Scilab Textbook Companion for Electronics Devices and Circuits by G. S. N. Raju[1]

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June 3, 2014

[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: Electronics Devices and Circuits

Author: G. S. N. Raju

Publisher: I. K. International, New Delhi

Edition: 1

Year: 2006

ISBN: 81-89866-02-8

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

Common Electronic Materials and Properties

Scilab code Exa 1.1 Fusing current

```
//Ex1.1
clc
disp("I = K(d^1.5)") //formula used for fusing
   current
d=0.0031
disp("d = "+string(d)+"inches") //initializing
   values of diameter
I1=10244*(d^1.5);I2=7585*(d^1.5); I3=5320*(d^1.5);
   I4=3148*(d^1.5); I5=1642*(d^1.5)  //calculation
   for fusing current
disp("for Copper, I = 10244*(d^1.5) = "+string(I1)+"
   Amp.")
disp("for Aluminum, I = 7585*(d^1.5) = "+string(I2)+
   "Amp.")
disp("for Silver, I = 5320*(d^1.5) = "+string(I3)+"
   Amp.")
disp("for Iron, I = 3148*(d^1.5) = "+string(I4)+"Amp
   .")
disp("for Tin, I = 1642*(d^1.5) = "+string(I5)+"Amp.
```

```
")
```

Scilab code Exa 1.2 Fusing current

```
//Ex1.2
clc
disp("fusing current , I = K(d^1.5) Amp.")//formula used for fusing current
d=0.0201
disp("d = "+string(d)+"inches") //initializing value of diameter
I1=10244*(d^1.5);I2=7585*(d^1.5); I3=5320*(d^1.5); I4=3148*(d^1.5); I5=1642*(d^1.5)  //calculation for fusing current
disp("for Copper, I = 10244*(d^1.5) = "+string(I1)+"Amp.")
disp("for Aluminum, I = 7585*(d^1.5) = "+string(I2)+"Amp.")
disp("for Silver, I = 5320*(d^1.5) = "+string(I3)+"Amp.")
disp("for Iron, I = 3148*(d^1.5) = "+string(I4)+"Amp.")
disp("for Tin, I = 1642*(d^1.5) = "+string(I5)+"Amp.")


// note : calculation for fusing current of Iron is wrong.
```

Scilab code Exa 1.3 Fusing Current

```
//Ex1.3
clc
```

```
disp("fusing current, I = K(d^1.5) Amp.") //formula
    used for fusing current
disp("(a)")
d=0.0159
disp("d = "+string(d)+"inches") //initializing value
     of diameter
I1=10244*(d^1.5);I2=7585*(d^1.5); I3=5320*(d^1.5);
    I4=3148*(d^1.5); I5=1642*(d^1.5)  //calculation
    for fusing current
disp("for Copper, I = 10244*(d^1.5) = "+string(I1)+"
    Amp.")
disp("for Aluminum, I = 7585*(d^1.5) = "+string(I2)+
    "Amp.")
disp("for Silver, I = 5320*(d^1.5) = "+string(I3)+"
    Amp.")
disp("for Iron, I = 3148*(d^1.5) = "+string(I4)+"Amp
    .")
disp("for Tin, I = 1642*(d^1.5) = "+string(I5)+"Amp.
    ")


disp("(b)")
d=0.0063
disp("d = "+string(d)+"inches") //initializing value
     of diameter
I1=10244*(d^1.5);I2=7585*(d^1.5); I3=5320*(d^1.5);
    I4=3148*(d^1.5); I5=1642*(d^1.5)  //calculation
    for fusing current
disp("for Copper, I = 10244*(d^1.5) = "+string(I1)+"
    Amp.")
disp("for Aluminum, I = 7585*(d^1.5) = "+string(I2)+
    "Amp.")
disp("for Silver, I = 5320*(d^1.5) = "+string(I3)+"
    Amp.")
disp("for Iron, I = 3148*(d^1.5) = "+string(I4)+"Amp
    .")
disp("for Tin, I = 1642*(d^1.5) = "+string(I5)+"Amp.
    ")
```

```
disp("(c)")
d=0.0403
disp("d = "+string(d)+"inches") //initializing value
    of diameter
I1=10244*(d^1.5);I2=7585*(d^1.5); I3=5320*(d^1.5);
    I4=3148*(d^1.5); I5=1642*(d^1.5)   //calculation
    for fusing current
disp("for Copper, I = 10244*(d^1.5) = "+string(I1)+"
    Amp.")
disp("for Aluminum, I = 7585*(d^1.5) = "+string(I2)+
    "Amp.")
disp("for Silver, I = 5320*(d^1.5) = "+string(I3)+"
    Amp.")
disp("for Iron, I = 3148*(d^1.5) = "+string(I4)+"Amp
    .")
disp("for Tin, I = 1642*(d^1.5) = "+string(I5)+"Amp.
    ")


disp("(d)")
d=0.0452
disp("d = "+string(d)+"inches") //initializing value
    of diameter
I1=10244*(d^1.5);I2=7585*(d^1.5); I3=5320*(d^1.5);
    I4=3148*(d^1.5); I5=1642*(d^1.5)   //calculation
    for fusing current
disp("for Copper, I = 10244*(d^1.5) = "+string(I1)+"
    Amp.")
disp("for Aluminum, I = 7585*(d^1.5) = "+string(I2)+
    "Amp.")
disp("for Silver, I = 5320*(d^1.5) = "+string(I3)+"
    Amp.")
disp("for Iron, I = 3148*(d^1.5) = "+string(I4)+"Amp
    .")
disp("for Tin, I = 1642*(d^1.5) = "+string(I5)+"Amp.
    ")
```

```
disp("(e)")
d=0.0508
disp("d = "+string(d)+"inches") //initializing value of diameter
I1=10244*(d^1.5);I2=7585*(d^1.5); I3=5320*(d^1.5); I4=3148*(d^1.5); I5=1642*(d^1.5) //calculation for fusing current
disp("for Copper, I = 10244*(d^1.5) = "+string(I1)+"Amp.")
disp("for Aluminum, I = 7585*(d^1.5) = "+string(I2)+"Amp.")
disp("for Silver , I = 5320*(d^1.5) = "+string(I3)+"Amp.")
disp("for Iron, I = 3148*(d^1.5) = "+string(I4)+"Amp.")
disp("for Tin, I = 1642*(d^1.5) = "+string(I5)+"Amp.")


disp("(f)")
d=0.162
disp("d = "+string(d)+"inches") //initializing value of diameter
I1=10244*(d^1.5);I2=7585*(d^1.5); I3=5320*(d^1.5); I4=3148*(d^1.5); I5=1642*(d^1.5) //calculation for fusing current
disp("for Copper, I = 10244*(d^1.5) = "+string(I1)+"Amp.")
disp("for Aluminum, I = 7585*(d^1.5) = "+string(I2)+"Amp.")
disp("for Silver , I = 5320*(d^1.5) = "+string(I3)+"Amp.")
disp("for Iron, I = 3148*(d^1.5) = "+string(I4)+"Amp.")
disp("for Tin, I = 1642*(d^1.5) = "+string(I5)+"Amp.")
```

```
// note : in part (e) ... calculation for fusing
    current of silver is wrong.
// note : in part (f) ... calculation for fusing
    current of Iron is wrong.
```

Scilab code Exa 1.4 Resistance of wire

```
//Ex1.4
clc
A=0.5189*10^-6//wire cross sectional area
rho=1.725*10^-8//resistivity
l=100 //wire length
disp("A ="+string(A)+"merer square")
disp("rho ="+string(rho)+"ohm-m")
disp("l ="+string(l)+"m")
disp("R = rho*l/A = "+string(rho*l/A)+"ohm") //
    resistance
```

Scilab code Exa 1.5 Resistance of Copper Wire

```
//Ex1.5
clc
A=0.2588*10^-6//wire cross-sectional area
rho=1.725*10^-8//resistivity
l=100 //wire length
disp("A ="+string(A)+"merer square")
disp("rho ="+string(rho)+"ohm-m")
disp("l ="+string(l)+"m")
disp("R = rho*l/A = "+string(rho*l/A)+"ohm") //
    resistance of wire
```

Scilab code Exa 1.6 Resistance of Tungsten Wire

```
//Ex1.6
clc
R1 = 14//resistance at temperature T1
alpha=0.005
T1=20;//initial temperature
T2=120 //final temperature
disp("R1 = "+string(R1)+ "ohm; alpha = "+string(
   alpha)+"; T1 = "+string(T1)+"degreeC; T2 = "+
   string(T2)+"degreeC")
disp("R2 = R1(1+(alpha*(T1-T2))) = "+string(R1*(1+(
   alpha*(T2-T1))))+"ohm") //resistance at
   temperature T2
```

Scilab code Exa 1.7 Force on Electron

```
//EX1.7
clc
Ex=3;Ey=4;Ez=2//electric field
e=1.6*10^-19 //electorn charge
disp("E = 3ax + 4ay + 2az k V/m")
disp("e = 1.6*10^-19 C")
disp("F=eE = "+string(Ex*e*1000)+"ax + "+string(Ey*e
   *1000)+"ay + "+string(Ez*e*1000)+"az N") //force
```

Scilab code Exa 1.8 Electric Field applied on Electron

```
//Ex1.8
```

```
clc
F=0.1*10^-12//force applied
e = 1.6*10^-19//electron charge
disp("F= "+string(F)+"N ; e = "+string(e)+"C")
disp("E = F/e ="+string(F/e)+"V/m")//electric field
```

Scilab code Exa 1.9 Charge in Region

```
//Ex1.9
clc
F = 3*(10^-12) //force applied
E = 5*(10^-6)  //electric field
disp("F = "+string(F)+"N")
disp("E = "+string(E)+"V/m")
disp("Q= F/E = "+string(F/E)+"C") //chage
```

Scilab code Exa 1.10 Force on Electorn

```
//Ex1.10
clc
B = 2*10^-6 //magnetic flux density
V = 4*10^6  //electron velocity
e= 1.6*10^-19//elcetron charge
disp("B ="+string(B)+" ax wb/m.sq")
disp("V ="+string(V)+" az m/s")
disp(" e = "+string(e)+ "C")
disp("F = e[VxB] ="+string(e*V*B)+" ay N")//force
```

Scilab code Exa 1.11 Force on Electron due to field

```
//Ex1.11
clc
Hx = 1*10^-3  //magnetic field in x-axis
Hy = 2*10^-3  //magnetic field in y-axis
V = (4*10^6)  //electron velocity
micro_not=(4*%pi*(10^-7)) //permitivity in vaccum
e=1.6*10^-19  //charge of electorn
disp("H = "+string(Hx)+"ax  + "+string(Hy)+"ay A/m")
disp("V = "+string(V)+"ay m/s")
Bx = micro_not*Hx; By = micro_not*Hy //magnetic flux
    density
disp("B = micro_not*H = "+string(Bx)+"ax + "+string(
   By)+"ay wb/m.sq")
disp("F = e[VxB]  = "+string(e*V*Bx)+"az N") //force
   on electron due to field


// note : there is a misprint in the textbook for
   the above problem
```

Scilab code Exa 1.12 Donor atom concentration

```
//Ex1.12
clc
n = 5*10^22//number of atoms in silicon/cm_cube
donors = 10^-7 //donor atoms
disp("n = "+string(n)+" /cm.cube")
disp("donors = "+string(donors))
disp("ND = "+string(n*donors)+" /cm.cube") //donor
   atom concentration
```

Scilab code Exa 1.13 Free electron concentration

```
//Ex1.13
clc
ND =5*10^16//donor atom concentration
disp("n = "+string(ND)+"/cm.cube") //free electrons
```

Scilab code Exa 1.14 Hole concentration

```
//Ex1.14
clc
ni = 1.5*10^10 //intrinsic concentration
ND = 5*10^16 //donor atom concentration
disp("ni ="+string(ni)+"/cm.cube")
disp("ND = "+string(ND)+" /cm.cube")
disp("p = (ni^2)/ND = "+string((ni^2)/ND)+"atom/cm.
    cube") //hole concentration
```

Scilab code Exa 1.15 Resistivity of Intrinsic semiconductor

```
//Ex1.15
clc
ni = 1.52*10^10 //intrinsic concentration
e=1.6*10^-19 //charge of electron
micro_n = 1350; micro_p = 480 // charge mobility
disp("e = "+string(e)+"C")
disp("ni = pi ="+string(ni)+"/cm.cube")
disp("micro_n = "+string(micro_n)+"cm.sq/V-s")
disp("micro_p = "+string(micro_p)+"cm.sq/V-s")
disp("sigma = e(micro_n*ni + micro_p*pi ) ="+string(
    e*(micro_n*ni + micro_p*ni))+"mho/cm") //
    conductivity
disp("rho = 1/sigma ="+string(1/(e*(micro_n*ni +
    micro_p*ni)))+"ohm-cm") //resistivity
```

Scilab code Exa 1.16 Mobility and conductivity

```
//Ex1.16
clc
ni = 2.5*(10^13) //intrinsic concentration
donor = 10^-7 //donor atoms
ND = 4.41*(10^22)*(10^-7) //donor atom concentration
e = 1.6*(10^-19) //electron charge
micro_n = 3800; micro_p = 1800 //charge mobility
disp("ni ="+string(ni)+" /cm.cube")
disp("donor = "+string(donor))
disp("n = ND ="+string(ND)+" /cm.cube")
disp("p = (ni^2)/ND = "+string((ni^2)/ND)+" /cm.cube
    ") //hole concentration
disp("micro_n = 3800 cm.sq/V-s; micro_p = 1800 cm.sq
    /V-s")
sigma = ni*e*(micro_n+micro_p) //conductivity
disp("sigma = ni*e(micro_n + micro_p) = "+string(
    sigma)+"mho/cm")
```

Scilab code Exa 1.17 Carrier concentration

```
//Ex1.17
clc
ni = 2.5*10^19 //intrinsic concentration
NA = 10^21 //acceptor atom concentration
disp("ni = "+string(ni)+" /m.cube")
disp("NA = "+string(NA)+" /m.cube ")
disp("np = (ni^2)/ NA ="+string((ni^2)/NA)+"e/m.cube
    ") //electron concentration
//textbook has not calcutated for hole concentration
```

Scilab code Exa 1.18 Trivalent Impurity

```
//Ex1.18
clc
micro_p = 1800 //hole mobility
rho_p = 1 //resistivity
e = 1.6*10^-19 //electorn charge
disp("micro_p ="+string(micro_p)+" cm.sq/V-s")
disp("rho_p = "+string(rho_p)+"ohm-cm")
disp("e = "+string(e)+"C")
disp("pp = 1/(e*micro_p*rho_p) = "+string(1/(e*
    micro_p*rho_p))+" holes/cm.cube") //number of
    trivalent impurity
```

Scilab code Exa 1.19 Pentavalent Impurity

```
//Ex1.19
clc
micro_n = 1300 //eletron mobility
rho_n = 2 //resistivity
e = 1.6*10^-19 //electron charge
disp("micro_n ="+string(micro_n)+" cm.sq/V-s")
disp("rho_n = "+string(rho_n)+"ohm-cm")
disp("e"+string(e)+"C")
disp("nn = 1/(e*micro_n*rho_n) = "+string(1/(e*
    micro_n*rho_n))+" e/cm.cube") //number of
    pentavalent impurity
```

Scilab code Exa 1.20 carrier concentration and conductivity

```
//Ex1.20
clc
EGo = 1.1 //energy band gap
micro_n = 0.13 //electron mobility
micro_p = 0.05 //hole mobility
N = 3*10^25 //atom concentration
K = 1.38*10^-23 //Boltzmann constant
T = 300 //room temperature
e=1.6*10^-19//electron charge
disp("EGo = "+string(EGo)+"eV = "+string(EGo*e)+"J")
disp("micro_n = "+string(micro_n)+" m.sq/V-s")
disp("micro_p = "+string(micro_p)+"m.sq/V-s")
disp("N = "+string(N)+" /m.cube")
disp("T = "+string(T)+"degree_K")
disp("K = "+string(K)+"J/K")
disp("ni = N*exp(-(EGo/(2*T*K))) = "+string(N*exp(-(EGo*e/(2*T*K))))+" /m.cube") //intrinsic concentration
ni = N*exp(-(EGo*e/(2*T*K)))
disp("sigma = ni*e(micro_n+micro_p) = "+string(ni*e*(micro_n+micro_p))+"mho/m") //conductivity
```

Scilab code Exa 1.21 Volt Equivalent Temperature

```
//Ex1.21
clc
K = 1.38*10^-23 //Boltzmann constant
e = 1.6*10^-19 //electron charge
T = 300 //room temperature
disp("K = "+string(K)+" J/K")
disp("e = "+string(e)+"C")
disp("T = "+string(T)+"degree_K")
disp("VT = K*T/e = "+string(K*T/e)+"V") //volt-equivalent temperature
```

Chapter 2

Passive Component and DC Sources and Circuit Theorems and Basic Meters

Scilab code Exa 2.1 Capacitance of capacitor

```
//Ex2_1
clc
Q = 2*10^-6; V = 10
disp("Q = "+string(Q)+"C")// charge
disp("V = "+string(V)+"V") //voltage
disp("C = Q/V = "+string(Q/V)+"F")//calculation for
    capacitance
```

Scilab code Exa 2.2 Charge stored in Capacitor

```
//Ex2_2
clc
C= 10*10^-6
V = 10
```

```
disp("C ="+string(C)+"F")//capacitance
disp("V = "+string(V)+"V")//voltage
disp("Q = C*V = "+string(C*V)+"C")//calculation for
    charge
```

Scilab code Exa 2.3 Capacitance of capacitor

```
//Ex2_3
clc
Q = 5*10^-12
V = 50
disp("Q = "+string(Q)+"C")//charge
disp("V = "+string(V)+"V")//voltage
disp("C = Q/V = "+string(Q/V)+"F")//calculation for
    capacitance
```

Scilab code Exa 2.4 Charge stored in Capacitor

```
//Ex2_4
clc
I = 10*10^-6
t= 10
disp("I = "+string(I)+"A")//current
disp("t = "+string(t)+"seconds")//time
disp("Q = I*t = "+string(I*t)+"C")//calculation for
    charge
```

Scilab code Exa 2.5 Charge stored and voltage across capacitor

```
//Ex2_5
```

```
clc
C = 2.0*10^-6
t= 2
I = 10*10^-6
Q = I*t
disp("C = "+string(C)+"F")//capacitance
disp("t = "+string(t)+"seconds")//time
disp("I = "+string(I)+"A")//current
disp("Q = I*t = "+string(Q)+"C")//calculation for
    charge
disp("V = Q/C = "+string(Q/C)+"V")//calculation for
    voltage
```

Scilab code Exa 2.6 Reactance of Capacitor

```
//Ex2_6
clc
C = 12* 10^ -6
f = 1.0*10^3
Xc = 1/(2*%pi*f*C)
disp("C = "+string(C)+"F")//capacitance
disp("at... f = "+string(f)+"Hz")//frequency
disp("Xc = 1/(2*pi*f*C) = "+string(1/(2*%pi*f*C))+"
    ohm")//calculation for capacitive reactance
```

Scilab code Exa 2.7 Reactance of Capacitor

```
//Ex2_7
clc
C = 0.2*10^-6
f1 = 1.0*10^3
f2 = 50
disp("C = "+string(C)+"F")//capacitance
```

```
disp("at... f = "+string(f1)+"Hz")//frequency
disp("Xc = 1/(2*pi*f*C) = "+string(1/(2*%pi*f1*C))+"
   ohm")//calculation for capacitive reactance
disp("at... f = "+string(f2)+"Hz")//frequency
disp("Xc = 1/(2*pi*f*C) = "+string(1/(2*%pi*f2*C))+"
   ohm")//calculation for capacitive reactance
```

Scilab code Exa 2.8 Series Capacitance

```
//Ex2_8
clc
C1 = 0.5*10^-6
C2 = 0.5*10^-6
CT = (C1*C2)/(C1+C2)
disp("C1 = "+string(C1)+"F")//capacitance 1
disp("C1 = "+string(C1)+"F")//capacitance 2
disp("1/CT = 1/C1 + 1/C2 = (C1*C2)/(C1+C2) = "+
   string(C1*C2/(C1+C2))+"F")//series capacitance
// proper ans. = 0.25*10^-6F
```

Scilab code Exa 2.9 Parallel Capacitance

```
//Ex2_9
clc
C1 = 0.2*10^-12
C2 = 0.6*10^-12
C3 = 1.0*10^-12
disp("C1 = "+string(C1)+"F")//capacitance
disp("C2 = "+string(C2)+"F")//capacitance
disp("C3 = "+string(C3)+"F")//capacitance
disp("CT = C1+C2+C3 = "+string(C1+C2+C3)+"F")//
   parallel capacitance
```

Scilab code Exa 2.10 Energy Stored in Capacitor

```
//Ex2_10
clc
C = 10*10^-6
V = 100
W = C*(V^2)/2
disp("C = "+string(C)+"F")//capacitance
disp("V = "+string(V)+"V")//voltage
disp("W = C*(V^2)/2 = "+string(W)+"Joules")//calculating for energy stored
```

Scilab code Exa 2.11 Instantanous Current in capacitor

```
//Ex2_11
clc
C = 10*10^-6
delta_V = 100
delta_t = 10
ic = C*delta_V/delta_t
disp("C = "+string(C)+"F")//capacitance
disp("delta_V = "+string(delta_V)+"V")//change in voltage
disp("delta_t = "+string(delta_t)+"sec")//change in time
disp("ic = C*(delta delta_V/delta_t) = "+string(ic)+"A")//calculation for instantaneous current
```

Scilab code Exa 2.12 Rate of Current

```
//Ex2_12
clc
Ii = 10
If = 15
delta_t = 2
dI = Ii - If
disp("Ii = "+string(Ii)+"A")//initial current
disp("If = "+string(If)+"A")//final current
disp("delta_t = "+string(delta_t)+"sec")//time taken
    to change current
disp("dI/dt = "+string(abs(dI)/delta_t)+"Amp/sec.")
    //calculation for rate of change of current
//wronge answer given in the textbook i.e. 0.5 Amp/
    sec.
```

Scilab code Exa 2.13 Inductance Value

```
//Ex2_13
clc
r = 5.0//rate of current change
vL = 50//induced voltage
L = vL/(r)
disp("diL/dt = "+string(r)+"A/s")//rate of current
    change
disp("vL = "+string(vL)+"V")
disp("vL = L*(diL/dt)")
disp("L = vL/(diL/dt) = "+string(L)+" Henry")//
    calculation for inductane
```

Scilab code Exa 2.14 Energy in Inductor

```
//Ex2_14
clc
```

```
I = 5
L = 5
WL = L*(I^2)/2
disp("I = "+string(I)+"A")//current flow
disp("L = "+string(L)+"H")//inductance
disp("WL= "+string(WL)+"joules")//energy stored
```

Scilab code Exa 2.15 Coupling Coefficient

```
//Ex2_15
clc
flux1 = 100*10^-6
flux2 = 50*10^-6
flux12 = flux1 - flux2
disp("flux1 = "+string(flux1)+"Wb")//flux of coil 1
disp("flux2 = "+string(flux2)+"Wb")//flux of coil 2
disp("K = flux linkage between coil 1 and coil 2/flux of coil 1")//coefficient of coupling
disp("  = "+string(flux12/flux1))
```

Scilab code Exa 2.16 Mutual Inductance

```
//Ex2_16
clc
L1 = 100*10^-3
L2 = 50*10^-3
K = 0.3
M = K*(L1*L2)^0.5
disp("L1 = "+string(L1)+"H")//inductance of coil 1
disp("L2 = "+string(L2)+"H")//inductance of coil 2
disp("K = "+string(K))//coefficient of coupling
disp("M = K*(L1*L2)^0.5")
disp("M = "+string(M)+"H")//mutual inductance
```

Scilab code Exa 2.17 Series Inductance

```
//Ex2_17
clc
L1 = 10*10^-3
L2 = 15*10^-3
LT = L1 + L2
disp("L1 = "+string(L1)+"H")//inductance of coil 1
disp("L2 = "+string(L2)+"H")//inductance of coil 2
disp("LT = L1+L2 = "+string(LT)+"H")//series
   inductance
```

Scilab code Exa 2.18 Parallel Inductance

```
//Ex2_18
clc
L1 = 1*10^-3
L2 = 5*10^-3
LT = (L1*L2)/(L1+L2)
disp("L1 = "+string(L1)+"H")//inductance of coil 1
disp("L2 = "+string(L2)+"H")//inductance of coil 2
disp("1/LT = 1/L1 + 1/L2")
disp("LT = (L1*L2)/(L1+L2) = "+string(LT)+"H")//
   parallel inductance
```

Scilab code Exa 2.19 Source Resistance

```
//Ex2_19
clc
```

```
VNL = 50
VL = 40
IL = 4
Rs = (VNL - VL)/IL
disp("VNL  = "+string(VNL)+"V")//no load voltage
disp("VL  = "+string(VL)+"V")//load voltage
disp("IL  = "+string(IL)+"A")//load current
disp("Rs = (VNL - VL)/IL = "+string(Rs)+"ohm")//
    source resistane
```

Scilab code Exa 2.20 Series Voltage

```
//Ex2_20
clc
V = 2.5
disp("V1 = V2 = V3 = V4 = "+string(V)+"V")//four
    batteries of equal voltage connected in series
disp("VT = V1+V2+V3+V4 = "+string(V+V+V+V)+"V")//
    resultant voltage(series voltage)
```

Scilab code Exa 2.21 Net Voltage

```
//Ex2_20
clc
V = 2
disp("V1 = V2 = V3 = V4 = "+string(V)+"V")//four
    batteries of equal voltage connected in series
disp("VT = V1 = V2 = V3 = V4 = "+string(V)+"V")//
    parallel voltage
```

Scilab code Exa 2.22 Thevenin Equivalent Circuit

```
//Ex2_22
clc
//considering the fig. 2.17 given in the question
R1 = 1
R2 = 3
R3 = 2
V = 20
disp("R1 ="+string(R1)+"ohm")//value of resitance R1
disp("R2 ="+string(R2)+"ohm")//value of resitance R2
disp("R3 ="+string(R3)+"ohm")//value of resitance R3 (across A and B terminals,
                              //across which thevenin equivalate circuit is need to determine)
disp("V ="+string(V)+"V")//value of D.C. voltage applied

//TO FIND THEVENIN'S RESISTANCE (RTH),..
//CONSIDERING FIG 2.17
// WE REMOVE THE RESISTANCE (R1) ACROSS LOAD TERMINAL AB I.E.
//AND ALSO WE SHORT THE VOLTAGE SOURCE
//NOW ACCORDING TO MODIFIED CIRCUIT

disp("1/RTH = 1/R3 + 1/R2 = "+string(1/((1/R3)+(1/R2)))+"ohm")//R1 and R2 are in parallel

//TO FIND THEVENIN VOLTAGE (VTH),..
//CONSIDERING FIG 2.17
//WE DISCONNECT LOAD RESISTANCE (R1) AND MADE TERMINAL AB OPEN CIRCUIT
//ACCORDING TO MODIFIED CIRCUIT

//applying KVL in the loop, to find the amount of current flowing in circuit
//taking current as 'I' amperes
```

```
disp("V = (R3*I)+(R2*I)")
I = V/(R2+R3)
disp("or, I = V/(R2+R3) = "+string(I)+"amperes")
//Voltage drop across R2 resistance = Thevenin voltage
//thus, voltage across AB i.e., thevenin voltage, is given as
disp("VTH = R2*I = "+string(R2*I)+"V")

// NOTE : Notations used in the program are as mentioned in the main fig. 2.17
```

Chapter 3

Electrodynamics and CRO

Scilab code Exa 3.1 Force on electron

```
//Ex3_1
clc
E = 20*10^3
e = -(1.6*10^-19)
F = e*E
disp("E = "+string(E)+"ax V/m")//initializing
    electic field
disp("e = "+string(e)+"C")//intializing electron
    charge
disp("F = eE = "+string(F)+"ax N")//calculation for
    force on electron due to electric field

//  NOTE : answer provided in the textbook is wrong
    Correct answer is, -3.2*10^16ax N
```

Scilab code Exa 3.2 Force on electron

```
//Ex3_2
```

```
clc
E = 50*10^3
e = -1.6*10^-19
N = 10^6
F = N*e*E
disp("E = "+string(E)+" az V/m")//value of Electric field applied
disp("e = "+string(e)+"C")//value of eletron charge
disp("N = "+string(N))//total number of charge
disp("F = NeE = "+string(F)+" az N")//force on electron
```

Scilab code Exa 3.3 Force on electron

```
//Ex3_3
clc
v = 5*10^6
e = -1.6*10^-19
B = 20*10^-6
F = e*v*B
disp("v = "+string(v)+"m/s")//velocity of electron
disp("e = "+string(e)+"C")//charge of electron
disp("B = "+string(B)+"Wb/m-sq")//magnetic field
disp("F = e(VxB) = e*v*B = "+string(F)+"N")//force on the electron due to field
```

Scilab code Exa 3.4 Force on electron

```
//Ex3_4
clc
Bx = 40*10^-6
By = 10*10^-6
N = 10^6
```

```
e = -1.6*10^-19
v = 8*10^6
disp("B = "+string(Bx)+"ax + "+string(By)+"ay Wb/m-sq")//magnetic field
disp("N = "+string(N))//number of electrons
disp("e = "+string(e)+"C")//electron charge
disp("v = "+string(v)+"ax m/s")//velocity of electron
disp("F = Q(VxB) = "+string(e*N*v*By)+" az N")//force on electron
//as we are taking curl of V and B,.. thus Vx X Bx = 0
//force will be only due to V x By.
```

Scilab code Exa 3.5 Current density

```
//Ex3_5
clc
e = -1.6*10^-19
n = 10^6
v = 5*10^6
J = n*e*v
disp("e = "+string(e)+"C")//charge of electrons
disp("n = "+string(n)+" /m-cube")//electron density
disp("v = "+string(v)+"m/s")//electron velocity
disp("J = nev = "+string(abs(J))+"A/m-sq")//current density
```

Scilab code Exa 3.6 Current density

```
//Ex3_6
clc
v = 2*10^7
```

```
e = -1.6*10^-19
n = 10^8
J = n*e*v
disp("v = "+string(v)+"m/s")//velocity of electron
disp("e = "+string(e)+"C")//electron charge
disp("n = "+string(n)+" /m-cube")//electron density
disp("J = nev = "+string(abs(J))+"A/m-sq")//current
    density

//note: formula for current density in the solution
    in the textbook is misprinted
//      also the answer is provide in the textbook
    for above problem is misprinted.
```

Scilab code Exa 3.7 Frequeny of Signal

```
//Ex3_7
clc
l = 4//cycle length
t = 10*10^-6//scale setting
T = l*t//time period for full cycle
disp("T = "+string(T)+" s")
disp("Frequency = 1/T = "+string(1/T)+"Hz")//
    frequency of the signal
```

Scilab code Exa 3.8 RMS voltage

```
//Ex3_8
clc
Vpp = 4.2*10*10^-3//peak to peak voltage of
    sinusoidal signal //notation not used in
    textbook
Vm = Vpp/2//maximum positive voltage
```

```
Vrms = Vm/(2^.5)//root mean square value of voltage
disp("Vm = "+string(Vm)+"V")
disp("Vrms = Vm/(2^.5) = "+string(Vrms)+"V")
```

Scilab code Exa 3.9 Current in 100 ohm resistance

```
//Ex3_9
clc
V = 4.5*10^-3//applied dc voltage
r = 100// given resistance
I = V/r//flow of current
disp("DC voltage = "+string(V)+"V")
disp("The current in 100 ohm = "+string(I)+"A")
```

Scilab code Exa 3.10 Deflection Sensitivity

```
//Ex3_10
clc
l = .03
d = 0.01
L = 0.18
Va = 1000
disp("l = "+string(l)+"m")//lenght of deflection plate
disp("d = "+string(d)+"m")//plate separation
disp("L = "+string(L)+"m")//distance of screen from plate
disp("Va = "+string(Va)+"V")//anode voltage
SE = (l*L)/(2*d*Va)
disp("SE = (l*L)/(2*d*Va) = "+string(SE)+"m/V")
```

Scilab code Exa 3.11 force on current element

```
//Ex3_11
clc
disp("fm = BIL")//formula used for finding FORCE ON
    CURRENT ELEMENT
B = 2.0
IL = 10*10^-3
fm = B*IL
disp("B = "+string(B)+"Wb/m-sq")//magnetic field
disp("IL = "+string(IL)+"A-m")//current element
disp("fm ="+string(fm)+"Newton")//answer displayed
```

Scilab code Exa 3.12 Velocity of electron and kinetic energy

```
//Ex3_12
clc
disp("v = (2*e*Va/m)^.5")//formula used to calculate
    velocity of electrons
e = -1.6*10^-19
m = 9.1*10^-31
Va = 3.0*10^3
disp("e = "+string(e)+"C")//electron charge
disp("m = "+string(m)+"Kg")//mass of electron
disp("Va = "+string(Va)+"V")//potential difference =
    anode voltage
v = abs((2*e*Va/m))^.5
disp("v = "+string(v)+"m/s")
W = e*Va//kinetic energy
disp("W = e*Va = "+string(W)+"joules")//Kinetic
    energy
```

Scilab code Exa 3.13 Deflection of electron beam

```
//Ex3_13
clc
e = -1.6*10^-19
m = 9.1*10^-31
Va = 400
v = (abs(2*e*Va/m))^.5
disp("e = "+string(e)+"C")//electron charge
disp("m = "+string(m)+"Kg")//mass of electron
disp("Va = "+string(Va)+"V")//anode voltage
disp("v = (2*e*Va/m)^.5 = "+string(v)+"m/s")//formula used to calculate velocity of electrons
//as electron traces a circular path, radius of circular path
H = 47.75
micro_not = 4*%pi*10^-7
B = H*micro_not
disp("B = "+string(B)+"Wb/m-sq")
r = (v/(e/m)/B)
disp("r = (v/(e/m))/B = "+string(r)+"m")

//  NOTE : Question is incompletely solved in the textbook
```

Scilab code Exa 3.14 Deflection sensitivity

```
//Ex3_14
clc
l = 22
d = 1.5
Va = 625
e = 1.6*10^-19
m = 9.1*10^-31
disp("l = "+string(l)+"cm")//distance from location of magnetic field
disp("d = "+string(d)+"cm")//length over which
```

```
magnetic field is present
disp("Va = "+string(Va)+"V")//voltage applied to anode
disp("e = "+string(e)+"C")//electron charge
disp("m = "+string(m)+"Kg")//mass of electron
SH = l*10^-2*d*10^-2*(e/(2*m*Va))^.5
disp("SH = D/B = l*d*(e/(2*m*Va))^.5 = "+string(SH)+"m/tesla")//magnetic deflection sensitivity in terms of meter and tesla
// as B = micro_not*H
micro_not = 4*%pi*10^-7
disp("SH = D/H = micro_not*l*d*(e/(2*m*Va))^.5 = "+string(SH*micro_not)+"m-sq/Amp.")//magnetic deflection sensitivity in terms of meter and amperes
```

Scilab code Exa 3.15 Electric field and velocity and deflection sensitivity

```
//Ex3_15
clc
Vd = 50
d = 1
disp("(a)")
disp("Vd = "+string(Vd)+"V")//voltage applied to deflection plates
disp("d = "+string(d)+"cm")//plate separation
E = Vd/d/10^-2
disp("E = Vd/d = "+string(E)+"V/m")//electric field produced

disp("(b)")
e = -1.6*10^-19
m = 9.1*10^-31
Va = 500
v = abs((2*e*Va/m))^.5
```

```
disp("v = (2*e*Va/m)^.5")// formula for Velocity OF Electron
disp("e = "+string(e)+"C")//electron charge
disp("m = "+string(m)+"Kg")//mass of electron
disp("Va = "+string(Va)+"V")//voltage applied at anode
disp("v = "+string(v)+"m/s")

disp("(c)")
l = 2
L = 30
Va = 500
SE = l*L/2/Va/d*10
disp("l = "+string(l)+"cm")//length of deflection plate
disp("L = "+string(L)+"cm")//distance between plates and screen
disp("d = "+string(d)+"cm")//plate separation
disp("Va = "+string(Va)+"V")//anode voltage
disp("SE = (l*L)/(2*Va*d) = "+string(SE)+"mm/volts")//Electrostatic deflection sensitivity
```

Scilab code Exa 3.16 Phase difference using Lissajous pattern

```
//Ex3_16
clc
//considering Lissajous pattern given in question
y1 = 0
y2 = 5
phi = asind(y1/y2)
disp("y1 = "+string(y1)+"cm")//minor axis
disp("y2 = "+string(y2)+"cm")//major axis
disp("phi = sin-1(y1/y2) = "+string(phi)+"degree")//phase difference
```

Scilab code Exa 3.17 Phase difference using Lissajous pattern

```
//Ex3_17
clc
//considering Lissajous pattern given in question
y1 = 4
y2 = 5
phi = asind(y1/y2)
disp("y1 = "+string(y1)+"unit")//minor axis
disp("y2 = "+string(y2)+"unit")//major axis
disp("phi = sin-1(y1/y2) = "+string(phi)+"degree")//
   phase difference
```

Scilab code Exa 3.18 Phase difference using Lissajous pattern

```
//Ex3_16
clc
//considering Lissajous pattern given in question
y1 = 4
y2 = 4
phi = asind(y1/y2)
disp("y1 = "+string(y1)+"cm")//minor axis
disp("y2 = "+string(y2)+"cm")//major axis
disp("phi = sin-1(y1/y2) = "+string(phi)+"degree")//
   phase difference
```

Scilab code Exa 3.19 Phase difference using Lissajous pattern

```
//Ex3_16
```

```
clc
//considering Lissajous pattern given in question
y1 = 2
y2 = 6
phi = asind(y1/y2)
disp("y1 = "+string(y1)+"cm")//minor axis
disp("y2 = "+string(y2)+"cm")//major axis
disp("phi = sin-1(y1/y2) = "+string(phi)+"degree")//
    phase difference
disp("OR")
phi = 180 - phi
disp("phi = "+string(phi)+"degree")
```

Chapter 4

Diode Characteristics and Applications

Scilab code Exa 4.1 Current in silicon diode

```
//Ex4_1
clc
Irs = 0.2*10^-6
Vf = 0.1
VT = 26*10^-3
eta = 1//for germanium
I = Irs*(exp(Vf/eta/VT)-1)
disp("Irs = "+string(Irs)+"A")//reverse saturation current
disp("Vf = "+string(Vf)+"V")//applied voltage
disp("VT = "+string(VT)+"V")//voltage at room temperature
disp("eta = "+string(eta))
disp("I = Irs*(exp(Vf/eta/VT)-1)")//current at room temperature
disp("I = "+string(I)+"A")

//current in silicon:
eta = 2//for silicon
```

```
disp("eta = "+string(eta))
I = Irs*(exp(Vf/eta/VT)-1)
disp("I = "+string(I)+"A")




// note: incomplete solution in textbook for above
    question.
```

Scilab code Exa 4.2 Voltage in silicon diode

```
//Ex4_2
clc
Irs = 2.0*10^-6
I = 10*10^-3
VT = 26*10^-3
eta = 2//for silicon
disp("Irs = "+string(Irs)+"A")//reverse saturation
    current
disp("I = "+string(I)+"A")//forward current
disp("VT = "+string(VT)+"V")//voltage at room
    temperature
disp("eta = "+string(eta))
Vf = eta*VT*log((I/Irs)+1)//voltage produced
disp("Vf = eta*VT*log((I/Irs)+1) = "+string(Vf)+"V")
```

Scilab code Exa 4.3 Dynamic resistance of diode

```
//Ex4_3
clc
If = 3*10^-3//forward current
eta = 1//for germanium
```

```
T = 300//room temperature
VT = T/11600//voltage at room temperature
disp("If = "+string(If)+"A")
disp("eta = "+string(eta))
disp("T = "+string(T)+"degreeK")
disp("VT = "+string(VT)+"V")
Rdf = (eta*VT/If)//dynamic resistance at room
    temprature
disp("Rdf = (eta*VT/If) = "+string(Rdf)+"ohm")
```

Scilab code Exa 4.4 Transition Capacitance

```
//Ex4_4
clc
A = 4*10^-6
W = 1.5*10^-6
apsilent_r = 16//for germanium
apsilent_not = 8.85*10^-12//permitivity in vaccum
disp("A = "+string(A)+"m_sq")//cross sectional are
disp("W = "+string(W)+"m")//width of depletion layer
disp("apsient_r = "+string(apsilent_r))//relative
    permittivity
disp("CT = apsilent*A/W")//transition capacitance
disp("   = "+string(apsilent_r*apsilent_not*A/W)+"F"
    )


// note: units given in textbook in the solution for
     cross sectional area and width are misprinted.
```

Scilab code Exa 4.5 Diffusion Capacitance

```
//Ex4_5
```

```
clc
I = 10*10^-3
eta = 1//for germanium
VT = 26*10^-3
tawo = 6*10^-3
CD = I*tawo/eta/VT
disp("I = "+string(I)+"A")//forward current
disp("eta = "+string(eta))
disp("VT = "+string(VT)+"V")//voltagr at room
    temperature
disp("tawo = "+string(tawo)+"sec")//mean lifetime
disp("CD = I*tao/eta/VT = "+string(CD)+"F")//
```

Chapter 5

Rectifier and DC Power Supplies

Scilab code Exa 5.1 Current and ripple factor

```
//Ex5_
clc
Vm = 24
RL = 1.8*10^3
Im = Vm/RL
Irms = Im/2
Idc = Im/(%pi)
r = ((Irms/Idc)^2 - 1)^.5
disp("Vm = "+string(Vm)+"V")//applied voltage to
    half wave rectifier
disp("RL = "+string(RL)+"ohm")//load resistance
disp("Im = Vm/RL = "+string(Im)+"A")//peak current
disp("Irms = Im/2 = "+string(Irms)+"A")//rms current
disp("Idc = Im/pi = "+string(Idc)+"A")//D.C. current
disp("r ((Irms/Idc)^2 - 1)^.5 = "+string(r))//ripple
    factor
```

Scilab code Exa 5.2 DC and peak voltage

```
//Ex5_2
clc
Vm = 18

//in half wave circuit
Vdc = Vm/%pi
PIV = Vm
disp("Vm = "+string(Vm)+"V")//peak voltage to
    rectifier
disp("Vdc = Vm/pi = "+string(Vdc)+"V")//D.C. voltage
disp("PIV = Vm = "+string(PIV)+"V")//peak inverse
    voltage

//in full wave circuit
Vdc = (2*Vm/%pi)
PIV = 2*Vm
disp("Vdc = 2*Vm/pi = "+string(Vdc)+"V")//D.C.
    voltage
disp("PIV = 2*Vm = "+string(PIV)+"V")//peak inverse
    voltage for center trapped

//in full wave Bridge rectifier
disp("PIV = Vm = "+string(Vm)+"V")//peak inverse
    voltage
```

Scilab code Exa 5.3 Current and Voltage and Ripple Factor

```
//Ex5_3
clc
Vm = 12
RL = 1.5*10^3
Im = Vm/RL
Irms = Im/(2^.5)
```

```
Idc = (2*Im/%pi)
r =(((Irms/Idc)^2)-1)^.5
disp("Vm = "+string(Vm)+"V")//peak voltage to full rectifier
disp("Im = Vm/RL = "+string(Im)+"A")//peak current
disp("Irms = Im/(2^0.5) = "+string(Irms)+"A")//rms current
disp("Idc = (2*Im/pi) = "+string(Idc)+"A")//D.C. current
disp("r = (((Irms/Idc)^2)-1)^0.5 = "+string(r))//ripple factor
```

Scilab code Exa 5.4 Power and Rectification Efficiency

```
//Ex5_4
clc
Idc = 10*10^-3
Irms = 14*10^-3
RL = 1*10^3
Pdc = (Idc^2)*RL
Pac = (Irms^2)*RL
disp("Idc = "+string(Idc)+"A")//D.C. current
disp("Irms = "+string(Irms)+"A")//rms current
disp("RL = "+string(RL)+"ohm")//load resistance
disp("Pdc = (Idc^2)*RL = "+string(Pdc)+"W")//D.C. power
disp("Pac = (Irms^2)*RL = "+string(Pac)+"W")//A.C. power
disp("eta_r = Pdc/Pac = "+string(Pdc/Pac*100)+"%")//Rectification efficiency
```

Scilab code Exa 5.5 Voltage and Current and Power and percentage regulation

```
//Ex5_5
clc
disp("v = 12 sin(wt)")
Vm = 12
RL = 1*10^3
Rf = 10
Im = Vm/(RL+Rf)
Idc =Im/%pi
Vdc = Idc*RL
Irms = Im/2
Pi = (Irms^2)*(RL+Rf)
VNL = Vm/%pi
VL = Idc*RL
Regulation = (VNL - VL)/VL
disp("Vm = "+string(Vm)+"V")//amplitude of applied
    signal
disp("RL = "+string(RL)+"ohm")//load resistance
disp("Rf = "+string(Rf)+"ohm")//forward resistance
disp("Im = Vm/(RL+Rf) = "+string(Im)+"A")//peak
    current
disp("Idc = Im/pi = "+string(Idc)+"A")//D.C. current
disp("Vdc = Idc*RL = "+string(Vdc)+"V")//D.C,
    voltage
disp("Pi = (Irms^2)*(RL+Rf)")
disp("Irms = Im/2 = "+string(Irms)+"A")//rms current
disp("Pi = "+string(Pi)+"W")//input power
disp("%Regulation = (VNL - VL)/VL")
disp("VNL = Vm/pi = "+string(VNL)+"V")//non load
    voltage
disp("VL = Idc*RL = "+string(VL)+"")//load voltage
disp("%Regulation = "+string(Regulation*100)+"%")//
    percentage regulation


//   NOTE : THE POWER CALCULATED IN THE TEXTBOOK IS
    WRONG.
```

Scilab code Exa 5.6 Peak Inverse Voltage

```
//Ex5_6
clc
Vdc = 15
disp("Vdc = "+string(Vdc)+"V")//applied D.C. voltage
//Half Wave Rectifier
Vm = %pi*Vdc
PIV = Vm
disp("Vm = Vdc*pi = "+string(Vm)+"V")//D.C. voltage
    for half wave rectifier
disp("PIV = Vm = "+string(PIV)+"V")//peak inverse
    voltage for half wave rectifier
//Full Wave Rectifier
Vm = %pi*Vdc/2
PIV = 2*Vm
disp("Vm = Vdc*pi/2 = "+string(Vm)+"V")//D.C.
    voltage for full wave rectifier
disp("PIV = 2*Vm = "+string(PIV)+"V")//peak inverse
    voltage for full wave rectifier
//Bridge Rectifier
Vm = %pi*Vdc/2
PIV = Vm
disp("Vm = Vdc*pi/2 = "+string(Vm)+"V")//D.C.
    voltage for bridge rectifier
disp("PIV = Vm = "+string(PIV)+"V")//peak inverse
    voltage for bridge rectifier
```

Scilab code Exa 5.11 Half wave rectification

```
//Ex5_11
clc
```

```
Rf = 10
RL = 150
eta_r = 40.6/(1+Rf/RL)
disp("Rf = "+string(Rf)+"ohm")//forward resistance
disp("RL = "+string(RL)+"ohm")//load resistance
disp("eta_r = 40.6/(1+Rf/RL) = "+string(eta_r)+"%")
    //rectification efficiency
```

Scilab code Exa 5.12 Full wave rectification

```
//Ex5_12
clc
Rf = 12.5
RL = 100
eta_r = 80.1/(1+Rf/RL)
disp("Rf = "+string(Rf)+"ohm")//forward resistance
disp("RL = "+string(RL)+"ohm")//load resistance
disp("eta_r = 80.1/(1+Rf/RL) = "+string(eta_r)+"%")
    //rectification efficiency
```

Scilab code Exa 5.13 Bridge Rectifier

```
//Ex5_13
clc
Vdc = 32
Vm = %pi*Vdc/2
Vrms = Vm/(2^.5)
PIV = Vm
disp("Vdc = "+string(Vdc)+"V")//D.C. voltage
disp("Vm = pi*Vdc/2 = "+string(Vm)+"V")//peak
    voltage
disp("Vrms = Vm/(2^.5) = "+string(Vrms)+"V")//rms
    voltage
```

```
disp("PIV = "+string(PIV)+"V")//peak inverse voltage


// note : value calculated for Vrms in the textbook
   is wrong.
```

Scilab code Exa 5.14 Ripple Voltage

```
//Ex5_14
clc
C = 10*10^-3
f = 50
Idc = 200*10^-3
Vr = Idc/(2*f*C)
disp("C = "+string(C)+"F")//circuit capacitance
disp("f = "+string(f)+"Hz")//operating frequency
disp("Idc = "+string(Idc)+"A")//D.C. current
disp("Vr = Idc/(2*f*C) = "+string(Vr)+"V")//ripple
   voltage
```

Scilab code Exa 5.15 Ripple factor and DC current and load resistance

```
//Ex5_15
clc
C = 600*10^-6
T = 20*10^-3
Vr = 1.2
Vdc = 9
Vac =Vr/(2*(3^.5))
r = Vac/Vdc
Idc = (Vr*C)/(T/2)
RL = Vdc/Idc
disp("C = "+string(C)+"F")//rectifier capacitance
```

```
disp("T = "+string(T)+" s")//time
disp("Vr = "+string(Vr)+"V")//ripple voltage
disp("Vdc = "+string(Vdc)+"V")//D.C. voltage
disp("Vac = "+string(Vac)+"V")//A.C. voltage
disp("r = "+string(r))//ripple factor
disp("Idc = "+string(Idc)+"A")//D.C. current
disp("RL = "+string(RL)+"ohm")//load resistance
```

Scilab code Exa 5.16 Design pi section full wave filter

```
//Ex5_16
clc
L = 1// assuming inductance
f = 50//operating frequency
XL = 2*%pi*f*L//inductance
RL = 100//assuming load resistance
r = .01//ripple factor

//let , capacitances C1 = C2 = C
//that implies XC1 = XC2 = XC
disp("XL = 2*%pi*f*L = "+string(XL)+"ohm")
disp("r = "+string(r))
XC = ((r*8*XL*RL)/(2^.5))^.5//capacitive resistance
disp("XC = ((r*8*XL*RL)/(2^.5))^.5 = "+string(XC)+"
   ohm")
disp("XC = 1/wC = 1/(2*pi*f*C) = "+string(XC))
C = 1/(2*%pi*f*XC)//capacitance
disp("C = 1/(2*pi*f*XC) = "+string(C)+"F")
// thus, design parameters are :
disp("design parameters:")
disp("C1 = C2 = "+string(C)+"F")
disp("RL = "+string(RL)+"ohm")
disp("L = "+string(L)+"H")


```

```
// Note : the calculations done in the textbook for
   the given problem is wrong.
```

Scilab code Exa 5.17 DC voltage and current and Resistance

```
//Ex5_17
clc
f =50
disp("vi = 16 sin(wt)")
Vdc = 16
RL = 100
C1 = 2*10^-3
C2 = 2*10^-3
L = 1.0
Idc = Vdc/RL
XC1 = 1/(2*%pi*f*C1)
XC2 = 1/(2*%pi*f*C2)
XL = 2*%pi*f*L
r = ((2^.5)*XC1*XC2)/(8*XL*RL)
disp("L = "+string(L)+"H")//inductance
disp("C1 = "+string(C1)+"F")//capacitance 1
disp("C2 = "+string(C2)+"F")//capacitance 2
disp("RL = "+string(RL)+"ohm")//load resistance
disp("f = "+string(f)+"Hz")//operating frequency
disp("Vdc = "+string(Vdc)+"V")//d.c. voltage
disp("Idc = Vdc/RL = "+string(Idc)+"A")//d.c.
   current
disp("XL = 2*%pi*f*L = "+string(XL)+"ohm")//
   inductive resistance
disp("XC1 = 1/(2*%pi*f*C1) = "+string(XC1)+"ohm")//
   capacitive resistance due to capacitance 1
disp("XC2 = 1/(2*%pi*f*C2) = "+string(XC2)+"ohm")//
   capacitive resistance due to capacitance 2
disp("r = ((2^.5)*XC1*XC2)/(8*XL*RL) = "+string(r))
   //ripple factor
```

Chapter 6

Transistor Characteristics And Applications

Scilab code Exa 6.1 current gain

```
//Ex6_1
clc
IB = 40*10^-6
IC = 3*10^-3
beta = IC/IB
alpha = beta/(1+beta)
disp("IB = "+string(IB)+"A")//base current
disp("IC = "+string(IC)+"A")//collector current
disp("beta = IC/IB = "+string(beta))//current gain
   in CE configuration
disp("alpha = beta/(1+beta) = "+string(alpha))//
   current gain in CB configuration
```

Scilab code Exa 6.2 Transistor current and current gain

```
//Ex6_2
```

```
clc
IE = 1.2*10^-3
beta = 60
alpha = beta/(1+beta)
disp("beta = "+string(beta))//current gain in CE
   configuration
disp("alpha = beta/(1+beta) = "+string(alpha))//
   current gain in CB configuraion
disp("IE = "+string(IE)+"A")//emitter current
IB = IE/(beta+1)
IC = beta*IB
disp("IB = IE/(beta+1) = "+string(IB)+"A")//base
   current
disp("IC = beta*IB = "+string(IC)+"A")//collector
   current
```

Scilab code Exa 6.3 Unknown Resistance in transistor

```
//Ex6_3
clc
alpha = 0.98
VBE = 0.7
IE = -2*10^-3
Re = 100
RL = 3.3*10^3
disp("alpha = "+string(alpha))//current gain
disp("VBE = "+string(VBE)+"V")//voltage across base-
   emitter
disp("IE = "+string(IE)+"A")//emitter current
disp("Re = "+string(Re)+"ohm")//emitter resistance
disp("RL = "+string(RL)+"ohm")//load resistance
//now according to circuit given for the question in
    the textbook
IC = -alpha * IE
disp("IC = -alpha*IE = "+string(IC)+"A")//collector
```

```
current
IB = -IC - IE
disp("IB = -IC - IE = "+string(IB)+"A")//base current
VBN = VBE+(abs(IE)*Re)
disp("VBN = VBE+(IE*Re) = "+string(VBN)+"V")//voltage across base and ground(N)
//ASSUMING... value for R1 = 30*10^3 ohm
R1 = 30*10^3
disp("R1 = "+string(R1)+"ohm")//resistancfe R1 as given in circuit
I = VBN/R1
disp("I = VBN/R1 = "+string(I)+"A")//current across resistance R1
//ASSUMING... VCC = 9V
VCC = 9//collector voltage
disp("VCC = "+string(VCC)+"V")
VCN = VCC - (RL*(IC+I+IB))
disp("VCN = VCC - RL*(IC+I+IB)) = "+string(VCN)+"V")//voltage across collector and ground(N)
// according to the given diagram for the question in the textbook, unknown resistance is,
R = (VCN - VBN)/(I+IB)
disp("R = (VCN - VBN)/(I+IB) = "+string(R)+"ohm")//unknown resistance
```

Scilab code Exa 6.4 transistor current and resistance

```
//Ex6_4
clc
RC = 2.3*10^3
Re = 1*10^3
VCC = 12
VCE = 5
VBE = 0.7
```

```
beta = 50
disp("RC = "+string(RC)+"ohm")//collector resistance
disp("Re = "+string(Re)+"ohm")//emitter resistance
disp("VCC = "+string(VCC)+"V")//supply voltage
disp("VCE = "+string(VCE)+"V")//voltage across collector and emitter
disp("VBE = "+string(VBE)+"V")//voltage across base and emitter
disp("beta = "+string(beta))//current gain
// according to the given circuit , we have
IB = (VCC - VCE)/((beta+1)*[RC+Re])
disp("IB = (VCC - VCE)/((beta+1)*[RC+Re]) = "+string(IB)+"A")//base current
IC = beta*IB
disp("IC = "+string(IC)+"A")//collector current
//from the circuit we have,
Rt = (VCE-VBE)/IB
disp("Rt = (VCE - VBE)/IB = "+string(Rt)+"ohm")//resistance Rt as given in circuit
```

Scilab code Exa 6.5 Base curre3nt and collector resistance

```
//Ex6_5
clc
VBB = 1
VCC = 12
IC = 12*10^-3
VCE = 4
beta = 80
VBE = 0.7
disp("VBB = "+string(VBB)+"V")//base supply voltage
disp("VCC = "+string(VCC)+"V")//collector supply voltage
disp("IC = "+string(IC)+"A")//collector current
disp("VCE = "+string(VCE)+"V")//voltage across
```

```
collector and emitter
disp("beta = "+string(beta))//current gain
disp("VBE = "+string(VBE)+"V")//voltage across base
    and emitter
IB = IC/beta
disp("IB = IC/beta = "+string(IB)+"A")//base current
RC = (VCC - VCE)/IC
disp("RC = (VCC - VCE)/IC = "+string(int(RC))+"ohm")
    //collector resistance
```

Scilab code Exa 6.6 Current gain and base reistance

```
//Ex6_6
clc
VCC = 9
VBB = 3
IC = 2*10^-3
beta = 50
VBE = 0.7
VCE = 4
disp("VCC = "+string(VCC)+"V")//collector supply
    voltage
disp("VBB = "+string(VBB)+"V")//base supply voltage
disp("IC = "+string(IC)+"A")//collector current
disp("beta = "+string(beta))//current gain
disp("VBE = "+string(VBE)+"V")//voltage across base
    and emitter
disp("VCE = "+string(VCE)+"V")//voltage across
    collector and emitter
IB = IC/beta
disp("IB = IC/beta = "+string(IB)+"A")//base current
RB = (VBB - VBE)/IB
disp("RB = (VBB - VBE)/IB = "+string(RB)+"ohm")//
    base resistance according to the given in circuit

```

```
// note: misprint in the question, author is asking for IB instead of beta, as beta is already provided.
// note: calculation done in the textbook for the problem is wrong.
```

Scilab code Exa 6.7 base current and transistor resistance

```
//Ex6_7
clc
VCC = 12
VBB = 3
IC = 12*10^-3
VCE = 5.5
beta = 100
VBE = 0.7
Re = 50
disp("VCC = "+string(VCC)+"V")//collector supply voltage
disp("VBB = "+string(VBB)+"V")//base supply voltage
disp("IC = "+string(IC)+"A")//collector current
disp("VCE = "+string(VCE)+"V")//voltage across collector and emitter
disp("beta = "+string(beta))//current gain
disp("VBE = "+string(VBE)+"V")//voltage across base and emitter
disp("Re = "+string(Re)+"ohm")//emittter resistance
IB = IC/beta
disp("IB = IC/beta = "+string(IB)+"A")//base current
//from base-emitter circuit;
IE = IC+IB
Rb = (VBB - VBE - (IE*Re))/IB
disp("Rb = (VBB - VBE - IE*Re)/IB = "+string(Rb)+"ohm")//base resistance
```

```
//from collector-emitter circuit , we have
Rc = (VCC - VCE - (IE*Re))/(IC)
disp("Rc = (VCC - VCE - (IE*Re))/IC = "+string(Rc)+"
    ohm")//collector resistance


//NOTE : in textbook the notation used for base and
    emitter resistance in fig. and in calculation are
     different



// note : calculation perform in the textbook is
    wrong for the above problem
```

Scilab code Exa 6.8 Base and current current

```
//Ex6_8
clc
VBB = 10
RB = 500*10^3
VCC = 15
RC = 1.2*10^3
beta =100
disp("beta = "+string(beta))//current gain
disp("VBB = "+string(VBB)+"V")//base supply voltage
disp("RB = "+string(RB)+"ohm")//resistance across
    base terminal
disp("VCC = "+string(VCC)+"V")//collector supply
    voltage
disp("RC = "+string(RC)+"ohm")//resistance across
    collector terminal
IB = VBB/RB
disp("IB = VBB/RB = "+string(IB)+"A")//base current
IC = beta*IB
```

```
disp("IC = beta*IB = "+string(IC)+"A")//collector current
VCE = VCC - (IC*RC)
disp("VCE = VCC - IC*RC = "+string(VCE)+"V")// voltage across collector and emitter


// the answer printed in the textbook for VCE is wrong.
```

Scilab code Exa 6.9 resistance and conductance calculation of CC configuration

```
//Ex6_9
clc
ic = 2*10^-3
ie = ic// as base current is negligble
VT = 25*10^-3
re = VT/ie
gm = ie/VT
disp("ic = "+string(ic)+"A")//collector current
disp("ie = "+string(ie)+"A")//emitter current with negligble base current
disp("VT = "+string(VT)+"V")//voltage at room temperature
disp("re = VT/ie = "+string(re)+"ohm")//emitter resistance
disp("gm = ie/VT = "+string(gm)+"mho")//conductance
rc = 100*10^3//slope of output characteristics
disp("rc = "+string(rc)+"ohm")
hoe = 1/rc
disp("hoe = 1/rc = "+string(hoe)+"Mho")//output conductance
```

Scilab code Exa 6.10 common emitter current gain

```
//Ex6_10
clc
ic = 2.5*10^-3
ib = 50*10^-6
disp("ib = "+string(ib)+"A")//base current
disp("ic = "+string(ic)+"A")//collector current
beta = ic/ib
disp("beta = ic/ib = "+string(beta))//current gain
```

Scilab code Exa 6.11 common base current gain

```
//Ex6_11
clc
ic = 3*10^-3
ib = 3.08*10^-3
disp("ib = "+string(ib)+"A")//base current
disp("ic = "+string(ic)+"A")//collector current
alpha = ic/ib
disp("alpha = ie/ib = ic/ib = "+string(alpha))//
    current gain, assuming ie = ic
```

Scilab code Exa 6.12 peak to peak collector voltage and current

```
//Ex6_12
clc
//given, collector voltage swings between 11V to 4V
//thus,
```

```
vc = 11-4
disp("vc = 11 - 4 = "+string(vc)+"V")//PEAK-to-PEAK collector voltage
//given, collector current swings between 5mA to 1.4 mA
//thus,
ic = (5 - 1.4)*10^-3
disp("ic = 5m - 1.4m = "+string(ic)+"A")//PEAK-to-PEAK collector current
```

Scilab code Exa 6.13 Current gain in CE amplifier

```
//Ex6_13
clc
ic = 4*10^-3
ib = 80*10^-6
disp("ib = "+string(ib)+"A")//base current
disp("ic = "+string(ic)+"A")//collector current
Ai = ic/ib
disp("Ai = ic/ib = "+string(Ai))//current gain in CE amplifier
```

Chapter 7

Transistor Biasing and Stabilization Techniques

Scilab code Exa 7.1 Emitter Resistance

```
//Ex7_1
clc
Ie = 6.0*10^-3
Ve = 1.1
Re = Ve/Ie
disp("Ie = "+string(Ie)+"A")//current flowing in
   emitter resistance
disp("Ve = "+string(Ve)+"V")//voltage drop across
   emitter resistance
disp("Re = "+string(Re)+"ohm")//emitter resistance
```

Scilab code Exa 7.2 Thermal resistance of transistor

```
//Ex7_2
clc
TA = 30
```

```
TJ = 48
PD = 4
TR = (TJ - TA)/PD
disp("TA = "+string(TA)+"degreeC")//ambient temperature at which transistor is operated
disp("TJ = "+string(TJ)+"degreeC")//junction temperature
disp("PD = "+string(PD)+"W")//dissipated power
disp("TR = (TJ - TA)/PD = "+string(TR)+"degreeC/W")//termal resistance
```

Scilab code Exa 7.3 power dissipation of transistor

```
//Ex7_3
clc
TA = 28
TJ = 50
TR = 10
PD = (TJ - TA)/TR
disp("TA = "+string(TA)+"degreeC")//ambient temperature at which transistor is operated
disp("TJ = "+string(TJ)+"degreeC")//junction temperature
disp("TR = "+string(TR)+"degreeC/W")//termal resistance
disp("PD = (TJ - TA)/TR = "+string(PD)+"W")//dissipated power
```

Scilab code Exa 7.4 Q point in fixed bias circuit

```
//Ex7_4
clc
RC = 4*10^3
```

```
RB = 1.2*10^6
VCC = 9
VBE = .2
beta = 80
disp("RC = "+string(RC)+"ohm")//collector resistance
disp("RB = "+string(RB)+"ohm")//base resistance
disp("VCC = "+string(VCC)+"V")//collector supply
    voltage
disp("VBE = "+string(VBE)+"V")//voltage across base
    and emittter
disp("beta = "+string(beta))//current gain
IB = (VCC - VBE)/RB
disp("IB = (VCC - VBE)/RB = "+string(IB)+"A")//base
    current
IC = beta*IB
disp("IC = beta*IB = "+string(IC)+"A")//collector
    current
VCE = VCC - (IC*RC)
disp("VCE = VCC - (IC*RC) = "+string(VCE)+"V")//
    collector-emitter voltage
disp("The Q-point is("+string(VCE)+"V, "+string(IC)+
    "A)")//Q-point in fixed bias circuit
```

Scilab code Exa 7.5 claculate base resistance to obtain optimum operatin point

```
//Ex7_5
clc
VBE = 0.6
beta = 100
disp("beta = "+string(beta))//current gain
disp("VBE = "+string(VBE)+"V")//voltage across base
    and emitter
//according to given circuit;
VCC = 12
```

```
RC = 5*10^3
disp("VCC = "+string(VCC)+"V")//collector supply voltage
disp("RC = "+string(RC)+"ohm")//collector resistance
// optimum operating point is half of (VCC/RC)
IC = (1/2)*(VCC/RC)
disp("IC = VCC/(2*RC) = "+string(IC)+"A")//collector current at optimum operating point
IB = IC/beta
disp("IB = IC/beta = "+string(IB)+"A")//base current
//from the closed circuit in the given fig., we have
disp("IB*RB = VCC - VBE")
RB = (VCC - VBE)/IB
disp("RB = (VCC - VBE)/IB = "+string(RB)+"ohm")//veriable resistance across base-collector as given in circuit
```

Scilab code Exa 7.6 Q point for voltage divider base bias circuit

```
//Ex7_6
clc
RC = 2*10^3
beta = 100
VCC = 9
RB = 500*10^3
VBE = 0.6
disp("RC = "+string(RC)+"ohm")//collector resistance
disp("beta = "+string(beta))//current gain
disp("VCC = "+string(VCC)+"V")//collector supply voltage
disp("RB = "+string(RB)+"ohm")//base resistance
disp("VBE = "+string(VBE)+"V")//base-emitter voltage
IB = (VCC - VBE)/RB
disp("IB = (VCC - VBE)/RB = "+string(IB)+"Amp")//base current
```

```
IC = beta*IB
disp("IC = beta*IB = "+string(IC)+"A")//collector
    current
VCE = VCC - IC*RC
disp("VCE = VCC - IC*RC = "+string(VCE)+"V")//
    collector-emitter voltage
disp("operating point is("+string(VCE)+"V, "+string(
    IC)+"A)")
```

Scilab code Exa 7.7 Q point for self bias circuit

```
//Ex7_7
clc
VCC = 12
RB = 300*10^3
RC = 1.5*10^3
Re = 2*10^3
beta = 100
disp("VCC = "+string(VCC)+"V")//collector supply
    voltage
disp("RB = "+string(RB)+"ohm")//base resistance
disp("RC = "+string(RC)+"ohm")//collector resistance
disp("Re = "+string(Re)+"ohm")//emitter resistance
disp("beta = "+string(beta))//current gain
IB = VCC/(RB + beta*Re)
disp("IB = VCC/(RB + beta*Re) = "+string(IB)+"A")//
    base current
IC = beta*IB
disp("IC = beta*IB = "+string(IC)+"A")//collector
    current
IE = IB + IC
disp("IE = IB + IC = "+string(IE)+"A")//emitter
    current
VCE = VCC - IC*RC - IE*Re
disp("VCE = VCC - IC*RC - IE*Re = "+string(VCE)+"V")
```

```
    //collector-emitter voltage
disp("quiescent point is("+string(VCE)+"V, "+string(
    IC)+"A)")
```

Scilab code Exa 7.8 Operating point and stability factor of silicon transistor

```
//Ex7_8
clc
VCC = 9
RC = 3*10^3
RB = 500*10^3
beta = 100
VBE = 0.7
disp("VCC = "+string(VCC)+"V")//collector supply
    voltage
disp("RC = "+string(RC)+"ohm")//collector resistance
disp("RB = "+string(RB)+"ohm")//base resistance
disp("beta = "+string(beta))//current gain
disp("VBE = "+string(VBE)+"V")//emitter-base voltage
//for a Fixed Bais Circuit;
IB = (VCC - VBE)/RB
disp("IB = (VCC - VBE)/RB  = "+string(IB)+"A")//base
     current
IC = beta*IB
disp("IC = beta*IB = "+string(IC)+"A")//collector
    current
VCE = VCC - IC*RC
disp("VCE = VCC - IC*RC = "+string(VCE)+"V")//
    collector-emitter voltage
disp("operating point is("+string(VCE)+"V, "+string(
    IC)+"A)")
S = 1+beta
disp("S = 1 + beta = "+string(S))//stability factor

```

```
// NOTE : in the textbook author has taken beta = 100 for calculation
//          but has mention beta = 50 in Question
//          I am working with beta = 100.
```

Scilab code Exa 7.9 Operating point and stability factor of self bias circuit

```
//Ex7_9
clc
R1 = 80*10^3
R2 = 25*10^3
Re = 2*10^3
Rc = 2*10^3
beta = 100
VCC = 12
VBE = 0.7
disp("R1 = "+string(R1)+"ohm")
disp("R2 = "+string(R2)+"ohm")
disp("Re = "+string(Re)+"ohm")//emitter resistance
disp("Rc = "+string(Rc)+"ohm")//collector resistance
disp("beta = "+string(beta))//current gain
disp("VCC = "+string(VCC)+"V")//collector supply voltage
disp("VBE = "+string(VBE)+"V")//base-emitter voltage
Rb = R1*R2/(R1+R2)
disp("Rb = R1*R2/(R1+R2) = "+string(Rb)+"ohm")//base resistance
VB = VCC*(R2/(R1+R2))
disp("VB = VCC(R2/(R1+R2)) = "+string(VB)+"V")//base voltage
IB = (VB - VBE)/(Rb*(1+((1+beta)*(Re/Rb))))
disp("IB = (VB - VBE)/(Rb*(1+((1+beta)*(Re/Rb))))")
disp("   = "+string(IB)+"A")//base current
```

```
IC = beta*IB
disp("IC = beta*IB = "+string(IC)+"A")//collector current
IE = IC
VCE = VCC - IC*Rc - IE*Re
disp("VCE = VCC - IC*Rc - IE*Re = "+string(VCE)+"V")//collector-emitter voltage
disp("operating point is("+string(VCE)+"V, "+string(IC)+"A)")
S = (1+beta)*[(1+Rb/Re)/(1+beta+Rb/Re)]
disp("S = (1+beta)*[(1+Rb/Re)*(1+beta+Rb/Re)] = "+string(S))
disp("S'' = -(beta/Re)/(1+beta+Rb/Re) = "+string((-beta/Re)/(1+beta+Rb/Re)))
```

Scilab code Exa 7.10 Stability factor of self bias circuit

```
//Ex7_10
clc
delta_IC = 0.01*10^-3
delta_beta = 5
disp("delta_IC = "+string(delta_IC)+"A")//change of collector current
disp("delta_beta = "+string(delta_beta)+"A")//change in current gain
disp("S'''' = delta_IC/delta_beta = "+string(delta_IC/delta_beta))//stability
```

Scilab code Exa 7.11 Thermal resistance of transistor

```
//Ex7_11
clc
TA = 30
```

```
TJ = 48
PD = 4
TR = (TJ - TA)/PD
disp("TA = "+string(TA)+" degreeC")//ambient temperature at which transistor is operated
disp("TJ = "+string(TJ)+" degreeC")//junction temperature
disp("PD = "+string(PD)+"W")//dissipated power
disp("TR = (TJ - TA)/PD = "+string(TR)+" degreeC/W")//termal resistance
```

Scilab code Exa 7.12 power dissipation of transistor

```
//Ex7_12
clc
TA = 28
TJ = 50
TR = 10
PD = (TJ - TA)/TR
disp("TA = "+string(TA)+" degreeC")//ambient temperature at which transistor is operated
disp("TJ = "+string(TJ)+" degreeC")//junction temperature
disp("TR = "+string(TR)+" degreeC/W")//termal resistance
disp("PD = (TJ - TA)/TR = "+string(PD)+"W")//dissipated power
```

Chapter 8

Analysis of transistor Amplifier using Hybrid Equivalent Circuit

Scilab code Exa 8.1 Calculating h parameters

```
//Ex8_1
clc
disp("(a)")
Vce=0
Ic=2*10^-3
Ib=30*10^-6
Vbe=50*10^-3
disp("Vce = "+string(Vce)+"V")//collector-emitter voltage
disp("Ic = "+string(Ic)+"A")//collector current
disp("Ib = "+string(Ib)+"A")//base current
disp("Vbe = "+string(Vbe)+"V")//base-emitter voltage
hfe=Ic/Ib
disp("hfe = Ic/Ib = "+string(hfe))//current gain in CE amplifier
hie=Vbe/Ib
disp("hie = Vbe/Ib = "+string(hie)+"ohm")//input
```

```
    impedance in CE amplifier
disp("(b)")
Ib=0
Vce=1
Vbe=0.3*10^-3
Ic=0.1*10^-3
disp("Vce = "+string(Vce)+"V")//collector-emitter
    voltage
disp("Ic = "+string(Ic)+"A")//collector current
disp("Ib = "+string(Ib)+"A")//base current
disp("Vbe = "+string(Vbe)+"V")//base-emitter voltage
hoe=Ic/Vce
disp("hoe = Ic/Vce = "+string(hoe)+"mho")//output
    conductance in CE amplifier
hre=Vbe/Vce
disp("hre = Vbe/Vce = "+string(hre))//voltage gain
    in CE amplifier

// note: textbook answers has printing mistake,
    regaeding hre.
```

Scilab code Exa 8.2 current gain and input resistance

```
//Ex8_2
clc
RL = 8*10^3
hie=1.0*10^3
hre=2.5*10^-4
hfe=50
hoe=25*10^-6
disp("RL = "+string(RL)+"ohm")//load resistance
//h-parameters for CE transistor amplifier are as
    follows:
disp("hie = "+string(hie)+"ohm")//input resistance
    of CE transistor
```

```
disp("hre = "+string(hre))//voltage gain of CE transistor
disp("hfe = "+string(hfe))//current gain of CE transistor
disp("hoe = "+string(hoe)+"mho")//output conductance of CE transistor
//calculation for current gain:
Ai=-hfe/(1+(hoe*RL))
disp("Ai = -hfe/(1+(hoe*RL)) = "+string(Ai))
disp("Ai = "+string(abs(Ai)))
//calculation for input resistance:
Ri = hie+(hre*Ai*RL)
disp("Ri = hie+(hre*Ai*RL) = "+string(Ri)+"ohm")

//note : answer in the textbook regarding above problem is not accuratly calculated.
```

Scilab code Exa 8.3 current and voltage gain

```
//Ex8_3
clc
RL = 8*10^3
Rs= 500
hie=1.0*10^3
hre=2.5*10^-4
hfe=50
hoe=25*10^-6
disp("RL = "+string(RL)+"ohm")//load resistance
disp("Rs = "+string(Rs)+"ohm")//source resistance
//h-parameters for CE transistor amplifier are as follows:
disp("hie = "+string(hie)+"ohm")//input resistance of CE transistor
disp("hre = "+string(hre))//voltage gain of CE transistor
```

```
disp("hfe = "+string(hfe))//current gain of CE transistor
disp("hoe = "+string(hoe)+"mho")//output conductance of CE transistor

Ai=-hfe/(1+(hoe*RL))
disp("Ai = -hfe/(1+(hoe*RL)) = "+string(Ai))//calculation for current gain

Ri = hie+(hre*Ai*RL)
disp("Ri = hie+(hre*Ai*RL) = "+string(Ri)+"ohm")//calculation for input resistance

Ais=(Ai*Rs)/(Ri+Rs)
disp("Ais = (Ai*Rs)/(Ri+Rs)= "+string(Ais))//current gain with source resistance

Avs = Ai*RL/Ri
disp("Avs = Ai*RL/Ri = "+string(Avs))//voltage gain with source resistance

//note : in the textbook above problem has given two values for hie BUT no value for hfe ...
//        thus assuming hie=50 as hfe =50, as given in the previous example 8_2

//note : answer in the textbook is not accuratly calculated.
```

Scilab code Exa 8.4 current and voltage gain and input and output resistance

```
//Ex8_4
clc
RL=5*10^3
```

```
Rs=1.2*10^3
hre=2.5*10^-4
hie=1.1*10^3
hfe=100
hoe=25*10^-6
disp("RL = "+string(RL)+"ohm")//load resistance
disp("Rs = "+string(Rs)+"ohm")//source resistance
//h-parameters for CE transistor amplifier are as follows:
disp("hie = "+string(hie)+"ohm")//input resistance of CE transistor
disp("hre = "+string(hre))//voltage gain of CE transistor
disp("hfe = "+string(hfe))//current gain of CE transistor
disp("hoe = "+string(hoe)+"mho")//output conductance of CE transistor
//calculation for current gain:
Ai=-hfe/(1+(hoe*RL))
disp("Ai = -hfe/(1+(hoe*RL)) = "+string(abs(Ai)))
//calculation for input resistance:
Ri = hie+(hre*Ai*RL)
disp("Ri = hie+(hre*Ai*RL) = "+string(Ri)+"ohm")
//calculation for voltage gain:
Av = Ai*RL/Ri
disp("Av = Ai*RL/Ri = "+string(Av))
//calculation for output resistance:
Go=hoe-((hre*hfe)/(hie+Rs))
Ro = 1/Go
disp("Ro = 1/Go")
disp("Go = hoe-((hre*hfe)/(hie+Rs)) = "+string(Go)+"mho")
disp("Ro = "+string(Ro)+"ohm")

//note : in the textbook, above problem has given two values for "hfe" and no value for "hre"...
//         thus assuming value for "hre = 2.5*10^-4" as taken in previous example 8_2
```

```
//          and "hfe=100"

//note : in text LOAD RESISTANCE is noted as Rc in
    question , but RL in solution.
//         I have work with Load Resistance with
    notification RL.
```

Scilab code Exa 8.5 Amplifier current gain

```
//Ex8_5
clc
RL = 22*10^3
hfb=-0.98
hob=7.6*10^-7
disp("RL = "+string(RL)+"ohm")//load resistance
disp("hfb = "+string(hfb))//forward current gain in
   CB amplifier
disp("hob = "+string(hob)+"mho")//output conductance
     in CB amplifier
Ai = -hfb/(1+(hob*RL))
disp("Ai = -hfb/(1+(hob*RL)) = "+string(Ai))//
    current gain
```

Scilab code Exa 8.6 voltage gain of CE amplifier

```
//Ex8_6
clc
hfb = -0.999
hib = 50
hob = 0.82*10^-6
hrb = 4*10^-6
RL = 22*10^3
disp("RL = "+string(RL)+"ohm")//load impedence
```

```
//h−parameters for CB transistor amplifier are as follows:
disp("hib = "+string(hib)+"ohm")//input resistance of CB transistor
disp("hrb = "+string(hrb))//voltage gain of CB transistor
disp("hfb = "+string(hfb))//current gain of CB transistor
disp("hob = "+string(hob)+"mho")//output conductance of CB transistor
Av = -(hfb*RL)/((RL*(hib*hob-hfb*hrb))+hib)
disp("Av = −(hfb∗RL)/((RL∗(hib∗hob−hfb∗hrb))+hib) = "+string(Av))//voltage gain


//note : answer provided in the textbook is not precised.
```

Scilab code Exa 8.7 current and voltage gain and input and output resistance

```
//Ex8_7
clc
RL = 1.2*10^3
//assuming Rs = RL as given in problem
Rs = RL
//assuming values for h−parameters
hie = 1.0*10^3
hre=2.5*10^-4
hfe = 50
hoe = 25*10^-6
disp("RL = "+string(RL)+"ohm")//load resistance
disp("Rs = RL = "+string(RL)+"ohm")//source resistance
//h−parameters for CE transistor amplifier are as
```

```
follows:
disp("hie = "+string(hie)+"ohm")//input resistance of CE transistor
disp("hre = "+string(hre))//voltage gain of CE transistor
disp("hfe = "+string(hfe))//current gain of CE transistor
disp("hoe = "+string(hoe)+"mho")//output conductance of CE transistor
//calculation for current gain:
Ai=-hfe/(1+(hoe*RL))
disp("Ai = -hfe/(1+(hoe*RL)) = "+string(Ai))
//calculation for input impedence:
Ri = hie+(hre*Ai*RL)
disp("Ri = hie+(hre*Ai*RL) = "+string(Ri)+"ohm")
//calculation for voltage gain:
disp("Av = Ai*RL/Ri")
Av = Ai*RL/Ri
disp("    = "+string(Av))
//calculation for output impedence:
Ro = 1/((hoe - (hfe*hre)/(hie+Rs)))
disp("Ro = 1/((hoe - (hfe*hre)/(hie+Rs)))")
disp("      = "+string(Ro)+"ohm")
//current gain with source impedence:
Ais=(Ai*Rs)/(Ri+Rs)
disp("Ais = (Ai*Rs)/(Ri+Rs)= "+string(Ais))
//voltage gain with source impedence:
Avs = Av*Ri/(Ri+Rs)
disp("Avs = Av*Ri/(Ri+Rs) = "+string(Avs))



// NOTE : calculation in the textbook for the above problem is wrong.
//         while calculating Ri author has use "hie = 1.2*10^3" instead of ASSUMED9 value i.e., "hie = 1.0*10^3"
```

Scilab code Exa 8.8 load resistance of CE transistor

```
//Ex8_8
clc
Ai = -60
hfe = 100
hoe = 10*10^-6
disp("hfe = "+string(hfe))//forward current gain
disp("hoe = "+string(hoe)+"A/V")//output conductance
disp("Ai = "+string(Ai))//current gain
disp("But, ...
Ai = -hfe/(1+ hoe*RL)")
RL = -(1/hoe)*(1+(hfe/Ai))
disp("Thus,...
RL = -(1/hoe)*(1+(hfe/Ai)) = "+string(RL)+"ohm")//
    load resistance
```

Scilab code Exa 8.9 voltage gain of CE amplifier

```
//Ex8_9
clc
Ai = -60
Ri = 2.0*10^3
RL = 15*10^3
disp("Ai = "+string(Ai))//current gain
disp("Ri = "+string(Ri)+"ohm")//input resistance
disp("RL = "+string(RL)+"ohm")//load resistance
Av = Ai*RL/Ri
disp("Av = Ai*RL/Ri = "+string(Av))//voltage gain

//note : in textbook,
```

```
//        author notify LOAD RESISTANCE as 'Rc' in
   question BUT 'RL' in solution.
//        I have work with "load resistance notified
   as RL".
```

Scilab code Exa 8.10 current gain of CE amplifier

```
//Ex8_10
clc
Av = -200
Ri = 10*10^3
RL = 3*10^3
Ai = Av*Ri/RL
disp("Av = "+string(Av))//voltage gain
disp("Ri = "+string(Ri)+"ohm")//input resistance
disp("RL = "+string(RL)+"ohm")//load resistance
disp("Ai = Av*Ri/RL = "+string(Ai))//current gain

// note : there are mis-printring in the textbook
   for the above problem regading formula and
   notations.
//         answer in the textbook for above problem
   is wrong.
```

Scilab code Exa 8.11 Input resistance of CE amplifier

```
//Ex8_11
clc
Av = -250
Ai = -50
RL = 12*10^3
disp("Av = "+string(Av))//voltage gain
disp("Ai = "+string(Ai))//current gain
```

```
disp("RL = "+string(RL)+"ohm")//load resistance
Ri = Ai*RL/Av
disp("Ri = Ai*RL/Av = "+string(Ri)+"ohm")//input
    resistance
```

Chapter 9

Field Effect Transistor

Scilab code Exa 9.1 Pinch off Voltage

```
//Ex9_1
clc
h = 5*10^-4        //channel height in centimeters
a= (1/2)*h         //channel width in centimeters
rho = 10           //resistivity in ohm_cm
sigma = 1/rho      //conductivity in mho/cm
micro_p = 500        //mobility in cm_sq/Vs
apsilent_r = 12    //relative permiability in F/cm of silicon
apsilent_not=8.854*10^-14  //permiability in vaccum in F/cm
disp("a = "+string(a)+"cm")
disp("sigma = "+string(sigma)+"mho/cm")
disp("micro_p = "+string(micro_p)+"cm-sq/Vs")
disp("apsilent_r = "+string(apsilent_r)+"F/cm")
Vp = (a^2)*sigma/(2*apsilent_r*apsilent_not*micro_p)    // pinch off voltage for silicon p channel FET
disp("Vp = (a^2)*sigma/(2*apsilent_r*apsilent_not*micro_p)")
disp("Vp = "+string(Vp)+"V")
```

Scilab code Exa 9.2 Impedance and amplification factor

```
//Ex9_2
clc
//calculating for conductance:
delta_ID = (4*10^-3)-(2*10^-3)//change in drain current in amperes
delta_VGS = 3-2//chande in gate-source voltage in volts
disp("delta_ID = "+string(delta_ID)+"A")
disp("delta_VGS = "+string(delta_VGS)+"V")
gm = delta_ID/delta_VGS//condutance at VDS = constant
disp("gm = delta_ID/delta_VGS")
disp("gm = "+string(gm)+" mho")
//calculating for drain resistance:
delta_ID = (3.2-3)*10^-3//change in drain current in amperes
delta_VDS = (12-8)//change in voltage across drai and source
disp("delta_ID = "+string(delta_ID)+"A")
disp("delta_VDS = "+string(delta_VDS)+"V")
rd = delta_VDS/delta_ID
disp("rd = delta_VDS/delta_ID")
disp("rd = "+string(rd)+" ohm")
//calculating for micro:
micro  = rd*gm//amplification factor
disp("micro = rd*gm")
disp("micro = "+string(micro))
```

Scilab code Exa 9.3 pinch off voltage

```
//Ex9_3
clc
disp("Vp = (a^2)*sigma/(2*apsilent*micro_p)")// piunch off voltage
h = 2*10^-4      //channel height in centimeters
a= h/2        //channel width in centimeters
rho = 1          //resistivity in ohm_cm
sigma = 1/rho     //conductivity in mho/cm
micro_p = 1800       //mobility in cm_sq/Vs
apsilent_r = 16  //relative permiability in F/cm of germanium
apsilent_not=8.854*10^-14  //permiability in vaccum in F/cm
disp("a = "+string(a)+"cm")
disp("rho = "+string(rho)+"ohm-cm")
disp("sigma = "+string(sigma)+"mho/cm")
disp("micro = "+string(micro_p)+"cm_sq/Vs")
disp("apsilent_r = "+string(apsilent_r)+"F/cm")
disp("apsilent_not = "+string(apsilent_not)+"F/cm")
Vp = (a^2)*sigma/(2*apsilent_r*apsilent_not*micro_p)  // pinch off voltage for germanium p_channel FET
disp("Vp = "+string(Vp)+"V")
```

Scilab code Exa 9.4 Conductance and Resistance

```
//Ex9_4
clc
gm1= 2*10^-3; gm2 =4*10^-3//conductance
disp("gm1 = "+string(gm1)+"mho")
disp("gm2 = "+string(gm2)+"mho")
Effective_gm = gm1+gm2
disp("Effective gm = gm1 + gm2 = "+string(Effective_gm)+"mho")//resulant conductance
rd1 = 20*10^3; rd2 = 30*10^3//resistances
Effective_rd = (rd1*rd2)/(rd1+rd2)
```

```
disp("rd1 = "+string(rd1)+"ohm")
disp("rd2 = "+string(rd2)+"ohm")
disp("Effective rd = (rd1*rd2)/(rd1+rd2) = "+string(
   Effective_rd)+"ohm")//resulant resistance
```

Scilab code Exa 9.5 Resistance

```
//Ex9_5
clc
VGS = 4// voltage applied to gate terminal
IG = 2*10^-9//current flowing in gate
RGS = VGS/IG
disp("VGs = "+string(VGS)+"V")
disp("IG = "+string(IG)+"A")
disp("RGS = VGS/IG = "+string(RGS)+"ohm")//
   resistance brtween gate and source
```

Scilab code Exa 9.6 Voltage

```
//Ex9_6
clc
Vp = -4//pinch off voltage
ID = 4*10^-3//drain current
IDSS = 6*10^-3//maximum drain current
disp("Vp = "+string(Vp)+"V")
disp("ID = "+string(ID)+"A")
disp("IDSS = "+string(IDSS)+"A")
VGS = abs(Vp)*((ID/IDSS)^.5-1)
disp("VGS = Vp*((ID/IDSS)^.5-1) = "+string(VGS)+"V")
   //voltage across gate and source
```

Scilab code Exa 9.7 Amplification Factor

```
//Ex9_7
clc
//parameters of JFET 1:
rd1 = 20*10^3//resistance
gm1 = 3*10^-3//conductance
disp("rd1 = "+string(rd1)+"ohm")
disp("gm1 = "+string(gm1)+"mho")
//parameters of JFET 2:
rd2 = 40*10^3//resistance
gm2 = 4*10^-3//conductance
disp("rd2 = "+string(rd2)+"ohm")
disp("gm2 = "+string(gm2)+"mho")
//the given JFETs are connected in parallel manner
micro = [(rd1*rd2*gm1)+(rd1*rd2*gm2)]/(rd1+rd2)
disp("micro = (rd1*rd2*gm1)+(rd1*rd2*gm2)/(rd1+rd2) = "+string(micro))//amplification factor
```

Scilab code Exa 9.8 Current and Voltage

```
//Ex9_8
clc
//according to the given figure in the textbook for problem 8 in chapter 9:
VGS = -2//voltage across gate and source
IDSS = 6*10^-3//maximum drain current
Vp = -6//pinch-off voltage
disp("IDSS = "+string(IDSS)+"A")
disp("Vp = "+string(Vp)+"V")
disp("VGS = "+string(VGS)+"V")
ID = IDSS*(1-(VGS/Vp))^2
disp("ID = IDSS*(1-(VGS/Vp))^2 = "+string(ID)+"A")//drainm current
Rd = 2*10^3//drain resistance
```

```
VDD = 9//drain voltage
VDS = VDD - ID*Rd
disp("VDD = "+string(VDD)+"V")//drain voltage
disp("Rd = "+string(Rd)+"ohm")//drain resistance
disp("VDS = VDD - ID*Rd = "+string(VDS)+"V")//
    voltage across drain and source
```

Scilab code Exa 9.9 Drain Voltage and Current

```
//Ex9_9
clc
Vp = -4//pinch off voltage
VGS = -1.5//gate source voltage
VDS_minimum = VGS - Vp//minimum VDS for Pinch Off
    voltage
disp("Vp = "+string(Vp)+"V")
disp("VGS = "+string(VGS)+"V")
disp("VDS_minimum = VGS - Vp = "+string(VDS_minimum)
    +"V")
IDSS = 6*10^-3//maximum drain current
ID = IDSS*(1-(VGS/Vp))^2//drain current at VGS = 0V
disp("IDSS = "+string(IDSS)+"A")
disp("ID = IDSS*(1-(VGS/Vp))^2 = "+string(ID)+"A")
```

Scilab code Exa 9.10 Drain Current and Voltage

```
//Ex9_10
clc
VGS = -2//voltage across gate and source
IDSS = 8*10^-3//maximum drain current
Vp = -6//pinch-off voltage
disp("IDSS = "+string(IDSS)+"A")
disp("Vp = "+string(Vp)+"V")
```

```
disp("VGS = "+string(VGS)+"V")
ID = IDSS*(1-(VGS/Vp))^2
disp("ID = IDSS*(1-(VGS/Vp))^2 = "+string(ID)+"A")//drainm current
RD = 2*10^3//drain resistance
VDD = 12//drain voltage
VDS = VDD - ID*RD
disp("VDD = "+string(VDD)+"V")//drain voltage
disp("RD = "+string(RD)+"ohm")//drain resistance
disp("VDS = VDD - ID*RD = "+string(VDS)+"V")//voltage across drain and source

// note : notification used for saturated drain-soucre current is given wrong in question i.e., IDS but is right in solution i.e., IDSS.
```

Chapter 10

Feedback Amplifier

Scilab code Exa 10.1 Close loop gain

```
//Ex10_1
clc
Av = 80//voltage gain
beta = 0.001//feedback ratio
disp("Av = "+string(Av))
disp("beta = "+string(beta))
Avf = Av/(1+beta*Av)//gain with negative feedback
disp("Avf = Av/(1+beta*Av) = "+string(Avf))
```

Scilab code Exa 10.2 Close loop gain and bandwidth

```
//Ex10_2
clc
Av = 50//voltage gain
beta = 0.01//feedback ratio
BW = 100*10^3//bandwidth
disp("Av = "+string(Av))
disp("beta = "+string(beta))
```

```
disp("Bandwidth = "+string(BW)+"Hz")
Avf = Av/(1+beta*Av)//gain with negative feedback
disp("Avf = Av/(1+beta*Av) = "+string(Avf))
BWf = BW*(1+beta*Av)//bandwidth with negative feedback
disp("(B.W)f = "+string(BWf)+"Hz")


// note : using variable "BW" instad of "B.W" ... as , if using B.W the software takes it as a function.
// similarly using "BWf" instead of (B.W)f.
```

Scilab code Exa 10.3 Feedback with reduced distortion

```
//Ex10_3
clc
Av = 200// voltage gain
D = 0.05// harmonic distortion in amplifier
Df = 0.02//final reduced distortion
beta = (D/Df-1)/Av//feedback gain
disp("Av = "+string(Av))
disp("D = "+string(D))
disp("Df = "+string(Df))
disp("beta = (D/Df - 1)/Av = "+string(beta))
disp("beta = "+string(beta*100)+"%")
```

Scilab code Exa 10.4 Change in close loop gain

```
//Ex10_4
clc
Av1 = 100//initial voltage gain
beta = 0.001//feedback ratio
```

```
disp("Av1 = "+string(Av1))
disp("beta = "+string(beta))
Af1 = Av1/(1+beta*Av1)//initial gain with negative feedback
disp("Af1 = Av1/(1+beta*Av1) = "+string(Af1))

Av2 = 150//final voltage gain
beta = 0.001//feedback ratio
disp("Av2 = "+string(Av2))
disp("beta = "+string(beta))
Af2 = Av2/(1+beta*Av2)//final gain with negative feedback
disp("Af2 = Av2/(1+beta*Av2) = "+string(Af2))

change_in_gain = Af2 - Af1//required change in gain
disp("change in gain required = Af2 - Af1 = "+string(change_in_gain))
delta_Avf = change_in_gain/Af1
disp("delta_Avf = Af2-Af1/Af1 = "+string(delta_Avf)+"%")
```

Scilab code Exa 10.5 Open loop gain and feedback ratio

```
//Ex10_5
clc
Av = 40//voltage gain in decibles
disp("Av = "+string(Av)+"dB")
Av = 10^(Av/20)//voltage gain in V/V
disp("Av = "+string(Av))
Avf = 20//voltage gain with negative feedback in decibles
disp("Avf = "+string(Avf)+"dB")
Avf = 10^(Avf/20)//voltage gain with negative feedback in V/V
disp("Avf = "+string(Avf))
```

```
beta = ((Av/Avf)-1)/Av//feedback ratio
disp("beta = (Av/Avf - 1)/Av = "+string(beta))



// note: solution in the textbook for the above problem is wrong.
```

Scilab code Exa 10.6 Close loop and bandwidth

```
//Ex10_6
clc
Av = 100//voltage gain
beta = 0.05//feedback ratio
BW = 400*10^3 //bandwidth
disp("Av = "+string(Av))
disp("beta = "+string(beta))
disp("B.W. = "+string(BW)+"Hz")
Af = Av/(1+beta*Av)//gain with negative feedback
disp("Af = Av/(1+beta*Av) = "+string(Af))
BWf = BW*(1+beta*Av)//bandwidth with negative feedback
disp("(B.W)f = "+string(BWf)+"Hz")


// note : using variable "BW" instad of "B.W" ... as, if using B.W the software takes it as a function.
// similarly using "BWf" instead of (B.W)f.
```

Scilab code Exa 10.7 Voltage gain and feedback ratio

```
//Ex10_7
```

```
clc
Po = 100//output power
RL = 10//load resistance
disp("Po = "+string(Po)+"W")
disp("RL = "+string(RL)+"ohm")
vo = (RL*Po)^0.5//output voltage
vi = 2//input voltage
disp("vo = (Rl*Po)^0.5 = "+string(vo)+"V")
disp(" vi = "+string(vi)+"V")
Av = vo/vi//voltage gain
disp("Av = vo/vi = "+string(Av))
D = 0.04// harmonic distortion in amplifier
Df = 0.0002//distortion after feedback
beta = (D/Df-1)/Av//feedback gain
disp("D = "+string(D))
disp("Df = "+string(Df))
disp("beta = (D/Df - 1)/Av = "+string(beta))
```

Scilab code Exa 10.8 Feedback ratio

```
//Ex10_8
clc
BW = 500*10^3//bandwidth
A = 200//gain of amplifier
BWf = 2*10^6//bandwidth with negative feedback
disp("B.W = "+string(BW)+"HZ")
disp("A = "+string(A))
disp("(B.W)f = "+string(BWf)+"Hz")
beta = ((BWf/BW)-1)/A//feedback ratio
disp("beta = ((B.W)f/B.W - 1)/A = "+string(beta))
disp("beta = "+string(beta*100)+"%")

// note : using variable "BW" instad of "B.W" ... as
    , if using B.W the software takes it as a
    function.
```

```
// similarly using "BWf" instead of (B.W)f.
```

Scilab code Exa 10.9 Gain and 3dB frequency

```
//Ex10_9
clc
A = 150//gain of amplifier
beta = 0.05//feedback ratio
disp("A = "+string(A))
disp("beta = "+string(beta))
Af = A/(1+beta*A)//gain with negative feedback
disp("Af = A/(1+beta*A) = "+string(Af))
fL = 20*10^3//lower 3dB frequency
fU = 160*10^3//upper 3dB frequency
disp("fL = "+string(fL)+"Hz")
disp("fU = "+string(fU)+"Hz")
fLf = fL/(1+beta*A)//lower 3dB gain with negative feedback
disp("fLf = fL/(1+beta*A) = "+string(fLf)+"Hz")
fUf = fU*(1+beta*A)//upper 3dB gain with negative feedback
disp("fUf = fU*(1+beta*A) = "+string(fUf)+"Hz")
```

Scilab code Exa 10.10 Voltage and input and output resistance

```
//Ex10_10
clc
//parameters of emitter follower circuit:
hie = 1.1*10^3//input resistance
hfe = 80//current gain
hoe = 2*10^-5//output conductance
Re = 2.2*10^3//emitter resistance
disp("hie = "+string(hie)+"ohm")
```

```
disp("hfe = "+string(hfe))
disp("hoe = "+string(hoe)+"mho")
disp("Re = "+string(Re)+"ohm")
gm = hfe/hie
Rif = hie*(1+gm*Re)//input resistance with feedback
disp("Rif = hie*(1+gm*Re) = "+string(Rif)+"ohm")
Rof = hie/(1+hfe)//output resistance with feedback
disp("Rof = hie/(1+hfe) = "+string(Rof)+"ohm")
Avf = gm*Re/(1+gm*Re)//voltage gain with negative
    feedback
disp("Avf = gm*Re/(1+gm*Re) = "+string(Avf))
```

Chapter 11

Power Amplifiers

Scilab code Exa 11.1 Efficiency

```
//Ex11_1
clc
VCC = 20//collector voltage
RL = 12//load resistance
disp("VCC = "+string(VCC)+"V")
disp("RL = "+string(RL)+"ohm")
Pi_dc = (VCC^2)/(2*RL)//input power
disp("Pi(dc) = (VCC^2)/(2*RL) = "+string(Pi_dc)+"W")
Po_ac = (VCC^2)/(8*RL)//output power
disp("Po_ac = (VCC^2)/(8*RL) = "+string(Po_ac)+"W")
eta = Po_ac/Pi_dc//efficiency
disp("eta = Po_ac/Pi_dc = "+string(eta*100)+"%")


// note : has modifed variables:
//        using Po_ac instead of Po(ac)
//        and   Pi_dc instead of Pi(dc).

// note: there is a misprinting in the above problem given in the textbook
//       author want to ask for efficiency instead
```

```
of frequency.
```

Scilab code Exa 11.2 Power Losses

```
//Ex11_2
clc
Po_ac = 64//output power
eta = 0.3//efficiency
Pi_dc = Po_ac/eta//input power
disp("Po_ac = "+string(Po_ac)+"W")
disp("eta = "+string(eta))
disp("Pi_dc = Po_ac/eta = "+string(Pi_dc)+"W")
power_losses = Pi_dc - Po_ac//power losses
disp("Power losses = Pi_dc - Po_ac = "+string(
    power_losses)+"W")

// note : has modifed variables:
//        using Po_ac instead of Po(ac)
//        and   Pi_dc instead of Pi(dc).
```

Scilab code Exa 11.3 Second Harmonic Distortion

```
//Ex11_3
clc
VCEmax = 18// highest value for collector emitter
    voltage
VCEmin = 2// lowest value for collector emitter
    voltage
VQ = 9//operating point voltage
disp("VCEmin = "+string(VCEmin)+"V")
disp("VCEmax = "+string(VCEmax)+"V")
disp("VQ = "+string(VQ)+"V")
```

```
D2 = [(1/2)*(VCEmax + VCEmin) - VQ]/(VCEmax - VCEmin)*100//second harmonic distortion
disp("D2 = [(1/2)*(VCEmax + VCEmin) - VQ]/(VCEmax - VCEmin)*100")
disp("    ="+string(D2)+"%")

// note : for above problem there is a misprint for the formula given in solution in the textbook
```

Scilab code Exa 11.4 Total Harmonic Distortion

```
//Ex11_4
clc
//according to the given eqution for output current, we have:
I1 = 5.0
I2 = 0.9
I3 = 0.6
I4 = 0.3
I5 = 0.01
D2 = I2/I1// second harmonic distortion
D3 = I3/I1//third harmonic distortion
D4 = I4/I1//fourth harmonic distortion
D5 = I5/I1//fifth harmonic distortion
disp("I1 = "+string(I1)+"A")
disp("I2 = "+string(I2)+"A")
disp("I3 = "+string(I3)+"A")
disp("I4 = "+string(I4)+"A")
disp("I5 = "+string(I5)+"A")
disp("D2 = I2/I1 = "+string(D2))
disp("D3 = I3/I1 = "+string(D3))
disp("D4 = I4/I1 = "+string(D4))
disp("D5 = I5/I1 = "+string(D5))
D = [(D2^2)+(D3^2)+(D4^2)+(D5^2)]^(1/2)//total harmonic distortion
```

```
disp("D = [(D2^2)+(D3^2)+(D4^2)+(D5^2)]^(1/2) = "+string(D*100)+"%")
```

Scilab code Exa 11.5 Amplifier Efficiency

```
//Ex11_5
clc
VCC = 9//collector voltage
Vp = 5//output peak voltage
VQ = VCC//operating point
VCEmax = VQ + Vp// maximum value of collector emitter voltage
VCEmin = VQ - Vp// minimum value of collector emitter voltage
disp("VCC = "+string(VCC)+"V")
disp("Vp = "+string(Vp)+"V")
disp("VQ = VCC = "+string(VQ)+"V")
disp("VCEmax = VQ + Vp = "+string(VCEmax)+"V")
disp("VCEmin = VQ - Vp = "+string(VCEmin)+"V")
eta = 50*[(VCEmax - VCEmin)/(VCEmax + VCEmin)]//amplifier efficiency
disp("eta = 50*[(VCEmax - VCEmin)/(VCEmax + VCEmin)] = "+string(eta)+"%")
```

Scilab code Exa 11.6 Efficiency

```
//Ex11_6
clc
VCC = 20//collector voltage
RL = 10//load resistance
disp("VCC = "+string(VCC)+"V")
disp("RL = "+string(RL)+"ohm")
Pi_dc = (VCC^2)/(RL)//input power
```

```
disp("Pi(dc) = (VCC^2)/(RL) = "+string(Pi_dc)+"W")
Po_ac = (VCC^2)/(2*RL)//output power
disp("Po_ac = (VCC^2)/(2*RL) = "+string(Po_ac)+"W")
eta = Po_ac/Pi_dc//efficiency
disp("eta = Po_ac/Pi_dc = "+string(eta*100)+"%")


// note : has modifed variables:
//        using Po_ac instead of Po(ac)
//        and   Pi_dc instead of Pi(dc).
```

Scilab code Exa 11.7 Turns Ratio

```
//Ex11_7
clc
RL = 3.6*10^3//output impedence of power amplifier
RL_dash = 4//resistance of speaker
n = (RL/RL_dash)^.5//turns ratio
disp("RL = "+string(RL)+"ohm")
disp("RL_dash = "+string(RL_dash)+"ohm")
disp("n = RL/RL_dash = "+string(n))
disp("turn ratio = "+string((numer(n)))+": "+string(
    denom(n)))
```

Scilab code Exa 11.8 Amplifier Efficiency

```
//Ex11_8
clc
VCC = 15//collector voltage
Vp = 12//output peak voltage
disp("VCC = "+string(VCC)+"V")
disp("Vp = "+string(Vp)+"V")
eta = 78.5*(Vp/VCC)//amplifier efficiency
```

```
disp("eta = 78.5*(Vp/VCC) = "+string(eta)+"%")
```

Scilab code Exa 11.9 Efficiency

```
//Ex11_9
clc
VCC = 25//collector voltage
Vi = 9//inout rms voltage
RL = 10//load resistnce
Vi_peak = 1.414*Vi//input peak voltage
Vo = Vi_peak//output peak voltage
Po_ac = (Vo^2)/(2*RL)//output power
Io = Vo/RL//output current
IC = (2/%pi)*Io//collector current
Pi_dc = VCC*IC//input power
eta = Po_ac/Pi_dc//efficiency
disp("VCC = "+string(VCC)+"V")
disp("Vi = "+string(Vi)+"V")
disp("RL = "+string(RL)+"ohm")
disp("Vi_peak = (2^2)Vi = "+string(Vi_peak)+"V")
disp("Vo = Vi_peak = "+string(Vo)+"V")
disp("Po_ac = (Vo^2)/(2*RL) = "+string(Po_ac)+"W")
disp("Io = Vo/RL = "+string(Io)+"A")
disp("IC = (2/%pi)*Io = "+string(IC)+"A")
disp("Pi_dc = VCC*IC = "+string(Pi_dc)+"W")
disp("eta = Po_ac/Pi_dc = "+string(eta*100)+"%")
```

Scilab code Exa 11.10 Efficiency

```
//Ex11_10
clc
VCC = 18//collector voltage
Vp = 15//output peak voltage
```

```
RL = 12//load resistnce
disp("VCC = "+string(VCC)+"V")
disp("Vp = "+string(Vp)+"V")
disp("RL = "+string(RL)+"ohm")
Ip = Vp/RL//output peak current
Idc = (2/%pi)*Ip//input direct current
disp("Ip = Vp/RL = "+string(Ip)+"A")
disp("Idc = (2/%pi)*Ip = "+string(Idc)+"A")
Pi_dc = VCC*Idc//input power
disp("Pi_dc = VCC*Idc = "+string(Pi_dc)+"W")
Po_ac = (Vp^2)/(2*RL)//output power
disp("Po_ac = (Vp^2)/(2*RL) = "+string(Po_ac)+"W")
eta = Po_ac/Pi_dc//efficiency
disp("eta = Po_ac/Pi_dc = "+string(eta*100)+"%")
```

Scilab code Exa 11.11 Voltage Gain

```
//Ex11_11
clc
Vop_p = 7//peak to peap output voltage
Vip_p = 100*10^-3//peak to peap input voltage
Av = Vop_p/Vip_p
disp("Av = output voltage/input voltage")
disp("   = "+string(Av))//voltage gain
```

Scilab code Exa 11.12 Power Gain

```
//Ex11_12
clc
Ai = 50//current gain
Av = 70//voltage gain
disp("Ai = "+string(Ai))
disp("Av = "+string(Av))
```

```
Ap = Ai*Av//power gain
disp("Ap = Ai*Av = "+string(Ap))
```

Scilab code Exa 11.13 Power Dissipated At Collector Junction

```
//Ex11_13
clc
vc = 9//collector voltage
ic = 3*10^-3//collector current
Pd = vc*ic//power dissipated at collector junction
disp("vc = "+string(vc)+"V")
disp("ic = "+string(ic)+"A")
disp("Pd = vc*ic = "+string(Pd)+"W")
```

Scilab code Exa 11.14 Power Efficiency

```
//Ex11_14
clc
Pac = 3.2*10^-3//output power
Pd = 27*10^-3//power dissipated collector junction
P_eta = Pac/Pd//power efficiency
disp("Pac = "+string(Pac)+"W")
disp("Pd = "+string(Pd)+"W")
disp("P_eta = Pac/Pd = "+string(P_eta*100)+"%")
```

Chapter 13

Oscillators

Scilab code Exa 13.1 Feedback fraction to obtain sustained oscillator

```
//Ex13_1
clc
A = 100//amplification gain
A_Beta = 1//for sustain oscillation
Beta = A_Beta/A//feeback ratio
disp("A = "+string(A))
disp("A_Beta = "+string(A_Beta))
disp("Beta = "+string(Beta))
```

Scilab code Exa 13.2 Frequency of RC phase oscillator

```
//Ex13_2
clc
Rf = 0.5*10^6//feeback resistance
Cf = 100*10^-12//capacitance across feedback
Rc = 0.5*10^6//critical resistance
f0 = 1/[2*%pi*Rf*Cf*(6+4*(Rc/Rf))^(1/2)]//frequency
    of oscillation
```

```
disp("Rf = "+string(Rf)+"ohm")
disp("Cf = "+string(Cf)+"F")
disp("Rc = "+string(Rc)+"ohm")
disp("f0 = 1/[2*pi*Rf*Cf*(6+4*(Rc/Rf))^(1/2)] = "+string(f0)+"Hz")
```

Scilab code Exa 13.3 Frequency of Wein Bridge oscillator

```
//Ex13_3
clc
Rf = 1.5*10^6//feeback resistance
Cf = 1*10^-9//capacitance across feedback
f0 = 1/(2*%pi*Rf*Cf)//frequency of oscillation
disp("Rf = "+string(Rf)+"ohm")
disp("Cf = "+string(Cf)+"F")
disp("f0 = 1/(2*pi*Rf*Cf) = "+string(f0)+"Hz")
```

Scilab code Exa 13.4 Feedback fractor and frequency of Colpitts oscillator

```
//Ex13_4
clc
C1 = 1*10^-9//capacitance of capacitor 1
C2 = 10*10^-9//capacitance of capacitor 2
L = 110*10^-6//inductance of inductor
beta = C1/C2//feedback factor
f0 = ((C1+C2)/(C1*C2*L))^.5/(2*%pi)//operating frequency
disp("C1 = "+string(C1)+"F")
disp("C2 = "+string(C2)+"F")
disp("L = "+string(L)+"H")
disp("beta = "+string(beta))
```

```
disp("f0 = ((C1+C2)/(C1*C2*L))^.5/(2*pi) = "+string(
    f0)+"Hz")

//note : unit given for inductance "L" is wrong in
    the textook for the above question.
```

Chapter 14

Operational Amplifier and Applications

Scilab code Exa 14.1 Common Mode Rejection Ratio

```
//Ex14_1
clc
Ad = 100//differential gain
Ac = 0.01//common mode gain
CMRR = Ad/Ac//Common Mode Rejection Ratio
CMRR_dB = 20*log10(CMRR)//Common Mode Rejection Ratio in decibles
disp("Ad = "+string(Ad))
disp("Ac = "+string(Ac))
disp("CMRR = Ad/Ac = "+string(CMRR))
disp("CMRR = "+string(CMRR_dB)+"dB")
```

Scilab code Exa 14.2 Common Mode Rejection Ratio

```
//Ex14_2
clc
```

```
CMRR_dB = 100//Common Mode Rejection Ratio in decibles
CMRR = 10^(100/20)//CMRR as a ratio
disp("CMRR = "+string(CMRR_dB)+"dB")
disp("CMRR = 10^(100/20) = "+string(CMRR))
```

Scilab code Exa 14.3 Output Voltage Of Op amp Adder Circuit

```
//Ex14_3
clc
Rf = 10*10^3//feedback resistance
R1 = 10*10^3//resistance 1
R2 = 2*10^3//resistance 2
v1 = 10//input voltage across resistance 1
v2 = 4//input voltage across resistance 2
//note: according to the given fig. in the textbook for the question we have:

vo = -Rf*((v1/R1)+(v2/R2))//output voltage of adder circuit
disp("Rf = "+string(Rf)+"ohm")
disp("R1 = "+string(R1)+"ohm")
disp("R2 = "+string(R2)+"ohm")
disp("v1 = "+string(v1)+"V")
disp("v2 = "+string(v2)+"V")
disp("vo = -Rf*((v1/R1)+(v2/R2)) = "+string(vo)+"V")
```

Scilab code Exa 14.4 Output Voltage Of Op amp Adder Circuit

```
//Ex14_4
clc
Rf = 1*10^3//feedback resistance
R1 = 1*10^3//resistance 1
```

```
R2 = 1*10^3//resistance 2
R3 = 1*10^3//resistance 3
v1 = 2//input voltage 1
v2 = 1//input voltage 2
v3 = 3//input voltage 3
vo = -Rf*((v1/R1)+(v2/R2)+(v3/R3))//output voltage of adder circuit
disp("Rf = "+string(Rf)+"ohm")
disp("R1 = "+string(R1)+"ohm")
disp("R2 = "+string(R2)+"ohm")
disp("R3 = "+string(R3)+"ohm")
disp("v1 = "+string(v1)+"V")
disp("v2 = "+string(v2)+"V")
disp("v3 = "+string(v3)+"V")
disp("vo = -Rf*((v1/R1)+(v2/R2)+(v3/R3)) = "+string(vo)+"V")
```

Scilab code Exa 14.7 Designing a close loop op amp

```
//Ex14_7
clc
Af = -20//closed loop gain of op-amp
R = 10*10^3//output resistance
Rf = -Af*R//feedback resistance
disp("Af = "+string(Af))
disp("R = "+string(R)+"ohm")
disp("Rf = -Af/R = "+string(Rf)+"ohm")
```