disp (Idiode,'The DC Diode Current in Amps')
disp ('i.e 175.4 mAmps')

C = Vspk-0.7;

PIV = C;
disp (PIV,'The PIV for each Diode in Volts')

f =120;
disp (f,'The Output Frequency in Hertz')
```

**Scilab code Exa 27.7** Example 185

```
// Grob's Basic Electronics 11e
// Chapter No. 27
// Example No. 27_7
clc; clear;
// Assume the transformer turns ratio Np:Ns = 4:1 in
   Fig. 27  21 a and 2:1 in Fig. 27  22a. Compare
   Vripple and Vdc if C = 500 uF and Rl = 250.

// Given data

```

```
A1 = 4/1;            // Turns ratio Np:Ns=4:1
B1 = 1/4;            // Turns ratio Ns:Np=1:4
A2 = 2/1;            // Turns ratio Np:Ns=2:1
B2 = 1/2;            // Turns ratio Ns:Np=1:2
Vp = 120;            // Primary voltage=120 Vac
Vb = 0.7;            //
t1 = 16.67*10^-3;    // Charging Time of Capacitor of
    Turns ratio Np:Ns=4:1=16.67 mSec
t2 = 8.33*10^-3;     // Charging Time of Capacitor of
    Turns ratio Np:Ns=4:1=8.33 mSec
Rl = 250;            // Load resistance=250 Ohms
C = 500*10^-6;       // Capacitor=500 uFarad

// Calculations for Turns Ratio Np:Ns=4:1

Vs1 = B1*Vp;
Vspk1 = Vs1*1.414;
Vopk1 = Vspk1 - Vb;
D = -t1/(Rl*C);

Vrp1 = Vopk1*(1-(%e^D));
disp (Vrp1,'The Ripple Voltage for Turns Ratio Np:Ns
   =4:1 in Volts(p-p)')
disp ('Appox 5.21 Volts(p-p)')

Vdc1 = Vopk1-(Vrp1/2);
disp (Vdc1,'The DC Voltage for Turns Ratio Np:Ns=4:1
    in Volts')
disp ('Appox 39.12 Volts')

// Calculations for Turns Ratio Np:Ns = 2:1

Vs2 = B2*Vp;
V2 = Vs2/2;
V2pk2 = V2*1.414
Vopk2 = V2pk2 - Vb;
E = -t2/(Rl*C);

```

```
Vrp2 = Vopk2*(1-(%e^E));
disp (Vrp2,'The Ripple Voltage for Turns Ratio Np:Ns
    =2:1 in Volts(p-p)')
disp ('Appox 2.69 Volts(p-p)')

Vdc2 = Vopk2-(Vrp2/2);
disp (Vdc2,'The DC Voltage for Turns Ratio Np:Ns=2:1
     in Volts')
disp ('Appox 40.38 Volts')
```

**Scilab code Exa 27.8** Example 186

```
// Grob's Basic Electronics 11e
// Chapter No. 27
// Example No. 27_8
clc; clear;
//  Calculate the LED current.

// Given data

Vin = 24;          // Input voltage=24 Volts
Vled = 2;          // Voltage drop at LED=2 Volts
Rs = 2.2*10^3;     // Source Resistance=2.2 kOhms

Iled = (Vin-Vled)/Rs;
disp (Iled,'The LED Current in Amps')
disp ('i.e 10 mAmps')
```

**Scilab code Exa 27.9** Example 187

```
// Grob's Basic Electronics 11e
// Chapter No. 27
// Example No. 27_9
```

```
clc; clear;
// Calculate the resistance Rs, required to provide
   an LED current of 25 mA.

// Given data

Vin = 24;           // Input voltage=24 Volts
Vled = 2;           // Voltage drop at LED=2 Volts
Iled = 25*10^-3;    // LED Current=25 mAmps

Rs = (Vin-Vled)/Iled;
disp (Rs,'The Resistance Rs, Required to Provide an
   LED Current of 25 mA in Ohms')
```

**Scilab code Exa 27.10** Example 188

```
// Grob's Basic Electronics 11e
// Chapter No. 27
// Example No. 27_10
clc; clear;
// Calculate the maximum rated zener current for a 1
   W, 10 V zener.

// Given data

Pzm = 1;        // Power rating of zener= 1 Watts
Vz = 10;        // Voltage rating of zener= 10 Volts

Izm = Pzm/Vz;
disp (Izm,'The Maximum Rated Current of Zener in
   Amps')
disp ('i.e 100 mAmps')
```

**Scilab code Exa 27.11** Example 189

```
// Grob's Basic Electronics 11e
// Chapter No. 27
// Example No. 27_11
clc; clear;
// If Vz=10 V, calculate Iz.

// Given data

Vin = 25;        // Input voltage=25 Volts
Vz = 10;         // Zener voltage=10 Volts
Rs = 1*10^3;     // Source Resistance=1 kOhms

Iz = (Vin-Vz)/Rs;
disp (Iz,'The Zener Current in Amps')
disp ('i.e 15 mAmps')
```

---

**Scilab code Exa 27.12** Example 190

```
// Grob's Basic Electronics 11e
// Chapter No. 27
// Example No. 27_12
clc; clear;
// If R L increases to 250 Ohms, calculate the
   following: Is, Il, Iz, and Pz.

// Given data

Vin = 25;        // Input voltage=25 Volts
Vz = 7.5;         // Zener voltage=7.5 Volts
Rl = 250;     // Load Resistance=250 Ohms
Is = 75*10^-3;   // Source current=75 mAmps

disp (Is,'The Source Current in Amps')
```

```
disp ('i.e 75 mAmps')

Il = Vz/Rl;
disp (Il,'The Load Current in Amps')
disp ('i.e 30 mAmps')

Iz = Is-Il;
disp (Iz,'The Zener Current in Amps')
disp ('i.e 45 mAmps')

Pz = Vz*Iz;
disp (Pz,'The Power Dissipation of Zener in Watts')
disp ('i.e 337.5 mWatts')
```

**Scilab code Exa 27.13** Example 191

```
// Grob's Basic Electronics 11e
// Chapter No. 27
// Example No. 27_13
clc; clear;
// Calculate Is, Il and Iz for (a)Rl=200 ohms; (b)Rl
   =500 ohms.

// Given data

Vin = 16;        // Vin=16 Volts given
Vz = 10;         // Vz=10 Volts given
Rs = 100;        // Source Resistance = 100 ohms
   given
Rla = 200;       // Load Resistance A = 200 ohms
   given
Rlb = 500;       //Load Resistance B = 500 ohms given

// For Rl 200 ohms

```

```
Is = (Vin-Vz)/Rs;
disp (Is,'The Source Current in Amps.')
disp ('i.e 60 mAmps')

Ila = Vz/Rla;
disp (Ila,'The Load Current for 200 ohms Load in
    Amps.')
disp ('i.e 50 mAmps')

Iza = Is-Ila
disp (Iza,'The Zener Current for 200 ohms Load in
    Amps.')
disp ('i.e 10 mAmps')

// For Rl 500 ohms

Ilb = Vz/Rlb;
disp (Ilb,'The Load Current for 500 ohms Load in
    Amps.')
disp ('i.e 20 mAmps')

Izb = Is-Ilb
disp (Izb,'The Zener Current for 500 ohms load in
    Amps.')
disp ('i.e 40 mAmps')
```

# Chapter 29

# Chapter 28 Bipolar Junction Transistors

**Scilab code Exa 28.1** Example 192

```
// Grob's Basic Electronics 11e
// Chapter No. 28
// Example No. 28_1
clc; clear;
// A transistor has the following currents: Ib is 20
    mA and Ic is 4.98 A. Calculate Ie.

// Given data

Ib = 20*10^-3;       // Base current=20 mAmps
Ic = 4.98;           // Collector current=4.98 Amps

Ie = Ic+Ib;
disp (Ie,'The Emitter Current Ie in Amps')
```

**Scilab code Exa 28.2** Example 193

```
// Grob's Basic Electronics 11e
// Chapter No. 28
// Example No. 28_2
clc; clear;
// A transistor has the following currents: Ie is
   100 mA, Ib is 1.96 mA. Calculate Ic.

// Given data

Ie = 100*10^-3;        // Emitter current=100 mAmps
Ib = 1.96*10^-3;       // Base current=4.98 Amps

Ic = Ie-Ib;
disp (Ic,'The Collector Current Ic in Amps')
disp ('i.e 98.04 mAmps')
```

**Scilab code Exa 28.3** Example 194

```
// Grob's Basic Electronics 11e
// Chapter No. 28
// Example No. 28_3
clc; clear;
// A transistor has the following currents: Ie is 50
    mA, Ic is 49 mA. Calculate Ib.

// Given data

Ie = 50*10^-3;        // Emitter current=50 mAmps
Ic = 49*10^-3;        // Collector current=20 mAmps

Ib = Ie-Ic;
disp (Ib,'The Base Current Ib in Amps')
disp ('i.e 1 mAmps')
```

**Scilab code Exa 28.4** Example 195

```
// Grob's Basic Electronics 11e
// Chapter No. 28
// Example No. 28_4
clc; clear;
// A transistor has the following currents: Ie is 15
    mA, Ib is 60 uA. Calculate Alpha(dc).

// Given data

Ie = 15*10^-3;        // Emitter current=15 mAmps
Ib = 60*10^-6;        // Base current=60 uAmps

Ic = Ie-Ib;

Adc = Ic/Ie;
disp (Adc,'The Value of Alpha(dc) is')
```

**Scilab code Exa 28.5** Example 196

```
// Grob's Basic Electronics 11e
// Chapter No. 28
// Example No. 28_5
clc; clear;
// A transistor has the following currents: Ic is 10
    mA and Ib is 50 uA. Calculate Beta(dc).

// Given data

Ic = 10*10^-3;        // Collector current=10 mAmps
Ib = 50*10^-6;        // Base current=50 uAmps
```

```

Bdc = Ic/Ib;
disp (Bdc,'The Value of Beta(dc) is')
```

**Scilab code Exa 28.6** Example 197

```
// Grob's Basic Electronics 11e
// Chapter No. 28
// Example No. 28_6
clc; clear;
// A transistor has Beta(dc) of 150 and Ib of 75
   uAmps. Calculate Ic.

// Given data

Bdc = 150;            // Beta(dc)=150
Ib = 75*10^-6;        // Base current=75 uAmps

Ic = Bdc*Ib;
disp (Ic,'The Collector Current Ic in Amps')
disp ('i.e 11.25 mAmps')
```

**Scilab code Exa 28.7** Example 198

```
// Grob's Basic Electronics 11e
// Chapter No. 28
// Example No. 28_7
clc; clear;
// A transistor has Beta(dc) of 100. Calculate Alpha
   (dc).

// Given data

```

```
Bdc = 100;   // Beta(dc)=100

Adc = Bdc/(1+Bdc);
disp (Adc,'The Value of Alpha(dc) is')
```

**Scilab code Exa 28.8** Example 199

```
// Grob's Basic Electronics 11e
// Chapter No. 28
// Example No. 28_8
clc; clear;
// A transistor has Alpha(dc) of 0.995. Calculate
   Beta(dc).

// Given data

Adc = 0.995;   // Alpha(dc)=100

Bdc = Adc/(1-Adc);
disp (Bdc,'The Value of Beta(dc) is')
```

**Scilab code Exa 28.9** Example 200

```
// Grob's Basic Electronics 11e
// Chapter No. 28
// Example No. 28_9
clc; clear;
// Calculate Pd if Vcc is 10 V and Ib is 50 uAmps.
   Assume Beta(dc) is 100.

// Given data

Bdc = 100;           // Beta(dc)=100
```

```
Ib = 50*10^-6;          // Base current=50 uAmps
Vcc = 10;               // Supply voltage=10 Volts

Vce = Vcc

Ic = Bdc*Ib;

Pd = Vce*Ic;
disp (Pd,'The Power Dissipation in Watts')
disp ('i.e 50 mWatts')
```

**Scilab code Exa 28.10** Example 201

```
// Grob's Basic Electronics 11e
// Chapter No. 28
// Example No. 28_10
clc; clear;
// The transistor has a power rating of 0.5 W. If
   Vce is 20 V, calculate the maximum allowable
   collector current, Ic, that can exist without
   exceeding the transistor s power rating.

// Given data

Pdmax = 0.5;            // Power dissipation(max)=0.5
   Watts
Vce = 20;               // Voltage (collector to emitter
   )=20 Volts

Ic = Pdmax/Vce;
disp (Ic,'The Maximum Allowable Collector Current Ic
   (max) in Amps')
disp ('i.e 25 mAmps')
```

**Scilab code Exa 28.11** Example 202

```
// Grob's Basic Electronics 11e
// Chapter No. 28
// Example No. 28_11
clc; clear;
// Assume that a transistor has a power rating Pd(max) of 350 mW at an ambient temperature Ta of 25 C . The derating factor is 2.8 mW/ C . Calculate the power rating at 50 C .

// Given data

f = 2.8*10^-3;          // Derating factor=2.8 mW/ C
Pd = 350*10^-3;         // Power dissipation(max)=350 mWatts
Ta = 25;                // Ambient Temperature=25 C
Tp = 50;                // Power rating at 50 C

delT = Tp-Ta;           // Difference between max and min temp

delPd = delT*f;

Prat = Pd-delPd;
disp (Prat,'The Power Rating at 50 C in Watts')
disp ('i.e 280 mWatts')
```

**Scilab code Exa 28.12** Example 203

```
// Grob's Basic Electronics 11e
// Chapter No. 28
```

```
// Example No. 28_12
clc; clear;
// Solve for Ib, Ic, Vce. Also, Construct a dc load
   line showing the valuse of Ic(sat), Vce(off), Icq
   , Vceq.

// Given data
Vcc = 12;                    // Supply voltage=12 Volts
Vbe = 0.7;                   // Base-Emitter Voltage=0.7
   Volts
Rb = 390*10^3;               // Base Resistor=390K Ohms
Rc = 1.5*10^3;               // Collector Resistor=1.5K
   Ohms
B = 150;                     // Beta(dc)=150

Ib = (Vcc-Vbe)/Rb;
disp (Ib,'The Base Current in Amps.')
disp ('Appox 28.97 mAmps')

Icq = B*Ib;
disp (Icq,'The Collector Current in Amps');
disp ('Appox 4.35 mAmps')

Vceq = Vcc-(Icq*Rc);
disp (Vceq, 'The Voltage Collector-Emitter in Volts'
   )

// For DC load line

Icsat = (Vcc/Rc);
Vceoff = Vcc;

Vce1=[Vceoff Vceq 0]
Ic1=[0 Icq Icsat]

//To plot DC load line

printf("Q(%f,%f)\n",Vceq,Icq)
```

```
plot2d(Vce1, Ic1)
plot(Vceq,Icq,".r")
plot(0,Icq,".r")
plot(Vceq,0,".r")
plot(0,Icsat,".b")
plot(Vceoff,0,".b")
xlabel("Vce in volt")
ylabel("Ic in Ampere")
xtitle("DC Load-line for Base-Biased Transistor
    Circuit")
```

**Scilab code Exa 28.13** Example 204

```
// Grob's Basic Electronics 11e
// Chapter No. 28
// Example No. 28_13
clc; clear;
// Solve for Vb, Ve, Ic, Vc, and Vce. Also,
    calculate Ic(sat) and Vce(off). Finally,
    construct a dc load line showing the values of Ic
    (sat), Vce(off), Icq, and Vceq.

// Given data

R1 = 33*10^3;        // Resistor 1=33 kOhms
R2 = 5.6*10^3;       // Resistor 2=5.6 kOhms
Rc = 1.5*10^3;       // Collector resistance=1.5
    kOhms
Re = 390;            // Emitter resistance=390 Ohms
Bdc = 200;           // Beta(dc)= 200
Vcc = 18;            // Supply voltage = 18 Volts
Vbe = 0.7;           // Base-Emmiter Voltage=0.7
    Volts

Vb = Vcc*(R2/(R1+R2));
```

```
disp (Vb,'The Base Voltage in Volts')

Ve = Vb-Vbe;
disp (Ve,'The Emmiter Voltage in Volts')

Ie = Ve/Re;          // Emitter current

Ic = Ie;

Vc = Vcc-(Ic*Rc);
disp (Vc,'The Collector Voltage in Volts')
disp ('Appox 10.65 Volts')

Vce = Vcc-(Ic*(Rc+Re));
disp (Vce,'The Collector-Emitter Voltage in Volts')
disp ('Appox 8.74 Volts')

Icsat = Vcc/(Rc+Re);
disp (Icsat,'The Current Ic(sat) in Amps')
disp ('i.e 9.52 mAmps')

Vceoff = Vcc;
disp (Vceoff,'The Voltage Vce(off) in Volts')

Icq = Ic
Vceq = Vce

Vce1=[Vcc Vceq 0]
Ic1=[0 Icq Icsat]

//To plot DC load line

printf("Q(%f,%f)\n",Vceq,Icq)
plot2d(Vce1, Ic1)
plot(Vceq,Icq,".r")
plot(0,Icq,".r")
plot(Vceq,0,".r")
plot(0,Icsat,".b")
```

```
plot(Vceoff,0,".b")
xlabel("Vce in Volt")
ylabel("Ic in mAmps")
xtitle("DC Load-line for Voltage Divider-Biased Transistor Circuit")
```

**Scilab code Exa 28.14** Example 205

```
// Grob's Basic Electronics 11e
// Chapter No. 28
// Example No. 28_14
clc; clear;
// For the pnp transistor, solve for Vb, Ve, Ic, Vc, and Vce.

// Given data

R1 = 33*10^3;       // Resistor1=33 kOhms
R2 = 6.2*10^3;      // Resistor2=6.2 kOhms
Rc = 2*10^3;        // Collector resistance=2 kOhms
Re = 500;           // Emitter resistance=500 Ohms
Vcc = 12;           // Supply voltage=12 Volts
Vbe = 0.7;          // Base-Emmiter Voltage=0.7 Volts


Vb = -Vcc*(R2/(R1+R2));
disp (Vb,'The Base Voltage in Volts')
disp ('Appox -1.9 Volts')

Ve = Vb-(-Vbe);
disp (Ve,'The Emitter Voltage in Volts')
disp ('Appox -1.2 Volts')

Ic = -(Ve/Re);       // Ic =~ Ie
disp (Ic,'The Collector Current in Amps')
```

```
disp ('Appox 2.4 mAmps')

Vc = -Vcc+(Ic*Rc)
disp (Vc,'The Collector Voltage in Volts')

Vce = -Vcc+(Ic*(Rc+Re));
disp (Vce,'The Collector-Emitter Voltage in Volts');
```

**Scilab code Exa 28.15** Example 206

```
// Grob's Basic Electronics 11e
// Chapter No. 28
// Example No. 28_15
clc;clear;
// Calculate Ie and Vc

// Given data

Vee = 6;          // Supply voltage at emitter=6 Volts
Vcc = 15;         // Supply voltage at collector=15 Volts
Vbe = 0.7;        // Base-Emmiter Voltage=0.7 Volts
Rc = 1.5*10^3;    // Collector resistance=1.5 kOhms
Re = 1*10^3;      // Emitter resistance=1 kOhms

Ie = (Vee-Vbe)/Re;
disp (Ie,'The Emitter current in Amps')
disp ('i.e 5.3 mAmps')

Ic = Ie;          // Ic =~ Ie

Vc = Vcc-Ic*Rc;
disp (Vc,'The Collector voltage in Volts')
```

# Chapter 30

# Chapter 29 Transistor Amplifiers

**Scilab code Exa 29.1** Example 207

```
// Grob's Basic Electronics 11e
// Chapter No. 29
// Example No. 29_1
clc; clear;
// For the diode circuit, calculate the ac
   resistance, rac, for the following values of R: (
   a) 10 kOhms, (b) 5 kOhms, and (c) 1 kOhms. Use
   the second approximation of a diode.

// Given data

R1 = 10*10^3;       // Resistance 1=10 kOhms
R2 = 5*10^3;        // Resistance 2=5 kOhms
R3 = 1*10^3;        // Resistance 3=1 kOhms
Vdc = 10;           // DC supply=10 Volts
V = 0.7;            // Starting voltage of diode=0.7
   Volts
A = 25*10^-3;       // Constant

```

```
// For R=10 kOhms

Id1 = (Vdc-V)/R1;

rac1 = A/Id1;
disp (rac1,'The Ac Resistance with R=10 kOhms in
   Ohms')

// For R=5 kOhms

Id2 = (Vdc-V)/R2;

rac2 = A/Id2;
disp (rac2,'The Ac Resistance with R=5 kOhms in Ohms
   ')

// For R=1 kOhms

Id3 = (Vdc-V)/R3;

rac3 = A/Id3;
disp (rac3,'The Ac Resistance with R=1 kOhms in Ohms
   ')
disp ('Appox 2.69 Ohms')
```

**Scilab code Exa 29.2** Example 208

```
// Grob's Basic Electronics 11e
// Chapter No. 29
// Example No. 29_2
clc;clear;
//A common-emitter amplifier circuit has an input of
   25 mVp-p and an output of 5 Vp-p. Calculate Av.

// Given data
```

```
Vin = 25*10^-3;        // Input voltage=25 mVolts(p-p)
Vo = 5;                // Output voltage=5 Volts(p-p).

Av = Vo/Vin;
disp (Av,'The Voltage Gain Av is')
```

**Scilab code Exa 29.3** Example 209

```
// Grob's Basic Electronics 11e
// Chapter No. 29
// Example No. 29_3
clc; clear;
// assume Av still equals 300. If vin is 5 mVp-p,
   calculate Vout.

// Given data

Vin = 5*10^-3;        // Input voltage=5 mVolts(p-p)
Av = 300;             // Voltage gain=300

Vo = Av*Vin;
disp (Vo,'The Output Voltage in Volts(p-p)')
```

**Scilab code Exa 29.4** Example 210

```
// Grob's Basic Electronics 11e
// Chapter No. 29
// Example No. 29_4
clc; clear;
// Assume that re varies from 3.33 Ohms to 6.67 Ohms
    as the temperature of the transistor changes.
   Calculate the variation in the voltage gain, Av.
```

```

// Given data

rl = 600;        // Load resistance=600 Ohms
re = 6.67;       // Internal emitter resistance=6.67
    Ohms

Av = rl/re;
disp (Av,'The Voltage Gain Av is')
disp ('Appox 90')
```

**Scilab code Exa 29.5** Example 211

```
// Grob's Basic Electronics 11e
// Chapter No. 29
// Example No. 29_5
clc; clear;
// Assume that r'e varies from 3.33 Ohms to 6.67
    Ohms. Calculate the minimum and maximum values
    for Av.

// Given data

rl = 600;      // Load resistance=600 Ohms
re1 = 3.33;    // Internal emitter resistance=3.33
    Ohms
re2 = 6.67;    // Internal emitter resistance=6.67
    Ohms
rE = 60;       // Emitter resistance=60 Ohms

Av1 = rl/(re1+rE);
disp (Av1,"The Voltage Gain Av(max) when r`e=3.33
    Ohms is")

Av2 = rl/(re2+rE);
```

```
disp (Av2,'The Voltage Gain Av(min) when r`e=6.67
    Ohms is')
disp ('Appox 9')
```

**Scilab code Exa 29.6** Example 212

```
// Grob's Basic Electronics 11e
// Chapter No. 29
// Example No. 29_6
clc; clear;
// Find the exact value of Av. Also, find  Vout.

// Given data

rl = 909;        // Load resistance=909 Ohms
re = 3.35;       // Internal emitter resistance=3.35
    Ohms
Vin = 1;         // Input voltage=1 Volts(p-p)

Av = rl/(re+rl);
disp (Av,'The Voltage Gain Av is')

Vo = Av*Vin;
disp (Vo,'The Output Voltage in Volts(p-p)')
disp ('i.e 996 mVolts(p-p)')
```

**Scilab code Exa 29.7** Example 213

```
// Grob's Basic Electronics 11e
// Chapter No. 29
// Example No. 29_7
clc; clear;
// Calculate Zin.
```

```

// Given data

rl = 909;               // Load resistance=909 Ohms
re = 3.35;              // Internal emitter resistance =3.35 Ohms
B = 100;                // Beta=100
R1 = 4.7*10^3;          // Resistance1=4.7 kOhms
R2 = 5.6*10^3;          // Resistance2=5.6 kOhms

Zibase = B*(re+rl);
A = (R1*R2)/(R1+R2);

Zin = (Zibase*A)/(A+Zibase);
disp (Zin,'The Input impedence in Ohms')
disp ('i.e 2.48 kOhms')
```

**Scilab code Exa 29.8** Example 214

```
// Grob's Basic Electronics 11e
// Chapter No. 29
// Example No. 29_8
clc; clear;
// Calculate the following quantities: Vb, Ve, Ic, Vc, Vce, r'e, Zin(base), Zin, Av, vb, and vout. Also, plot the dc load line.

// Given data

R1 = 22*10^3;     // Resistance1=22 kOhms
R2 = 18*10^3;     // Resistance2=18 kOhms
Rg = 600;         // Generator resistance=600 Ohms
Re = 1.5*10^3;    // Emitter resistance=1.5 kOhms
Rl = 1*10^3;      // Load resistance=1 kOhms
Vcc = 20;         // Supply Voltage=20 Volts
```

```
Vbe = 0.7;        // Voltage Base−Emitter=0.7 Volts
B = 200;          // Beta=200
vin = 5;          // Input Voltage=5 Volts(p−p)

// Calculate the DC quantities first:

Vb = Vcc*(R2/(R1+R2));
disp (Vb,'The Base Voltage in Volts')

Ve = Vb-Vbe;
disp (Ve,'The Emitter Voltage in Volts')

Ie = Ve/Re;
Ic = Ie;          // Ic =~ Ie
disp (Ic,'The Collector current in Amps')
disp ('i.e 5.53 mAmps')

Vc = Vcc;         // Since the collector is tied directly to Vcc
disp (Vc,'The Collector Voltage in Volts')

Vce = Vcc-Ve;
disp (Vce,'The Collector−Emmiter Voltage in Volts')

Icsat = Vcc/Re;

Vceoff = Vcc;

// Now, calculate AC quantities:

a = 25*10^-3;

re = a/Ie;
disp (re,'The AC emmiter resistance in Ohms')
disp ('Appox 4.52 Ohms')

b = Re*Rl;
c = Re+Rl;
```

```
rl = b/c;

Av = rl/(rl+re);
disp (Av,'The Voltage gain is')

Zinbase = B*(re+rl);
disp (Zinbase,'The Input Base Impedence in Ohms')
disp ('i.e 120.9 kOhms')

d = 1/Zinbase;
e = 1/R1;
f = 1/R2;

Zin = (d+e+f)^-1
disp(Zin,'The Input Impedence in Ohms')
disp ('i.e 9.15 kOhms')

vb = vin*(Zin/(Zin+Rg));
disp (vb,'The AC base voltage in Volts(p-p)')

vout = Av*vb;
disp(vout,'The AC output voltage in Volts(p-p)')

Icq = Ic
Vceq = Vce

Vce1=[Vcc Vceq 0]
Ic1=[0 Icq Icsat]

//To plot DC load line

printf("Q(%f,%f)\n",Vceq,Icq)
plot2d(Vce1, Ic1)
plot(Vceq,Icq,".r")
plot(0,Icq,".r")
plot(Vceq,0,".r")
plot(0,Icsat,".b")
plot(Vceoff,0,".b")
```

```
xlabel("Vce in Volt")
ylabel("Ic in mAmps")
xtitle("DC Load-line for Emitter Follower Circuit")
```

**Scilab code Exa 29.9** Example 215

```
// Grob's Basic Electronics 11e
// Chapter No. 29
// Example No. 29_9
clc; clear;
// Calculate the following: Ie, Vcb, r'e, Av, vout and zin.

// Given data

Rc = 1.5*10^3;        // Collector resistance=1.5 kOhms
Re = 1.8*10^3;        // Emitter resistance=1.8 kOhms
Rl = 1.5*10^3;        // Load resistance=1.5 kOhms
Vcc = 15;             // +ve Supply Voltage=15 Volts
Vee = 9;              // -ve Supply Voltage=9 Volts
Vbe = 0.7;            // Voltage Base-Emitter=0.7 Volts
vin = 25*10^-3;       // Input Voltage=25 mVolts(p-p)


Ie = (Vee-Vbe)/Re;
disp (Ie,'The Emmiter current in Amps')
disp ('i.e 4.61 mApms')

Ic = Ie;          // Ic =~ Ie

Vcb = Vcc-(Ic*Rc);
disp (Vcb,'The Collector-Base Voltage in Volts')
disp ('Appox 8.09 Volts')
```

```
a = 25*10^-3;

re = a/Ie;
disp (re,'The AC emmiter resistance in Ohms')

b = Rc*Rl;
c = Rc+Rl;

rl = b/c;

Av = rl/re;
disp (Av,'The Voltage gain is')

vout = Av*vin;
disp(vout,'The AC output voltage in Volts(p-p)')
disp ('Appox 3.46 Volts(p-p)')

d = Re*re
e = Re+re

Zin = d/e;
disp (Zin,'The Input Impedence in Ohms')
```

**Scilab code Exa 29.10** Example 216

```
// Grob's Basic Electronics 11e
// Chapter No. 29
// Example No. 29_10
clc; clear;
// Calculate the ac output voltage, vout.

// Given data

Rc = 1.2*10^3;        // Collector resistance=1.2
```

```
   kOhms
Re = 2.2*10^3;        // Emitter resistance=2.2 kOhms
Rl = 3.3*10^3;        // Load resistance=3.3 kOhms
Rg = 600;             // Generator Resistance=600 Ohms
Vcc = 12;             // +ve Supply Voltage=15 Volts
Vee = 12;             // -ve Supply Voltage=9 Volts
Vbe = 0.7;            // Voltage Base-Emitter=0.7
   Volts
vin = 1;              // Input Voltage=1 Volts(p-p)

Ie = (Vee-Vbe)/Re;

a = 25*10^-3;
re = a/Ie;

b = Rc*Rl;
c = Rc+Rl;
rl = b/c;

Av = rl/re;

d = Re*re
e = Re+re
Zin = d/e;

ve = vin*(Zin/(Zin+Rg));

vout = Av*ve;
disp(vout,'The AC output voltage in Volts(p-p)')
```

# Chapter 31

# Chapter 30 Field Effect Transistors

**Scilab code Exa 30.1** Example 217

```
// Grob's Basic Electronics 11e
// Chapter No. 30
// Example No. 30_1
clear; clc;
// Determine Id for each value of Vgs (a) 0V; (b)
    -0.5V; (c) -1V (d) -2V (e) -3V

// Given Data

Vgs1 = 0;           // Voltage Gate-Source 1=0 Volts
Vgs2 = -0.5;        // Voltage Gate-Source 2=-0.5
    Volts
Vgs3 = -1;          // Voltage Gate-Source 3=-1
    Volts
Vgs4 = -2;          // Voltage Gate-Source 4=-2
    Volts
Vgs5 = -3;          // Voltage Gate-Source 5=-3
    Volts
Vgsoff = -4;        // Voltage Gate-Source(off)=-4
```

```
    Volts
Idss = 10*10^-3        // Idss = 10m Amps

a = (1-(Vgs1/Vgsoff))
b = (1-(Vgs2/Vgsoff))
c = (1-(Vgs3/Vgsoff))
d = (1-(Vgs4/Vgsoff))
e = (1-(Vgs5/Vgsoff))

// Vgs = 0 Volts

Id1 = Idss*a*a
disp (Id1,'The Value of Id for Vgs = 0 Volts in Amps')
disp ('i.e 10 mAmps')

// Vgs = -0.5 Volts

Id2 = Idss*b*b
disp (Id2,'The Value of Id for Vgs = -0.5 Volts in Amps')
disp ('i.e 7.65 mAmps')

// Vgs = -1 Volts

Id3 = Idss*c*c
disp (Id3,'The Value of Id for Vgs = -1 Volts in Amps')
disp ('i.e 5.62 mAmps')

// Vgs = -2 Volts

Id4 = Idss*d*d
disp (Id4,'The Value of Id for Vgs = -2 Volts in Amps')
disp ('i.e 2.5 mAmps')

// Vgs = -3 Volts
```

```
Id5 = Idss*e*e
disp (Id5,'The Value of Id for Vgs = -3 Volts in
    Amps')
disp ('i.e 0.625 mAmps')
```

**Scilab code Exa 30.2** Example 218

```
// Grob's Basic Electronics 11e
// Chapter No. 30
// Example No. 30_2
clear; clc;
// Find the minimim and maximum value of Id and Vds
    if Vgs=-1.5 Volts

// Given Data

Idssmin = 2*10^-3;        // Idss(min)=2m Amp
Idssmax = 20*10^-3;       // Idss(max)=20m Amp
Vgs = -1.5;               // Voltage Gate-Source=-1.5V
Vgsoffmin = -2;           // Voltage Gate-Source(off)(
    min)=-2 Volts
Vgsoffmax = -8;           // Voltage Gate-Source(off)(
    max)=-8 Volts
Vdd = 20;                 // Supply Voltage(Drain)=20
    Volts
Rd = 1*10^3;              // Drain Resistance=1k Ohms

a = 1-(Vgs/Vgsoffmin);
b = 1-(Vgs/Vgsoffmax);

// Calculation using Minimum Values

Id1 = Idssmin*a*a;
disp (Id1,'The Value of Id in Amps using Minimum
```

```
Values')
disp ('i.e 125 uAmps')

Vds1 = Vdd-Id1*Rd;
disp (Vds1,'The Value of Vds in Volts using Minimum
   Values')

// Calculation using Maximum Values

Id2 = Idssmax*b*b;
disp (Id2,'The Value of Id in Amps using Maximum
   Values')
disp ('i.e 13.2 mAmps')

Vds2 = Vdd-Id2*Rd;
disp (Vds2,'The Value of Vds in Volts using Maximun
   Values')

Vp = -Vgsoffmax;

Vdsp = Vp+Vgs;
disp (Vdsp,'The Value of Vds(p) in Volts using
   Maximun Values')
```

**Scilab code Exa 30.3** Example 219

```
// Grob's Basic Electronics 11e
// Chapter No. 30
// Example No. 30_3
clear; clc;
// Calculate the value of Vd

// Given Data

Vs = 1;          // Voltage at Resistor Rs=1 Volts
```

```
Rs = 200;         // Source Resistor=200 Ohms
Vdd = 10;         // Supply Voltage(Drain)=10 Volts
Rd = 1*10^3;      // Drain Resistor=1k Ohms

Is=Vs/Rs;

Id = Is;

Vd = Vdd-Id*Rd;
disp (Vd,'The Drain Voltage Vd in Volts')
```

**Scilab code Exa 30.4** Example 220

```
// Grob's Basic Electronics 11e
// Chapter No. 30
// Example No. 30_4
clear; clc;
// Calculate Vg, Vs, Id, Vd.

// Given Data

R1 = 390*10^3;        // Resistor 1=390k Ohms
R2 = 100*10^3;        // Resistor 2=100k Ohms
Rd = 1*10^3;          // Drain Resistor=1k Ohms
Vdd = 15;             // Supply Voltage(Drain)=15
   Volts
Vgs = -1;             // Voltage Gate-Source=-1 Volts
Rs = 800;             // Source Resistor=800 Ohms

Vg = (R2/(R1+R2))*Vdd;
disp (Vg,'The Value of Vg in Volts')
disp ('i.e 3 Volts')

Vs = Vg-Vgs;
disp (Vs,'The Value of Vs in Volts')
```

```
disp ('i.e 4 Volts')

Id = Vs/Rs;
disp (Id,'The Value of Id in Amps.')
disp ('i.e 5 mAmps')

Vd = Vdd-Id*Rd
disp (Vd,'The Value of Vd in Volts')
disp ('Appox 10 Volts')
```

**Scilab code Exa 30.5** Example 221

```
// Grob's Basic Electronics 11e
// Chapter No. 30
// Example No. 30_5
clc; clear;
// Calculate the value Drain Current Id and Drain Voltage Vd.

// Given Data

Vdd = 15;             // Supply Voltage(Drain)=15 Volts
Vbe = 0.7;            // Voltage Base-Emitter=0.7 Volts
Re = 2.2*10^3;        // Emitter Resistor=2.2 kOhms
Rd = 1*10^3;          // Drain Resistor=1 kOhms
Vee = 15;             // Supply Voltage(Emitter)=15 Volts


Ic = (Vee-Vbe)/Re;

Id = Ic;
disp (Id,'The Drain Current Id in Amps')
```

```
disp ('i.e 6.5 mAmps')

Vd = Vdd-Id*Rd;
disp (Vd,'The Drain Voltage Vd in Voltage')
```

**Scilab code Exa 30.6** Example 222

```
// Grob's Basic Electronics 11e
// Chapter No. 30
// Example No. 30_6
clear; clc;
// Calculate the Voltage Gain Av and Output Voltage
   Vo

// Given Data

Rd = 1.5*10^3;        // Drain Resistor=1.5 kOhms
Rl = 10*10^3;         // Load Resistor=10 kOhms
Idss = 10*10^-3;      // Idss=10 mAmps
Vgs = -1;             // Voltage Gate-Source=-1 Volts
Vgsoff = -4;          // Voltage Gate-Source(off)=-4
   Volts
Vin = 0.2;            // Input Voltage=0.2 Volts(p-p)

gmo = 2*Idss/(-Vgsoff);

gm = gmo*(1-(Vgs/Vgsoff));

rl = (Rd*Rl)/(Rd+Rl);

Av = gm*rl;
disp (Av,'The Voltage Gain Av is')
disp ('Appox 4.875')

Vo = Av*Vin
```

```
disp (Vo,'The Output Voltage Vo in Volts(p-p)')
disp ('Appox 0.975 Volts(p-p)')
```

**Scilab code Exa 30.7** Example 223

```
// Grob's Basic Electronics 11e
// Chapter No. 30
// Example No. 30_7
clc; clear;
// Calculate Av, Vo & Zo.

// Given Data

Rs = 240;              // Source Resistor=240 Ohms
Rl = 1.8*10^3;         // Load Resistor=1.8 kOhms
Vgsoff = -8;           // Voltage Gate-Source(off)=-8
    Volts
Vgs = -2;              // Voltage Gate-Source=-2 Volts
Idss = 15*10^-3        // Idss=15 mAmps.
Vin = 1;               // Input Voltage=1 Volts(p-p)

rl = ((Rs*Rl)/(Rs+Rl));
gmo = 2*Idss/-Vgsoff;
gm = gmo*(1-(Vgs/Vgsoff));

Av = gm*rl/(1+gm*rl);
disp (Av,'The Voltage Gain Av is')

Vo = Av*Vin;
disp (Vo,'The Output Voltage Vo in Volts(p-p)')

A = (1/gm);
Zo = ((Rs*A)/(Rs+A));
disp (Zo,'The Output Impedence Zo in Ohms')
disp ('Appox 143.5 Ohms')
```

**Scilab code Exa 30.8** Example 224

```
// Grob's Basic Electronics 11e
// Chapter No. 30
// Example No. 30_8
clear; clc;
//Calculate Av, Vo, Zin.

// Given Data

Rd = 1.2*10^3;        // Drain Resistor=1.2 kOhms
Rl = 15*10^3;         // Load Resistor=15 kOhms
gm = 3.75*10^-3;      // Transconductance=3.75
    mSiemens
Vin = 10*10^-3;       // Input Voltage=10 mVpp
Rs = 200;             // Source Resistor=200 Ohms

rl = ((Rd*Rl)/(Rd+Rl));

Av = gm*rl;
disp (Av, 'The Voltage Gain Av is')

Vo = Av*Vin;
disp (Vo, 'The Output Voltage in Volts(p-p)')
disp ('Appox 41.6 mVolts(p-p)')

A = (1/gm);

Zi = ((Rs*A)/(Rs+A));
disp (Zi,'The Output Impedence Zi in Ohms')
disp ('Appox 114 Ohms')
```

**Scilab code Exa 30.9** Example 225

```
// Grob's Basic Electronics 11e
// Chapter No. 30
// Example No. 30_9
clear; clc;
//Determine Id for each value of Vgs (a) 2V; (b) -2V; (c) 0V

// Given Data
Vgs1 = 2;            // Voltage Gate-Source 1=2 Volts
Vgs2 = -2;           // Voltage Gate-Source 2=-2 Volts
Vgs3 = 0;            // Voltage Gate-Source 3=0 Volts
Vgsoff = -4;         // Voltage Gate-Source(off)=-4 Volts
Idss = 10*10^-3;     // Idss = 10m Amps

a = (1-(Vgs1/Vgsoff));
b = (1-(Vgs2/Vgsoff));
c = (1-(Vgs3/Vgsoff));

// Vgs = 2 Volts

Id1 = Idss*a*a;
disp (Id1,'The Value of Id for Vgs = 2 Volts in Amps')
disp ('i.e 22.5 mAmps')

// Vgs = -2 Volts

Id2 = Idss*b*b;
disp (Id2,'The Value of Id for Vgs = -2 Volts in Amps')
disp ('i.e 2.5 mAmps')

// Vgs = 0 Volts

```

```
Id3 = Idss*c*c;
disp (Id3,'The Value of Id for Vgs = 0 Volts in Amps
    ')
disp ('i.e 10 mAmps')
```

**Scilab code Exa 30.10** Example 226

```
// Grob's Basic Electronics 11e
// Chapter No. 30
// Example No. 30_10
clear; clc;
// Calculate the value of Rd to provide an Id(on) of
    10m Amps.

// Given Data

Vdd = 15;             // Suppy Voltage(Drain)=15 Volts
Vgson = 10;           // Voltage Gate-Source(on)=10
    Volts
Idon = 10*10^-3;      // Drain Current(on)=10m Amps

Rd = (Vdd-Vgson)/Idon;
disp (Rd,'The Drain Resistance in Ohms');

disp('A 470 Ohms resistor would provide the proper
    biasing voltage at the  gate')
```

# Chapter 32

# Chapter 31 Power Amplifiers

**Scilab code Exa 31.1** Example 227

```
// Grob's Basic Electronics 11e
// Chapter No. 31
// Example No. 31_1
clear; clc;
// Calculate the following dc quantities Icq, Vceq,
   Pd, Ic(sat) and Vce(off). Also draw the dc load
   line

// Given Data

R1 = 18*10^3;           // Resistor 1=18k Ohms
R2 = 2.7*10^3;          // Resistor 2=2.7k Ohms
Vcc = 20;               // Supply Voltage(Collector)=20
   Volts
Vbe = 0.7;              // Voltage Base-Emitter=0.7
   Volts
Re = 240;               // Emitter Resistor=240 Ohms
Rc = 1*10^3;            // Collector Resistor=1k Ohms

Vb = Vcc*(R2/(R1+R2));

```

```
Ve = Vb-Vbe;

//Ie = Ic;

Icq = Ve/Re;
disp (Icq,'The value of Icq in Amps')
disp ('i.e Appox 7.91 mAmps')

Vceq = Vcc-Icq*(Rc+Re);
disp (Vceq,'The value of Vceq in Volts')
disp ('Appox 10.19 Volts')

Pd = Vceq*Icq;
disp (Pd,'The Power Dissipation in Watts')
disp ('i.e 80.6 mWatts')

Icsat = Vcc/(Rc+Re);
disp (Icsat,'The value of Ic(sat) in Amps')
disp ('i.e 16.1 mAmps')

Vceoff = Vcc;
disp (Vceoff,'The value of Vce(off) in Volts')

// For DC load line

Vce1=[Vceoff Vceq 0]
Ic1=[0 Icq Icsat]

//To plot DC load line

printf("Q(%f,%f)\n",Vceq,Icq)
plot2d(Vce1, Ic1)
plot(Vceq,Icq,".r")
plot(0,Icq,".r")
plot(Vceq,0,".r")
plot(0,Icsat,".b")
plot(Vceoff,0,".b")
xlabel("Vce in volt")
```

```
ylabel("Ic in Ampere")
xtitle("DC Load-line for Common-Emitter Class A
    Amplifier Circuit")
```

**Scilab code Exa 31.2** Example 228

```
// Grob's Basic Electronics 11e
// Chapter No. 31
// Example No. 31_2
clc; clear;
// Claculate the following AC quantities Av, Vout,
    Pl, Pcc and percent efficiency. Also calculate
    the endpoints of ac loadline

// Given data

Icq = 7.91*10^-3;       // Collector Currect(Q-point
    )=7.91 mAmps
Rl = 1.5*10^3;          // Load Resistor=1.5 kOhms
Rc = 1*10^3;            // Collector Resistor=1
    kOhms
Vin = 25*10^-3;         // Input Voltage=25 mVolts(p
    -p)
R1 = 18*10^3;           // Resistor 1=18 kOhms
R2 = 2.7*10^3;          // Resistor 2=2.7 kOhms
Vcc = 20;               // Supply Voltage(Collector)
    =20 Volts
Vceq = 10.19;           // Voltage Colector-Emitter(
    Q-point)=10.19 Volts

rc = (25*10^-3)/Icq;
rl = (Rc*Rl)/(Rc+Rl)

Av = rl/rc;
disp (Av,'The Voltage Gain Av is')
```

```
disp ('Appox 190')

Vout = Av*Vin;
disp (Vout,'The Output Voltage in Volts')
disp ('Appox 4.75 Volts')

Pl = (Vout*Vout)/(8*Rl);
disp (Pl,'The Load Power in Watts')
disp ('i.e Appox 1.88 mWatts')

Ivd = Vcc/(R1+R2);
// Ic = Icq
Icc = Ivd+Icq;

Pcc = Vcc*Icc;
disp (Pcc,'The Dc Input Power in Watts')
disp ('i.e Appox 177.4 mWatts')

efficiency = ((Pl/Pcc)*100);
disp (efficiency,'The Efficiency in % is')
disp ('Appox 1%')

// Endpoints of AC load line

icsat = Icq+(Vceq/rl);
disp (icsat,'The Y-axis Value of AC Load-line is ic(
    sat) in Amps')
disp ('i.e 24.89 mAmps')

vceoff = Vceq+Icq*rl;
disp (vceoff,'The X-axis value of AC Load-line is
    vce(off) in Volts')

// For AC load line

Vce1=[vceoff Vceq 0]
Ic1=[0 Icq icsat]

```

```
//To plot AC load line

printf("Q(%f,%f)\n",Vceq,Icq)
plot2d(Vce1, Ic1)
plot(Vceq,Icq,".r")
plot(0,Icq,".r")
plot(Vceq,0,".r")
plot(0,icsat,".b")
plot(vceoff,0,".b")
xlabel("Vce in volt")
ylabel("Ic in Ampere")
xtitle("AC Load-line for Common-Emitter Class A
    Amplifier Circuit")
```

**Scilab code Exa 31.3** Example 229

```
// Grob's Basic Electronics 11e
// Chapter No. 31
// Example No. 31_3
clear; clc;
//Calculate the following quantities: Pl, Pcc, Pdmax
    & percent efficiency

// Given data

Vin = 20;        // Input Voltage=20 Volts(p-p)
Vopp = 20;       // Output Voltage(p-p)=20 Volts(p-p)
Vcc = 24;        // Supply Voltage(Collector)=24
    Volts
Vop = 10;        // Output Voltage(peak)=10 Volts
Rl = 8;          // Load Resistor=8 Ohms

Vopp1 = Vopp*Vopp;
Pl = (Vopp1/(8*Rl));
disp (Pl,'The Load Power in Watts');
```

```

Icc = ((Vop/Rl)*0.318);

Pcc = Vcc*Icc
disp (Pcc,'The DC Input Power in Watts');

eff = ((Pl/Pcc)*100);
disp (eff,'The Efficiency in % is');

Pd = (Vcc*Vcc)/(40*Rl);
disp (Pd,'The Maximum Power Dissipation in Watts');
```

**Scilab code Exa 31.4** Example 230

```
// Grob's Basic Electronics 11e
// Chapter No. 31
// Example No. 31_4
clear; clc;
// Calculate the following quantities Pl, Pcc & percent efficiency

// Given data

Rl = 8;                // Load Resistor=8 Ohms
Vopp = 50;             // Output Voltage(p-p)=50 Volts(p-p)
Vcc = 30;              // Supply Voltage(Collector)=30 Volts
Vopk = Vopp/2;         // Output Voltage(peak)

Pl = (Vopp*Vopp)/(8*Rl);
disp (Pl,'The Load Power in Watts');

Pcc = Vcc*0.636*(Vopk/Rl);
disp (Pcc,'The DC Input Power in Watts')
```

```

efficiency = ((Pl/Pcc)*100);
disp (efficiency,'The Efficiency in % is');
```

**Scilab code Exa 31.5** Example 231

```
// Grob's Basic Electronics 11e
// Chapter No. 31
// Example No. 31_5
clear; clc;
// Calculate the fr of LC tank circuit and dc bias
   voltage at base

// Given data

L = 100*10^-6;        // Inductor=100 uHenry
C = 63.325*10^-12;    // Capacitor=63.325 pFarad
Vin = 1.5;            // Input Voltage(peak)=1.5 Volts
Vbe = 0.7;            // Voltage Base-Emitter=0.7
   Volts

A = sqrt(L*C);
fr = 1/(2*3.14*A);
disp (fr,'The Resonant Frequency in Hertz')
disp ('i.e 2 MHz')

Vdc = (Vin-Vbe);
disp (Vdc,'The DC Bias Voltage at Base in Volts')
```

**Scilab code Exa 31.6** Example 232

```
// Grob's Basic Electronics 11e
// Chapter No. 31
```

```
// Example No. 31_6
clc; clear;
// Calculate the minimum base reisitance Rb,
   necessary to provide clamping action

// Given data

C = 0.01*10^-6;       // Capacitor=0.01 uFarad
fr = 2*10^6;          // Resonant Frequency=2 MHertz

fin = fr
T = 1/fin

Rb = 10*T/C
disp (Rb,'The Minimum Base Reisitance Rb to Provide
   Clamping Action in Ohms')
```

**Scilab code Exa 31.7** Example 233

```
// Grob's Basic Electronics 11e
// Chapter No. 31
// Example No. 31_7
clc; clear;
// Calculate the Bandwidth

// Given data

L = 100*10^-6;        // Inductor=100 uHenry
fr = 2*10^6;          // Resonant Frequency=2 MHertz
ri = 12.56;           // Resistance of Coil=12.56 Ohms
Rp = 100*10^3;        // Rp=100 kOhms

Xl = 2*3.14*fr*L;
Qcoil = Xl/ri;
Ztank = Qcoil*Xl;
```

```
A = Ztank;
B = Rp;
C = (A*B)/(A+B);
Qckt = C/Xl;

BW = fr/Qckt;
disp (BW,'The Bandwidth in Hertz')
disp ('i.e Appox 45 kHz')
```

# Chapter 33

# Chapter 32 Thyristors

**Scilab code Exa 32.1** Example 234

```
// Grob's Basic Electronics 11e
// Chapter No. 32
// Example No. 32_1
clear; clc;
// Calculate the frequency of the emmiter voltage
   waveform. Assume n=0.6

// Given data

Rt = 220*10^3;          // Resistor Rt=220k Ohms
Ct = 0.1*10^-6;         // Capacitor Ct=0.1u Farad
n = 0.6;                // Constant

A = 1/(1-n);
T = Rt*Ct*log(A);

f = 1/T;
disp (f,'The Frequency of the Emmiter Voltage
   Waveform in Hertz')
```

# Chapter 34

# Chapter 33 Operational Amplifiers

**Scilab code Exa 33.1** Example 235

```
// Grob's Basic Electronics 11e
// Chapter No. 33
// Example No. 33_1
clc; clear;
// Calculate the differential voltage gain, Ad, and
    the ac output voltage, Vout.

// Given data

Vin = 10*10^-3;     // Input voltage=10 mVolts(p-p)
Rc = 10*10^3;       // Collector resistance=10 kOhms
Ie = 715*10^-6;     // Emitter current=715 uAmps

re = (25*10^-3)/Ie;

Ad = Rc/(2*re);
disp (Ad,'The Differential Voltage Gain is')
disp ('i.e 142.86 ~= 143')

```

```
Av = Ad

Vo = Av*Vin;
disp (Vo,'The Ac Output Voltage in Volts(p-p)')
```

**Scilab code Exa 33.2** Example 236

```
// Grob's Basic Electronics 11e
// Chapter No. 33
// Example No. 33_2
clc; clear;
// calculate the common-mode voltage gain, ACM, and
   the CMRR (dB).

// Given data

Rc = 10*10^3;       // Collector resistance=10 kOhms
Re = 10*10^3;       // Emitter resistance=10 kOhms
Ad = 142.86;        // Differential gain=142.86

Acm = Rc/(2*Re);
disp (Acm,'The Common-Mode Voltage Gain Acm is')

CMRR = 20*log10(Ad/Acm);
disp (CMRR,'The Commom-Mode Rejection Ratio in dB')
```

**Scilab code Exa 33.3** Example 237

```
// Grob's Basic Electronics 11e
// Chapter No. 33
// Example No. 33_3
clc; clear;
```

```
// Calculate fmax for an op amp that has an Sr of 5 V/us and a peak output voltage of 10 V.

// Given data

Vpk = 10;        // Peak output voltage=10 Volts
Sr = 5/10^-6;    // Slew rate=5 V/us
pi = 3.14;       // JI=3.14

fo = Sr/(2*pi*Vpk);
disp (fo,'The Output Frequency in Hertz')
disp ('i.e 79.6 kHz')
```

**Scilab code Exa 33.4** Example 238

```
// Grob's Basic Electronics 11e
// Chapter No. 33
// Example No. 33_4
clc; clear;
// calculate the closed-loop voltage gain, Acl, and the output voltage, Vout.

// Given data

Vin = 1;         // Input voltage=1 Volts(p-p)
Rf = 10*10^3;    // Feedback resistance=10 kOhms
Ri = 1*10^3;     // Input resistance=1 kOhms

Acl = -(Rf/Ri);
disp (Acl,'The Closed-Loop Voltage Gain Acl is')

Vo = -Vin*Acl;
disp (Vo,'The Output Voltage in Volts(p-p)')
disp ('The -ve sign indicates that input and output voltages are 180  out-of-phase')
```

**Scilab code Exa 33.5** Example 239

```
// Grob's Basic Electronics 11e
// Chapter No. 33
// Example No. 33_5
clc; clear;
// If Avol equals 100,000, calculate the value of
   Vid.

// Given data

Avol = 100000;   // Open loop voltage gain=100,000
Vo = 10;         // Output voltage=10 Volts(p-p)

Vid = Vo/Avol;
disp (Vid,'The Differential Input Voltage in Volts(p
   -p)')
disp ('i.e 100 uVolts(p-p)')
```

**Scilab code Exa 33.6** Example 240

```
// Grob's Basic Electronics 11e
// Chapter No. 33
// Example No. 33_6
clc;clear;
// calculate Zin and Zout(CL). Assume AVOL is
   100,000 and Zout(OL) is 75 Ohms.

// Given data

Avol = 100000;   // Open loop voltage gain=100,000
```

```
Rf = 10*10^3;     // Feedback resistance=10 kOhms
Ri = 1*10^3;      // Input resistance=1 kOhms
Zool = 75;        // Output impedence (open-loop)=75
    Ohms

Zi = Ri;
disp (Zi,'The Input Impedence in Ohms')
disp ('i.e 1 kOhms')

Beta = Ri/(Ri+Rf);

A = Avol*Beta;

Zocl = Zool/(1+A);
disp (Zocl,'The Closed Loop Output Impedence in Ohms
    ')
```

---

**Scilab code Exa 33.7** Example 241

```
// Grob's Basic Electronics 11e
// Chapter No. 33
// Example No. 33_7
clc; clear;
// Calculate the 5-V power bandwidth.

// Given data

Vo = 10;              // Output voltage=10 Volts(p-p)
Sr = 0.5/10^-6;       // Slew rate=0.5 V/us

Vpk = Vo/2;

fo = Sr/(2*%pi*Vpk);
disp (fo,'The Output Frequency in Hertz')
disp ('i.e 15.915 kHz')
```

**Scilab code Exa 33.8** Example 242

```
// Grob's Basic Electronics 11e
// Chapter No. 33
// Example No. 33_8
clc; clear;
// Calculate the closed-loop voltage gain, Acl, and
   the output voltage, Vout.

// Given data

Vin = 1;        // Input voltage=1 Volts(p-p)
Rf = 10*10^3;   // Feedback resistance=10 kOhms
Ri = 1*10^3;    // Input resistance=1 kOhms

Acl = 1+(Rf/Ri);
disp (Acl,'The Closed-Loop Voltage Gain Acl is')

Vo = Vin*Acl;
disp (Vo,'The Output Voltage in Volts(p-p)')
```

**Scilab code Exa 33.9** Example 243

```
// Grob's Basic Electronics 11e
// Chapter No. 33
// Example No. 33_9
clc; clear;
// Calculate Zin(CL) and Zout(CL). Assume Rin is 2
   MOhms, Avol is 100,000, and Zout(OL) is 75 Ohms.

// Given data
```

```
Avol = 100000;   // Open loop voltage gain=100,000
Ri = 2*10^6;     // Input resistance=2 MOhms
B = 0.0909;      // Beta=0.0909
Zool = 75;       // Output impedence (open-loop)=75
   Ohms

Zicl = Ri*(1+Avol*B);
disp (Zicl,'The Input Impedence Closed-Loop in Ohms'
   )
disp ('i.e 18 GOhms')

A = Avol*B;

Zocl = Zool/(1+A);
disp (Zocl,'The Closed-Loop Output Impedence in Ohms
   ')
```

---

**Scilab code Exa 33.10** Example 244

```
// Grob's Basic Electronics 11e
// Chapter No. 33
// Example No. 33_10
clc; clear;
// Assume Rin is 2 MOhms, Avol is 100,000, and Zout(
   OL) is 75 Ohms. Calculate Zin(CL) and Zout(CL)

// Given data

Avol = 100000;   // Open loop voltage gain=100,000
Ri = 2*10^6;     // Input resistance=2 MOhms
B = 1;           // Beta=1
Zool = 75;       // Output impedence (open-loop)=75
   Ohms

```

```
Zicl = Ri*(1+Avol*B);
disp (Zicl,'The Input impedence closed-loop in Ohms'
    )
disp ('i.e 200 GOhms')

A = Avol*B;

Zocl = Zool/(1+A);
disp (Zocl,'The Closed loop Output Impedence in Ohms
    ')
```

**Scilab code Exa 33.11** Example 245

```
// Grob's Basic Electronics 11e
// Chapter No. 33
// Example No. 33_11
clc; clear;
// Calculate the closed-loop voltage gain, Acl, and
    the dc voltage at the op-amp output terminal.

// Given data

V = 15;          // Voltage at +ve terminal of op-amp
    =15 Volts
Rf = 10*10^3;    // Feedback resistance=10 kOhms
Ri = 1*10^3;     // Input resistance=1 kOhms
R1 = 10*10^3;    // Resistance1=10 kOhms
R2 = 10*10^3;    // Rsistance2=10 kOhms

Acl = -(Rf/Ri);
disp (Acl,'The Closed-Loop Voltage Gain Acl is')

Vo = V*(R2/(R1+R2));
disp (Vo,'The Output Voltage in Volts')
```

**Scilab code Exa 33.12** Example 246

```
// Grob's Basic Electronics 11e
// Chapter No. 33
// Example No. 33_12
clc; clear;
// Calculate the output voltage, Vout.

// Given data

V1 = 1;      // Input voltage1=1 Volts
V2 = -5;     // Input voltage2=-5 Volts
V3 = 3;      // Input voltage3=3 Volts

Vo = -(V1+V2+V3);
disp (Vo,'The Output Voltage in Volts')
```

**Scilab code Exa 33.13** Example 247

```
// Grob's Basic Electronics 11e
// Chapter No. 33
// Example No. 33_13
clc; clear;
// Calculate the output voltage, Vout.

// Given data

V1 = 0.5;        // Input voltage1=0.5 Volts
V2 = -2;         // Input voltage2=-2 Volts
Rf = 10*10^3;    // Feedback resistance=10 kOhms
R1 = 1*10^3;     // Resistance1=1 kOhms
R2 = 2.5*10^3;   // Rsistance2=2.5 kOhms
```

```

A = Rf/R1;
B = Rf/R2;

Vo = -(A*V1+B*V2);
disp (Vo,'The Output Voltage in Volts')
```

**Scilab code Exa 33.14** Example 248

```
// Grob's Basic Electronics 11e
// Chapter No. 33
// Example No. 33_14
clc; clear;
// Calculate the output voltage, Vout, if (a) Vx is
   1 Vdc and Vy is -0.25 Vdc, (b) -Vx is 0.5 Vdc and
    Vy is 0.5 Vdc, (c) Vx is 0.3 V and Vy is 0.3 V.

// Given data

Rf = 10*10^3;    // Feedback resistance=10 kOhms
R1 = 1*10^3;     // Resistance1=1 kOhms
Vx1 = 1;         // Input voltage Vx1 at -ve terminal
    of op-amp=1 Volts
Vy1 = -0.25;     // Input voltage Vy1 at +ve terminal
    of op-amp=-0.25 Volts
Vx2 = -0.5;      // Input voltage Vx2 at -ve terminal
    of op-amp=-0.5 Volts
Vy2 = 0.5;     // Input voltage Vy2 at +ve terminal
   of op-amp=0.5 Volts
Vx3 = 0.3;         // Input voltage Vx3 at -ve
   terminal of op-amp=0.3 Volts
Vy3 = 0.3;     // Input voltage Vy3 at +ve terminal
   of op-amp=0.3 Volts

A = -Rf/R1;
```

```
//   Case A

Voa = A*(Vx1-Vy1);
disp(Voa,'The Output Voltage of Case A in Volts')

//   Case B

Voa = A*(Vx2-Vy2);
disp(Voa,'The Output Voltage of Case B in Volts')

//   Case C

Voa = A*(Vx3-Vy3);
disp(Voa,'The Output Voltage of Case C in Volts')
```

**Scilab code Exa 33.15** Example 249

```
// Grob's Basic Electronics 11e
// Chapter No. 33
// Example No. 33_15
clc; clear;
// Assume that Rd increases to 7.5 k due to an
   increase in the ambient temperature. Calculate
   the output of the differential amplifier. Note:
   Rb is 5 kOhms.

// Given data

Vi = 5;           // Voltage input=5 Volts(dc)
Rf = 10*10^3;     // Feedback resistance=10 kOhms
R1 = 1*10^3;      // Resistance1=1 kOhms
Ra = 5*10^3;      // Resistance A at wein bridge=5
   kOhms
Rb = 10*10^3;     // Resistance B at wein bridge=10
```

```
    kOhms
Rc = 5*10^3;     // Resistance C at wein bridge=5
    kOhms
Rd = 7.5*10^3;   // Resistance D at wein bridge=7.5
    kOhms

Vx = Vi*(Ra/Rb);
Vy = Vi*(Rd/(Rd+Rc));
A = -Rf/R1

Vo = A*(Vx-Vy);
disp (Vo,'The Output of Differential Amplifier in
    Volts')
```

**Scilab code Exa 33.16** Example 250

```
// Grob's Basic Electronics 11e
// Chapter No. 33
// Example No. 33_16
clc; clear;
// Calculate the cutoff frequency , fc.

// Given data

Rf = 10*10^3;        // Feedback resistance=10 kOhms
Cf = 0.01*10^-6;     // Feedback capacitance=0.01
    uFarad

fc = 1/(2*%pi*Rf*Cf);
disp (fc,'The Cutoff Frequency in Hertz')
disp ('i.e 1.591 kHz')
```

**Scilab code Exa 33.17** Example 251

```
// Grob's Basic Electronics 11e
// Chapter No. 33
// Example No. 33_17
clear; clc;
// Calculate the Voltage gain, Acl at (a)0 Hz and (b
    ) 1 MHz

// Given data

f1 = 1*10^6;          // Frequency=1 MHertz
Rf = 10*10^3;         // Feedback resistance=10 kOhms
R1 = 1*10^3;          // Resistance1=1 kOhms
Cf = 0.01*10^-6;      // Feedback capacitance=0.01
    uFarad
pi = 3.14;

// At 0 Hz, Xcf = infinity ohms, So, Zf=Rf

Acl = -Rf/R1;
disp (Acl,'The Closed-Loop Voltage Gain at 0 Hz is')
    ;

// At 1 MHz

Xcf = 1/(2*pi*f1*Cf);

A = (Rf*Rf);
B = (Xcf*Xcf);

Zf = ((Xcf*Rf)/sqrt(A+B));

Acl1 = -Zf/R1;
disp (Acl1,'The Closed-Loop Voltage Gain at 1 MHz is
    ');
```

**Scilab code Exa 33.18** Example 252

```
// Grob's Basic Electronics 11e
// Chapter No. 33
// Example No. 33_18
clear; clc;
// Calculate the dB voltage gain, at (a)0 Hz and (b)
    1.591 kHz

// Given data

f1 = 1.591*10^3;     // Frequency=1.591 kHertz
Rf = 10*10^3;        // Feedback resistance=10 kOhms
Ri = 1*10^3;         // Input resistance=1 kOhms
Cf = 0.01*10^-6;     // Feedback capacitance=0.01
   uFarad

// At 0 Hz, Xcf = infinity ohms, So, Zf=Rf

A = Rf/Ri

Acl = 20*log10(A);
disp (Acl,'The Voltage Gain at 0 Hz in dB');

// At 1.591 kHz

Xcf = 1/(2*%pi*f1*Cf);
B = (Rf*Rf);
C = (Xcf*Xcf);
Zf = (Xcf*Rf/sqrt(B+C));
D = Zf/Ri;

Acl1 = 20*log10(D);
disp (Acl1,'The Voltage Gain at 1.591 kHz in dB')
disp ('Appox 17dB')
```

**Scilab code Exa 33.19** Example 253

```
// Grob's Basic Electronics 11e
// Chapter No. 33
// Example No. 33_19
clc; clear;
// Calculate the cutoff frequency, fc.

// Given data

Ri = 1*10^3;          // Input resistance=10 kOhms
Ci = 0.1*10^-6;       // Input capacitance=0.01 uFarad

fc = 1/(2*%pi*Ri*Ci);
disp (fc,'The Cutoff Frequency in Hertz')
disp ('i.e 1.591 kHz')
```

**Scilab code Exa 33.20** Example 254

```
// Grob's Basic Electronics 11e
// Chapter No. 33
// Example No. 33_20
clc; clear;
// Vin is 5 V, R is 1 kOhms, and Rl is 100 Ohms.
   Calculate the output current, Iout.

// Given data

Vin = 5;          // Input votage=5 Volts
Ri = 1*10^3;      // Input resistance=1 kOhms
Rl = 100;         // Load resistance=100 Ohms

```

```
Io = Vin/Ri;
disp (Io,'The Output Current in Amps')
disp ('i.e 5 mAmps')
```

**Scilab code Exa 33.21** Example 255

```
// Grob's Basic Electronics 11e
// Chapter No. 33
// Example No. 33_21
clc; clear;
// Iin is 1.5 mA, R is 1 kOhms, and Rl is 10 kOhms.
    Calculate Vout.

// Given data

Iin = 1.5*10^-3;      // Input votage=5 Volts
Ri = 1*10^3;          // Input resistance=1 kOhms
Rl = 100;             // Load resistance=100 Ohms

Vo = Iin*Ri;
disp (Vo,'The Output Voltage in Volts')
```

**Scilab code Exa 33.22** Example 256

```
// Grob's Basic Electronics 11e
// Chapter No. 33
// Example No. 33_22
clc; clear;
// R1 is 1 kOhms and R2 is 100 kOhms. Calculate UTP,
    LTP, and VH.

// Given data

```

```
R1 = 1*10^3;          // Resistance1=1 kOhms
R2 = 100*10^3;        // Resistance2=100 kOhms
Vcc = 15;             // Applied votage=15 Volts
Vsat = 13;            // Assume Saturation voltage=13
   Volts

Beta = R1/(R1+R2);

Utp = Beta*Vsat;
disp(Utp,'The Upper Trigger Point in Volts')
disp ('i.e 128.7 mVolts')

Ltp = -Beta*Vsat;
disp(Ltp,'The Lower Trigger Point in Volts')
disp ('i.e -128.7 mVolts')

Vh = Utp-Ltp;
disp (Vh,'The Hysterisis Voltage in Volts')
disp ('i.e 257.4 mVolts')
```

**Scilab code Exa 33.23** Example 257

```
// Grob's Basic Electronics 11e
// Chapter No. 33
// Example No. 33_23
clc; clear;
// Rl is 1 kOhms and the frequency of the input
   voltage equals 100 Hz. Calculate the minimum
   value of C required.

// Given data

f = 100;          // Applied frequency=100 Hertz
Rl = 1*10^3;      // Load resistance=1 kOhms

```

```
T = 1/f;

C = (10*T)/Rl;
disp(C,'The Minimum value of required Capacitor in Farads')
disp('i.e 100 uFarad')
```