Scilab Textbook Companion for Schaum's Outlines Of Electronic Devices And Circuits by J. J. Cathey[1]

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Book Description

Title: Schaum's Outlines Of Electronic Devices And Circuits

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

Exa Example (Solved example)

Eqn Equation (Particular equation of the above book)

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

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

Contents

List of Scilab Codes

Chapter 1

Circuit Analysis Port point of view

Scilab code Exa 1.2 Find the current i by superposition theorem

```
//Solved Example 1.2
//Page no 4
//Find the current i2 by superposition theorem
clear
clc
printf("\n Find the current i2 by superposition theorem")
R1=1                //ohm
R2=1                //ohm
R3=1                //ohm
Vs=10               //simWtv
Vb=10                   //v
a=0
V21=1/3*Vs//simWtv
i21=V21/R2
Is=3//A
temp=R1*R2/(R1+R2)//Temp=R1||R2
i32=Vb/(R3+temp)
i22=(R1/(R1+R2))*i32
```

```
i2=i21+i22
i1=(Vs/(R1+R2))
printf("\n the current i2 by superposition theorem =
    %1.2f A",i2)
```

Scilab code Exa 1.3 Find the Thevenin equivalent voltage VTh and impedance ZTh for the network to the left of terminals

```
//Solved Example 1.3 Page no 5
//Find the Thevenin equivalent voltage VTh and
    impedance ZTh
clear
clc
printf("\n Find the Thevenin equivalent voltage VTh
    and impedance ZTh")
Va=4//V
Ia=2//A
R1=2//ohm
R2=3//ohm
Vth=Va+Ia*R1
Zth=R1+R2
printf("\n Thevenin equivalent voltage VTh  is = %.2
    f V",Vth)
printf("\n Impedance ZTh is = %1.1f Ohm",Zth)
```

Scilab code Exa 1.4 For the circuit find vab

```
//Solved Example 1.4
//Page no 6
//Findthe Thevenin equivalent voltage VTh and
    impedance ZTh
clear
clc
```

```
printf("\n Find the Thevenin equivalent voltage VTh and impedance ZTh")
Va=4//V
a=0.25//A/V
R1=2//ohm
R2=3//ohm
Vth=Va/(1-a*R1)
Vdp=R1+R2
Idp=1-a*R1
Zth=Vdp/Idp
printf("\n Thevenin equivalent voltage VTh  is = %.f V",Vth)
printf("\n Impedance ZTh is = %.f Ohm",Zth)
```

Scilab code Exa 1.5 For the circuit find vab

```
//For the circuit find vab
//Solved Example 1.5 page no 17
clear
clc
printf("\n For the circuit find vab")
printf("\n The SPICE netlist code for k 0:001 follows")
printf("\n vab=V(3)=-101 V")
printf("\n The SPICE netlist code for k  0:05 follows")
printf("\ nvab=V(3)=-200 V")
```

Scilab code Exa 1.6 For the circuit find iL by the method of node voltages

```
//Solved Example 1.6
//Page no 7
```

```
//Find the Norton equivalent current IN and admittance YN
clear
clc
printf("\n Find the Norton equivalent current IN and admittance YN")
Va=4.0//V
a=0.25//A/V
R1=2//ohm
R2=3//ohm
I=2
Zth=5
Ia=(Va/(R1+R2))+((R1*I)/(R1+R2))
Yn=1/Zth
printf("\n Norton equivalent current IN  is = %.2f V",Ia)
printf("\n admittance YN is = %.2f Ohm",Yn)
```

Scilab code Exa 1.7 find the Thevenin equivalent for the network to the left of terminals a and b

```

//find the Thevenin equivalent for the network to the left of terminals a; b.
//Solved Example 1.7
//page no 19
clear
clc
printf("\n find the Thevenin equivalent for the network to the left of terminals a; b.")
V1=10//V
V2=15//V
R1=4//ohm
R2=6//ohm
I=(V1-V2)/(R1+R2)
```

```
printf("\n The value of I is =%0.2f A",I)
Vth=V1-I*R1
printf("\n The value of Thevenin Equivalent voltage=%0.2f V",Vth)
Zth=(R1*R2)/(R1+R2)
printf("\n The value of Thevenin Impedance =%0.2f ohm",Zth)
```

Scilab code Exa 1.8 find the Norton equivalent for the network to the left of terminals a andb

```

//find the Norton equivalent for the network to the left of terminals a; b.
//Solved Example 1.8 page no 19
clear
clc
printf("\n find the Norton equivalent for the network to the left of termin")
V1=10//V
V2=15//V
R1=4//ohm
R2=6//ohm
Iab1=V1/R1
Iab2=V2/R2
printf("\n Then by superpostion ")
In=Iab1+Iab2
Zth=(R1*R2)/(R1+R2)
Yn=1/Zth//Rth=Zth
printf("\n The value of In =%0.2f A and Yn= %0.4f A",In,Yn)
```

Scilab code Exa 1.9 find the Thevenin impedance as the ratio of open circuit voltage to short circuit current

```

//find the Thevenin impedance as the ratio of open
    -circuit voltage to short-circuit current
//Solved Example 1.9 page no 20
clear
clc
printf("\n find the Thevenin impedance as the
    ratio of open-circuit voltage to short-circuit
    current")
V1=10//V
V2=15//V
R1=4//ohm
R2=6//ohm
I=(V1-V2)/(R1+R2)
printf("\n The value of I is =%0.2f A",I)
Vth=V1-I*R1
Iab1=V1/R1
Iab2=V2/R2
printf("\n Then by superpostion ")
In=Iab1+Iab2
Zth=Vth/In
printf("\n The value of Zth is =%0.2f ohm",Zth)
```

Scilab code Exa 1.11 Determine the z parameters for the two port network

```
//Solved Example 1.11 Page no 14
//Find the half-cycle average value of the current
    through a resistance R
clear
clc
printf("\n Find the Norton equivalent current IN and
```

```
    admittance YN")
Va=4.0//V
a=0.25//A/V
R1=2//ohm
R2=3//ohm
I=2
Zth=5
Ia=(Va/(R1+R2))+((R1*I)/(R1+R2))
Yn=1/Zth
printf("\n Norton equivalent current IN  is = %.2f V
    ",Ia)
printf("\n admittance YN is = %.2f Ohm",Yn)
```

Scilab code Exa 1.12 Solve Problem using a SPICE method

```
//Solve Problem 1.11 using a SPICE method
//Solved Example 1.12 page no 21
clear
clc
printf("\nSolve Problem 1.11 using a SPICE method")
V1=1.231*(10^-2)     //V
I1=1*(10^-3)         //A
Z11=V1/I1           //Ohm
printf("\n The value of Z11=%0.2f Ohm",Z11)
V1=2.308*(10^-3)     //V
I2=1*(10^-3)         //A
Z12=V1/I2           //Ohm
printf("\n The value of Z12=%0.3f Ohm",Z12)
V2=4.615*(10^-3)     //V
I1=1*(10^-3)         //A
Z21=V2/I1            //Ohm
printf("\n The value of Z21=%0.3f Ohm",Z21)
V2=4.615*(10^-3)       //V
I2=1*(10^-3)           //A
Z22=V2/I2              //Ohm
```

```
printf("\n The value of Z22=%0.3f Ohm",Z22)
```

Scilab code Exa 1.13 Determine the h parameters for the two port network

```
//Determine the h parameters for the two-port
   network
//Solved Example 1.13 page no 22
clear
clc
printf("\nDetermine the h parameters for the two-
   port network")
V2=0         //V
Ia=0         //A
//h11=V1/I1
h11=10       //ohm
//Here I2=-I1
//Therefor h21=I2/I1 h21=-1
h21=-1 //ohm
Ia=V2/6     //A
I1=0         //A
V1=V2-10*(0.3)   //V
//h12=V1/V2
h12=0.5 //Ohm
I2=1.3   //A
V2=6     //V
h22=I2/V2    //Ohm
printf("\nThe value of h11=%1.3f ohm h21=%1.3f ohm
   h12=%1.3f ohm h22=%1.3f",h11,h21,h12,h22)
```

Scilab code Exa 1.15 Find the voltage gain ratio V2 by V1

```
//Find the voltage-gain ratio V2/V1
```

```
//Solved Example 1.15 page no 23
clear
clc
printf("\nFind the voltage−gain ratio V2/V1")
//Let V=V2/V1
RL=2000
h11=100 //ohm
h12=0.0025 //ohm
h21=20 //ohm
h22=0.001 //mS
V=1/(h12-(h11/h21)*((1/RL)+h22))
printf("\n The value of V2/V1=%0.1f",V)
```

Scilab code Exa 1.19 Find the average value of the current and the rms value of the current

```

//Find (a) the average value of the current and (b)
    the rms value of the current..
//Solved Example 1.19 page no 25
clear
clc
printf("\nFind (a) the average value of the current
    and (b) the rms value of the current.")
T=1
I0=(1/T)*(4*(T/2)+1*(T/2))//A
printf("\nI0=%0.1f A",I0)
I=(2*(1/T)*((4^2)*(T/2)+(1^2)*(T/2)))^(1/2)//A
printf("\nI=%0.2f A",I)
```

Chapter 2

Semiconductor Diodes

Scilab code Exa 2.1 what range of forward voltage drop vD can be approximated

```

//what range of forward voltage drop vD can (2.1) be approximated
//Solved Example Ex2.1 page no 48
clear
clc
printf("\n what range of forward voltage drop vD can (2.1) be approximated")
n=1
k=1.38//x 10^-23
T=25+273
q=1.6//x 10^-19
vd=((k*T)/(1.6*(10^4))*4.6151)
printf("\n vd = %0.4f V",vd)
```

Scilab code Exa 2.2 find the forward current and the reverse saturation current

```

//(a)find the forward current.
//(b)Find the reverse saturation current.
//Solved Example Ex2.2 page no 48
clear
clc
printf("\n find the forward and reverse saturation current")
iD2=(47.73*10)//mA
printf("\n iD2= %0.2f",iD2)
printf("\n iD1/(e^(0.3/0.02587)-1)=91nA")
```

Scilab code Exa 2.3 find the Vl

```

//find the Vl
//Solved Example Ex2.3 page no 48
clear
clc
printf("\n find the value of Vl")
Rl=100          // k
Rs=10           // k
Vl=(Rl/(Rl+Rs))
printf("\n The value of Vl = %0.4f vs",Vl)
```

Scilab code Exa 2.5 In the circuit D1 and D2 are ideal diodes and Find iD1 and iD2

```

//In the circuit D1 and D2 are ideal diodes. Find iD1 and iD2.
//Solved Example Ex2.5 page no 50
clear
```

```
clc
printf("\n In the circuit D1 and D2 are ideal diodes
    . Find iD1 and iD2.")
Vs=5                //V
V2=3                //V
iD2=((Vs-V2)/500)*1000//mA
printf("\n iD2= %d mA",iD2)
```

Scilab code Exa 2.7 Find iD and vD analytically

```
//Find iD and vD analytically
//Solved Example Ex2.7 page no 51
clear
clc
printf("\n Find iD and vD analytically")
vs=0.1 //cos wtV
Vb=2//V
printf("\n (100/200)*(2+0.1cos wt) V")
Rth=(100^2)/200          // k
printf("\n Rth= %d ohm",Rth)
printf("\n Rf=%d ohm",(0.7-0.5)/0.004)
```

Scilab code Exa 2.9 Use the small signal technique to find iD and vD

```
//Use the small-signal technique to find iD and vD
//Solved Example Ex2.9 page no 52
clear
clc
printf("\n Use the small-signal technique to find iD
    and vD")
Idq=5//mA
Vdq=0.75//V
vh=0.05//cos wt
```

```
Rth=50        // k
rd=50
rd=(0.7-0.5)/0.004
printf("\n rd= %d ohm",rd)
id=(vh/(Rth+rd))*1000
vd=(rd*id)/1000//cos wt V
printf("\n id= %0.1f cos wt mA",id)
printf("\n vd= %0.3f cos wt V",vd)
printf("\n iD = Idq + id = 5+0.5 cos wt mA")
printf("\n vD = Vdq + vd = 0.75+0.025 cos wt V")
```

Scilab code Exa 2.11 Find the value of Rl

```

//Solved Example Ex2.11 page no 54
clear
clc
Rs=200//
R1=200//
Rl=50// k
vs=400 //sin wt V
vth=(R1/(R1+Rs))*vs
printf("\n vth =%d sin wt V",vth)
Rth=((R1*Rs)/(R1+Rs))
printf("\n Rth =%d ohm",Rth)
id=-2*10^(-6)
Rl=Rl*(10^3)
vD=vth-(id)*(Rth+Rl)
printf("\n vD =%0.1f V",vD)
```

Scilab code Exa 2.13 Find the regulation of vo when Vb increases

```
//Find the regulation of vo when Vb increases from
    its nominal value of 4V to the value 6 V.
//Solved Example Ex2.13 page no 55
clear
clc
Vf1=1//v
Vf2=2//v
Rf1=100//
Rf2=200//
Vb1=4//v
Vb2=6//v
R=2000
V01=Vf2+((Vb1-Vf1-Vf2)*Rf2)/(R+Rf1+Rf2)
V02=Vf2+((Vb2-Vf1-Vf2)*Rf2)/(R+Rf1+Rf2)
Reg=((V02-V01)/V01)*100
printf("V01 is %0.3f and %0.3f",V01,V02)
printf("Reg = %0.3f",Reg)
```

Scilab code Exa 2.14 Find the percentage change in the average value of vL

```
//Find the percentage change in the average value of
    vL over the range of load variation,
//Solved Example Ex2.14 page no 56
clear
clc
Rl=10//
Rs=10//
Vs=10//v
Vl=(Rl/(Rl+Rs))*Vs      //V
printf("Vl = %0.3f",Vl)
Vl01=2.5//V
printf("\n For Rl=1000")
Rl=1000
Vs=10
```

```
Rs=10
Vl=(Rl/(Rl+Rs))*Vs
printf("\nVl = %0.3f",Vl)
Vl02=4.9//V
Reg=((Vl02-Vl01)/Vl01)*100
printf("Reg = %0.3f",Reg)
```

Scilab code Exa 2.15 find the average value of vL

```
//find the averagevalue of vL.
//Solved Example Ex2.15 page no 56
clear
clc
Rl=10//
Rs=10//
Vs=-10//v
Vl=(Rl/(Rl+Rs))*Vs
printf("Vl = %0.3f",Vl)
Vl0=2.5//V
printf("\n Vl0 Rl=%.3f",Vl0)
```

Scilab code Exa 2.26 Find the value of R2 and Rth

```
//Solved Example Ex2.26 page no 61
clear
clc
R1=6// k
R2=3// k
V1=5//v
V2=10//v
Rth=(R1*R2/(R1+R2))
printf("Rth = %0.3f",Rth)
R2=(R1*Rth/(R1-Rth))
```

```
printf("\nR2 = %0.3f",R2)
```

Scilab code Exa 2.30 Find the value of Vz

```

//Solved Example Ex2.30 page no 65
clear
clc
Vz=8.2       //V
R1=9         // k
iL=Vz/R1     //mA
printf("iL = %0.3f A",iL)
iZ=1
Vb=13.2
Rs=((Vb-Vz)/(iZ+iL))
printf("\n Rs = %0.3f ohm",Rs)
Vb=11.7
iZ=((Vb-Vz)/Rs)-iL
printf("\n iZ = %0.3f",iZ)
```

Scilab code Exa 2.31 Find the maximum allowable current iZ

```
//Find the maximum allowable current iZ when the
   Zener diode is acting as a regulator
//Solved Example Ex2.31 page no 65
clear
clc
Vz=5.2           //V
Pdmax=260        //mW
iZmax=Pdmax/Vz   //mA
printf("iZmax = %0.3f mA",iZmax)
Vs=15
R=(Vs-Vz)*1000/iZmax
```

```
printf("\n R = %0.3f ohm",R)
```

Chapter 3

CHARACTERISTICS OF BIPOLAR JUNCTION TRANSISTORS

Scilab code Exa 3.1 Find Ib and Ie

```
//Find IB and IE.
//Solved Example Ex3.1 page no 83
clear
clc
betaa=50
Ic=1.2          //mA
Iceo=3*10^-3    //mA
Ib=((Ic-Iceo)/betaa)*1000       //mA
printf("Ib = %0.2f X 10^-3 mA",Ib)
IE=(Ic)-(Ib*10^-3)
printf("\n IE = %0.2f  mA",IE)
```

Scilab code Exa 3.2 Find the collector current

```
//find the collector current for (a) IB = 0 and (b)
    IB = 40 A.
//Solved Example Ex3.2 page no 83
clear
clc
betaa=100
Ib=0                    //mA
Icbo=5//V               //mA
Iceo=(betaa+1)*Icbo     //mA
printf("\n When Ib =0 Iceo = %0.2f mA",Iceo)
Ib=40
Ic=((betaa*Ib)+(betaa+1)*Icbo)/1000
printf("\n When Ib =40 Ic = %0.3f mA",Ic)
```

Scilab code Exa 3.3 Find Icq and Ieq

```
//Find ICQ and IEQ.
//Solved Example Ex3.3 page no 83
clear
clc
alpha=0.98
betaa=alpha/(1-alpha)
Icbo=(5*10^-3)          //mA
Iceo=(betaa+1)*Icbo     //mA
printf("\n Iceo = %0.2f mA",Iceo)
Ibq=100*10^-3
Icq=(betaa*Ibq)+Iceo
printf("\n Icq = %0.2f mA",Icq)
Ieq=Icq+Ibq
printf("\n Ieq = %0.2f mA",Ieq)
```

Scilab code Exa 3.4 Find beta Icq and Ieq

```
//Find (a)Beta ; b() ICQ ,and (c) IEQ.
//Solved Example Ex3.4 page no 83
clear
clc
alpha=0.98
betaa=alpha/(1-alpha)
printf("\n Beta = %0.3f ",betaa)
Icq=1.47            //mA
Ieq=Icq/alpha       //mA
printf("\n Ieq = %0.3f mA",Ieq)
```

Scilab code Exa 3.5 Find the required value of RB

```
//Find the required value of RB.
//Solved Example Ex3.5 page no 84
clear
clc
Vbb=6            //V
Vbeq=0.7         //V
Ibq=40//10^-6
Rb=((Vbb-Vbeq)/Ibq)*1000
printf("\n Rb = %0.1f k ohm",Rb)
```

Scilab code Exa 3.6 Find VCEQ if RC is changed to 6 k

```
//find (a) IEQ and (b) VCEQ. (c) Find VCEQ if RC is changed to 6 k and all else remains the same.
//Solved Example Ex3.6 page no 84
clear
clc
b=100
a=b/(b+1)
Ibq=20//10^-6           //mA
```

```
Icq=(b*Ibq)/1000            //mA
Ieq=Icq/a                   //mA
printf("\n  Icq = %0.1f  mA",Icq)
printf("\n  Ieq = %0.2f  mA",Ieq)
```

Scilab code Exa 3.7 Find Vceq

```
//find (a) IEQ and (b) RB.(c) find VCEQ
//Solved Example Ex3.7 page no 85
clear
clc
b=80
a=b/(b+1)
Ibq=40//10^-6               //mA
Ieq=(Ibq/(1-a))/1000           //mA
printf("\n  Ieq = %0.2f  mA",Ieq)
Icq=(b*Ibq)/1000
printf("\n  Icq = %0.2f  mA",Icq)
```

Scilab code Exa 3.8 Find Rc and beta

```
//find graphically (a) ICQ;  b  RC;  c  IEQ, and
    (d)  if leakage current is negligible.
//Solved Example Ex3.8 page no 85
clear
clc
Vcc=14                  //V
Rc=(14/(6.5*10^-3))/1000        // k
Icq=2.25                    //mA
Ibq=20*10^-3                //mA
Ieq=Icq+Ibq                 //mA
printf("\n  Ieq = %0.2f  mA",Ieq)
b=Icq/Ibq
```

```
printf("\n  Beta = %0.2f  mA",b)
```

Scilab code Exa 3.9 Find the Q point collector current ICQ

```
//Find the Q-point collector current ICQ.
//Solved Example Ex3.9 page no 85
clear
clc
b=70
Vcc=15          //V
Vbeq=0.7        //V
Iceo=1.42       //mA
Rb=500//*10^3   // k
Ibq=((Vcc-Vbeq)/Rb)*1000
printf("\n  Ibq = %0.2f  mA",Ibq)
Icq=((b*Ibq/1000)+Iceo)
printf("\n  Icq = %0.2f  mA",Icq)
```

Scilab code Exa 3.12 Solved Example Ex12 page no 87 Find Re

```
//Find KVL around the emitter-base loop
//Solved Example Ex3.12 page no 87
clear
clc
Vceq=-6.4       //V
Vbeq=-0.3          //V
Vcbq=Vceq-Vbeq      //V
printf("\n  Vcbq = %0.2f  V",Vcbq)
Vee=2
Ieq=3
Re=((Vee+Vbeq)/Ieq)*1000
printf("\n  Re = %0.2f  Ohm",Re)
```

Scilab code Exa 3.13 Solved Example Ex 13 page no 88 Find Re

```
// Find KVL around the transistor terminals,
//Solved Example Ex3.13 page no 88
clear
clc
Vcc=12          //V
Vceq=6          //V
hf=100
Rc=2//*10^3     // k
Ibq=((Vcc-Vceq)/((hf+1)*Rc))*1000
printf("\n  Ibq = %0.2f  mA",Ibq)
Vbeq=0.7
Rf=((Vceq-Vbeq)/Ibq)*1000
printf("\n  Rf = %0.2f  Ohm",Rf)
```

Scilab code Exa 3.16 Solved Example Ex 16 page no 89 Find the minimum value of RC

```
//Solved Example Ex3.16 page no 89
clear
clc
b=80
a=(b/(b+1))
Ibq=30
Icq=Ibq*b/1000
printf("\n  Icq = %0.2f  mA",Icq)
Ieq=(Icq/a)
printf("\n  Ieq = %0.2f  OmA",Ieq)
```

Scilab code Exa 3.19 Find the value of RB that just results in saturation

```
//Find the value of RB that just results in saturation if (a) the capacitor is present , and
//(b) the capacitor is replaced with a short circuit .
//Solved Example Ex3.19 page no 91
clear
clc
b=50
Vbeq=0.3  //V
Vcc=12//v
Vs=2//v
Rc=4//Kohm
Rs=100//Kohm
Vce=0.2
Icq=(Vcc-Vce)/Rc
printf("\n  Icq = %0.2f  mA",Icq)
Rb=((Vcc-Vbeq)/(Icq/b))
printf("\n  Rb = %0.2f  Ohm",Rb)
```

Scilab code Exa 3.20 Find the value of R1 needed to bias the circuit so that VCEQ2 6V

```
//Find the value of R1 needed to bias the circuit so that VCEQ2 = 6V. (b) with R1 as found in part a, find VCEQ1.
//Solved Example Ex3.20 page no 91
clear
clc
b=50
b2=50
Vce=6        //V
Re=1         // k
Vcc=12//v    //V
```

```
Ieq2=(Vcc-Vce)/Re
printf("\n   Ieq2 = %0.2f   mA",Ieq2)
Ibq2=(Ieq2/((b+1)*(b2+1)))*1000
printf("\n   Ibq2 = %0.2f   mA",Ibq2)
```

Scilab code Exa 3.23 Solved Example Ex 23 page no 94 find IBQ and VCEQ

```
//Find the minimum value of RC that will maintain
   the transistor quiescent point at saturation,
//Solved Example Ex3.16 page no 89
clear
clc
b=80
a=(b/(b+1))
Ibq=30                    //mA
Icq=Ibq*b/1000            //mA
printf("\n   Icq = %0.2f   mA",Icq)
Ieq=(Icq/a)
printf("\n   Ieq = %0.2f   OmA",Ieq)
```

Scilab code Exa 3.26 Solved Example Ex 26 page no 96 Find R1 and R2

```
//Find R1 and R2
//Solved Example Ex3.26 page no 96
clear
clc
b=100
Vbeq=0.7                  //V
Vcc=15                    //V
Re=300                    // k
Rc=500                    // k
Icq=((Vcc)/(2*(Re+Rc)))*1000
```

```
printf("\n   Icq = %0.2f  mA",Icq)
Rb=(b*Re/10)/1000
printf("\n   Rb = %0.2f  Kohm",Rb)
Vbb=Vbeq+Icq*(1.1*Re)/1000
printf("\n   Vbb = %0.2f  V",Vbb)
R1=Rb/(1-Vbb/Vcc)
printf("\n   R1 = %0.2f  Kohm",R1)
R2=Rb*(Vcc/Vbb)
printf("\n   R2 = %0.2f  Kohm",R2)
```

Scilab code Exa 3.32 Solved Example Ex 32 page no 99 Determine the value of RB

```
// Find the value of . (c) Determine the value of RB
   .
//Solved Example Ex3.32 page no 99
clear
clc
Vcc=12          //v
Vbeq=0.7        //v
Re=1*10^3       // k
Icq=6*10^3      //mA
Ibq=50*10^-3    //mA
b=Icq/Ibq
printf("\n  B = %0.2f  mA",b)
```

Chapter 4

CHARACTERISTICS OF FIELD EFFECT TRANSISTORS AND TRIODES

Scilab code Exa 4.2 Calculate IDQ from the analog

```
//Calculate IDQ from the analog
//Solved Example Ex4.2 page no 118
clear
clc
Idon=5//*10^-3            //mA
Vgsq=6.90                 //V
Vt=4                      //V
Idq=Idon*((1-(Vgsq/Vt))^2)
printf("\n  Idq = %0.2f  mA",Idq)
```

Scilab code Exa 4.5 Find VGG RS and RD

```
//Find (a) VGG; b RS, and (c) RD.
//Solved Example Ex4.5 page no 118
clear
clc
Vgg=10               //V
Vgsq=8               //V
Idq=1*10^-3          //mA
Rs=((Vgg-Vgsq)/Idq)/1000          // k
printf("\n  Rs = %0.2f  K ohm",Rs)
Vdd=16               //V
Vdsq=12              //V
Idq=1
Rd=((Vdd-Vdsq-(Idq*Rs))/Idq)
printf("\n  Rd = %0.2f  K ohm",Rd)
```

Scilab code Exa 4.8 Determine appropriate values of RS and RD

```
//Determine appropriate values of RS and RD.
//Solved Example Ex4.8 page no 120
clear
clc
Rs=750              // k
printf("\n  Rs = %0.2f  K ohm",Rs)
Vdd=24              //V
Vdsq=15             //V
Idq=0.002            //mA
Rd=((Vdd-Vdsq-(Idq*Rs))/Idq)/1000
printf("\n  Rd = %0.2f  K ohm",Rd)
```

Scilab code Exa 4.10 Solved Example Ex 10 page no 121 Find Vdd and Vdsq

```
//find (a) VGG and (b) VDSQ
```

```
//Solved Example Ex4.10 page no 121
clear
clc
Idq=-8          //mA
Idss=-10        //mA
Vp0=-4          //V
Vgsq=Vp0*(((Idq/Idss)^(1/2))-1)
printf("\n  Vgsq = %0.2f  V",Vgsq)
Vdd=-20
Rd=1.5
Vdsq=Vdd-Idq*Rd
printf("\n  Vdsq = %0.2f  V",Vdsq)
```

Scilab code Exa 4.11 Find VGSQ IDQ and VDSQ

```
//Find (a) VGSQ;  b  IDQ, and (c) VDSQ.
//Solved Example Ex4.11 page no 121
clear
clc
Vt=4//V
R1=50//k ohm
R2=0.4//M ohm
Rs=0
Rd=2 //k ohm
Vdd=15//V
Vgsq=(R1/(R1+R2*10^3))*Vdd
printf("\n  Vgsq = %0.2f  V",Vgsq)
Idon=10//*10^-3
Idq=Idon*((1-(Vgsq/Vt))^2)
printf("\n  Idq = %0.2f  mA",Idq)
Vdsq=Vdd-(Idq*Rd)
printf("\n  Vdsq = %0.2f  V",Vdsq)
```

Scilab code Exa 4.13 Find VGSQ if IDQ 16mA and IDQ if VGSQ 5V

```
//Find (a) VGSQ if IDQ    16mA and (b) IDQ if VGSQ=
  − 5V.
//Example 4.13 page no 122
Vgsq=-4.5                    //V
Idq=-8                        //mA
VT=-3                          //V
Idon=(Idq/(1-Vgsq/VT)^2)
printf("\n Idon=%0.2f mA",Idon)
Idq=-16
Vgsq=VT*(1-(Idq/Idon)^(1/2))
printf("\n Vgsq=%0.2f V",Vgsq)
Vgsq=-5
```

Scilab code Exa 4.14 find IDQ and VGSQ

```
//find IDQ and VGSQ.
//Example 4.14 page no 123
clear
clc
Vdd=15                  //v
Vdsq=7                  //v
Rs=3                    // k
Rd=1                    // k
Idq=((Vdd-Vdsq)/(Rs+Rd))
printf("\n Idq=%0.2f mA",Idq)
Vgsq=-(Idq*Rd)
printf("\n Vgsq=%0.2f V",Vgsq)
```

Scilab code Exa 4.18 find VDSQ1 IDQ1 VGSQ1 VGSQ2 and VDSQ2

```
//find (a) VDSQ1; ()b) IDQ1; (c) VGSQ1, (d) VGSQ2, and (e) VDSQ2
//Example 4.18 page no 126
clear
clc
Idq1=1.22            //mA
Vdsq1=0              //V
Vdd=15               //V
Rs=2                 // k
Rd=5                 // k
Vgsq1=-(Idq1*Rs)
printf("\n Vgsq=%0.2f V" ,Vgsq1)
Vdsq2=Vdd-Vdsq1-Idq1*(Rs+Rd)
printf("\n Vdsq2=%0.2f V" ,Vdsq2)
```

Scilab code Exa 4.19 Find Vgsq1 Vgsq2 Vdsq1 Vdsq2 Idq2

```
//find (a) VGSQ1; b) IDQ2, (c) VGSQ2; d) VDSQ1, and (e) VDSQ2.
//Example 4.19 page no 127
clear
clc
Idq1=0               //mA
Idq2=2.92            //mA
Vdd=15               //V
Vgsq1=-4             //V
Rs=2                 // k
Rd=1                 // k
Vgsq2=-Vgsq1-Idq2*Rs
printf("\n Vgsq2=%0.2f V" ,Vgsq2)
Vdsq1=Vdd-(Idq1+Idq2)*Rd-Idq2*Rs-Vgsq2
printf("\n Vdsq1=%0.2f V" ,Vdsq1)
Rd=1
Idq1=0
Vdsq2=Vdd-(Idq1+Idq2)*Rd-Idq2*Rs
```

```
printf("\n Vdsq2=%0.2f V" ,Vdsq2)
```

Scilab code Exa 4.20 Find Vgsq

```
//Find VGSQ
//Example 4.20 page no 128
clear
clc
Vdd=15          //V
R2=40           // k
R1=60           // k
Vgsq=(R2/(R2+R1))*Vdd
printf("\n Vgsq=%0.2f V" ,Vgsq)
```

Scilab code Exa 4.23 Find Vdsq Vgsq and Idq

```
//determine (a) VGSQ, (b) IDQ, and (c) VDSQ.
//Example 4.23 page no 130

clear
clc
Idss=10         //mA
Vgsq=-1.34      //V
Vp0=4           //V
Rs=2            // k
Vdd=15          //V
Rd=500          // k
Idq=Idss*((1+(Vgsq/Vp0))^2)
Vdsq=Vdd-Idq*10^-3*(Rs*10^3+Rd)
printf("\n Idq=%0.2f mA" ,Idq)
printf("\n Vdsq=%0.2f V" ,Vdsq)
```

Scilab code Exa 4.24 find the perveance and the amplification factor m

```
//find (a) the perveance and (b) the amplification
   factor
//Example 4.24 page no 130
clear
clc
Ip=15              //mA
Vp=100             //v
Vp0=4              //v
Vg=-4              //v
k=(Ip/(Vp^(3/2)))*1000
m=-(Vp/Vg)
printf("\n  the perveance k=%0.2f mA/V^3/2" ,k)
printf("\n the amplification factor  m=%0.2f mA" ,m)
```

Scilab code Exa 4.26 Calculate the plate efficiency of the amplifier

```
//Calculate the plate efficiency of the amplifier
//Example 4.26 page no 130

clear
clc
Ip=(1/20)          //mA
Rl=10              // k
Vpp=2.4            //v
n=(((Ip)*Rl)/Vpp)
printf("\n  the perveance  n=%0.3f percent" ,n)
```

Chapter 5

TRANSISTOR BIAS CONSIDERATIONS

Scilab code Exa 5.1 Find leakage current at 90 c

```
//find its leakage current at 90 degree C.
//Example 5.1 page no 143
clear
clc
Icbo=(500*(2^((90-25)/10)))/1000
printf("\n The value of Icbo=%0.3f mA",Icbo)
```

Scilab code Exa 5.6 Find ICQ and VCEQ

```
//Find ICQ and VCEQ (a) for bet  50 and (b) for beta
    100
//Example 5.6 page no 145
clear
clc
Vee=4                //v
Vbeq=0.7             //v
```

```
Rb=25*10^3                    // k
b=50//Beta
Re=2*10^3                  // k
Icq=((Vee-Vbeq)/((Rb/b)+((b+1)/b)*Re))*1000
printf("\n The value of Icq=%0.3f mA" ,Icq)
Vcc=18               //v
Rc=6                 // k
Re=2//*10^3          // k
Vceq=Vcc+Vee-(Rc+((b+1)/b)*Re)*Icq              //v
printf("\n For beta=100")
printf("\n The value of Vceq=%0.3f V" ,Vceq)
printf("\n For beta=100")
b=100
Re=2*10^3
Icq=((Vee-Vbeq)/((Rb/b)+((b+1)/b)*Re))*1000
printf("\n The value of Icq=%0.3f mA" ,Icq)
Re=2//*10^3
Vceq=Vcc+Vee-(Rc+((b+1)/b)*Re)*Icq
printf("\n The value of Vceq=%0.3f V" ,Vceq)
```

Scilab code Exa 5.8 Example 5 8 page no 146 Find ICQ IBQ and VCEQ

```
//Find ICQ; IBQ, and VCEQ if (a)  beta 50 and (b)
   beta    100.
//Example 5.8 page no 146
clear
clc
Vcc=15                 //v
Vee=4                  //v
Vbeq=0.7               //v
b=50//Beta
Re=3*10^3                  // k
Rc=7                       // k
Ieq=(Vee-Vbeq)/Re*1000
printf("\n For beta=50")
```

```
printf("\n The value of Ieq=%0.3f mA",Ieq)
Icq=(b/(b+1))*Ieq
printf("\n The value of Icq=%0.3f mA",Icq)
Ibq=Icq/b
printf("\n The value of Ibq=%0.3f mA",Ibq)
Vee=5
Re=3//*10^3
Vceq=Vcc+Vee-(Ieq*Re)-(Icq*Rc)
printf("\n The value of Vceq=%0.3f V",Vceq)
printf("\n For beta=100")
b=100
printf("\n The value of Ieq=%0.3f mA",Ieq)
Icq=(b/(b+1))*Ieq
printf("\n The value of Icq=%0.3f mA",Icq)
Ibq=Icq/b
printf("\n The value of Ibq=%0.3f mA",Ibq)
Vee=5
Re=3//*10^3
Vceq=Vcc+Vee-(Ieq*Re)-(Icq*Rc)
printf("\n The value of Vceq=%0.3f V",Vceq)
```

Scilab code Exa 5.9 Find the sensitivity factor Sb and use it to calculate the change in ICQ

```
//Example 5.9 page no 147
clear
clc
Vcc=15
Vee=4
Vbeq=0.7
Rb=500
Sb=((Vcc-Vbeq)/Rb)*10^3
printf("\n The value of Sb=%0.3f ",Sb)
Icq=(Sb*(100-50))/1000
printf("\n The value of Icq=%0.3f mA",Icq)
```

Scilab code Exa 5.11 Example 11 page no 148 Find the exact change in ICQ

```
//(a) Find the exact change in ICQ. (b) Predict the
    new value of ICQ using stability-factor analysis.
//Example 5.11 page no 148
clear
clc
Vbb=6
Vbeq1=0.7
Icbo1=0.5
Rb=50
Re=1
B=75//Beta
Icq1=((Vbb-Vbeq1+Icbo1*(0.5*51*10^-3))/((Rb*10^3/B)+
    Re*10^3))*10^3
printf("\n The value of Icq1=%0.3f mA",Icq1)
Icbo2=(Icbo1*10^-6*2^2)*10^6
printf("\n The value of Icbo=%0.3f mA",Icbo2)
Vbeq=(-2*10^-3)*20
printf("\n The value of Vbeq=%0.3f V",Vbeq)
Vbeq2=Vbeq1+Vbeq
printf("\n The value of Vbeq2=%0.3f V",Vbeq2)
Icq2=((Vbb-Vbeq2+Icbo2*(2*51*10^-3))/((Rb*10^3/B)+Re
    *10^3))*10^3
printf("\n The value of Icq2=%0.3f mA",Icq2)
```

Scilab code Exa 5.16 Find an expression for ICQ at any temperature

```
//Find an expression for ICQ at any temperature.
//Example 5.16 page no 150
```

```
clear
clc
B=50//beta
Vee=5
Vbeq1=0.7
T2=125
Re=3*10^3
Icbo1=0.5//*10^-6
Icq2=(((B+1)/B)*((Vee-Vbeq1+0.002*(T2-25))/Re)+(2^((
   T2-25)/10))*Icbo1*10^-6)*10^3
printf("\n The value of Icq2=%0.3f mA",Icq2)
```

Scilab code Exa 5.19 Predict the change that will occur in ICQ as RE changes

```
//Determine a first-order approximation for the
   change in ICQ1
//Example 5.19 page no 152
clear
clc
B=75//beta
Rb=454.5         // k
Icbo=0.2*10^-6
Vbb=1.818
Vbeq=0.7
Re=90
deltaRe=110-90
Sre=((B*Rb*Icbo-B^2*(Vbb-Vbeq+Icbo*Rb))/((Rb+B*Re)
   ^2))*10^4
printf("\n The value of Sre=%0.3f * 10^-4 A/Ohm",
   Sre)
Icq=(Sre*deltaRe)/10
printf("\n The value of Icq=%0.3f * 10^-4 mA",Icq)
```

Scilab code Exa 5.25 Find Vdsqmax and Vdsqmin

```
//(a) Find the range of values of IDQ that could be expected in using this FET. (b) Find the corresponding range of VDSQ. (c) Comment on the
//desirability of this bias arrangement.
//Example 5.25 page no 156
clear
clc
Vdd=15
Idqmax=5.5
Idqmin=1.3
Rd=2.5              // k
Vdsqmax=Vdd-Idqmax*Rd
Vdsqmin=Vdd-Idqmin*Rd
printf("\n The value of Vdsqmax=%0.3f V",Vdsqmax)
printf("\n The value of Vdsqmin=%0.3f V",Vdsqmin)
```

Scilab code Exa 5.26 Find the Range of Vdsq

```
//(a) Find the range of IDQ that can be expected. (b) Find the range of VDSQ that can be expected. (c) Discuss
//the idea of reducing IDQ variation by increasing the value of RS.
//Example 5.26 page no 157
clear
clc
Vdd=24         //V
Idqmax=2.5
Idqmin=1.2
Rs=1           // k
```

```
Rd=3          // k
Vdsqmax=Vdd-Idqmax*(Rs+Rd)
Vdsqmin=Vdd-Idqmin*(Rs+Rd)
printf("\n The value of Vdsqmax=%0.3f V" ,Vdsqmax)
printf("\n The value of Vdsqmin=%0.3f V" ,Vdsqmin)
```

Scilab code Exa 5.28 Find the range of Idq

```
//a) Find the range of IDQ that can be expected if R1    1M and R2    3M. (b) Find the range of IDQ that can be expected if R1    1M
//and R2 = 7M. (c) Discuss the significance of the results of parts a and b.
//Example 5.28 page no 159
clear
clc
Vdd=24
Idqmax=4
Idqmin=2.8
Rs=2          // M
Rd=1          // M
Vdsqmax=Vdd-Idqmax*(Rs+Rd)
Vdsqmin=Vdd-Idqmin*(Rs+Rd)
printf("\n The value of Vdsqmax=%0.3f V" ,Vdsqmax)
printf("\n The value of Vdsqmin=%0.3f V" ,Vdsqmin)
```

Chapter 6

SMALL SIGNAL MIDFREQUENCY BJT AMPLIFIERS

Scilab code Exa 6.2 Find an expression for the current gain ratio Ai

```
//Find an expression for the current-gain ratio Ai
    iL=is and evaluate it
//Example 6.2 page no 175
clear
clc
a=0.99//alpha
Rc=4*10^3        // k
Rl=4*10^3        // k
Re=5*10^3        // k
re=30            //
rb=300           //
Ai=(a*Rc*Re)/((Rc+Rl)*(Re+re+(1-a)*rb))
printf("\n The value of Ai=%0.3f " ,Ai)
```

Scilab code Exa 6.7 Calculate the voltage gain Av and the current gain Ai

```
//Calculate (a) the voltage gain Av and (b) the current gain Ai.
//Example 6.7 page no 178
clear
clc
hfe=90
Rl=800//
Rc=800//
Rb=831// k
hie=200
hoe=100*10^-6
Av=-((hfe*Rl*Rc)/(hie*(Rc+Rl+hoe*Rl*Rc)))    // voltage gain Av
Ai=((Rb*hie)/(Rl*(Rb+hie)))*Av               // current gain Ai
printf("\n The value of Av=%0.3f " ,Av)
printf("\n The value of Ai=%0.3f " ,Ai)
```

Scilab code Exa 6.8 determine the voltage gain Av

```
//Determine the voltage gain Av
//Example 6.8 page no 179
clear
clc
vl=1.1528       //output voltage
vi=0.250        //input voltage
Av=-(vl/vi)     //voltage gain
printf("\n The value of Av=%0.3f " ,Av)
```

Scilab code Exa 6.18 Find Ai and Av

```
//Example 6.18 page no 185
clear
clc
Rs=5          // k
Rf=100        // k
hie=1.1
Rc=10         // k
Rl=10         // k
hfe=50
d=((1/Rs)+(1/Rf)+(1/hie))*((1/Rf)+((Rc+Rl)/(Rc*Rl)))
   +((1/Rf)*((hfe/hie)-(1/Rf)))
printf("\n The value of d=%0.3f ",d)
```

Scilab code Exa 6.19 Find Ai and iL

```
//Example 6.19 page no 186
clear
clc
hfb=-0.99
Rc=2.2*10^3
Rl=1.1*10^3
Re=3.3*10^3
hib=25
hob=10^-6
Av=((Rc*Rl*hfb)/(hib*(Rc+Rl+hob*(Rc*Rl))))
Ai=-((Re*Rc*hfb)/((Re+hib)+(Rc+Rl+hob*Rl*Rc)))
printf("\n The value of Av=%0.3f ",Av)
printf("\n The value of Ai=%0.3f ",Ai)
```

Scilab code Exa 6.22 Find the overall voltage gain Av

```
//Find (a) the final-stage voltage gain Av2  vo=vo1; (b) the final-stage input impedance Zin2;
//(c) the initial-stage voltage gain Av1  vo1=vin; (d) the amplifier input impedance Zin1; and
//(e) the amplifier voltage gain Av  vo=vi.
//Example 6.22 page no 189
clear
clc
hfe=40
Rc2=20*10^3      //
Rc1=10^4         //
hie=1500
hoe=30*10^-6
Av2=-((hfe*Rc2)/(hie*(1+hoe*Rc2)))       //final-stage voltage gain
printf("\n The value of Av2=%0.3f ",Av2)
Rb2=5*10^3       //
hie=1500
hfe=40
Zin2=(((Rb2*hie)/(Rb2+hie)))/1000            //final-stage input impedance Zin2
printf("\n The value of Zin2=%0.3f Kohm ",Zin2)
Zin2=Zin2*1000
Av1=-((hfe*Zin2*Rc1)/(hie*(Rc1+Zin2+hoe*Zin2*Rc1)))       //initial-stage voltage gain
printf("\n The value of Av1=%0.3f ",Av1)
```

Scilab code Exa 6.24 Find the overall voltage gain Av

```
//Example 6.24 page no 191
clear
clc
R11=90*10^3
R12=100*10^3
R22=90*10^3
```

```
R21=10*10^3
Av1=0.9879
hfe=100
Rl=5*10^3
Rc=5*10^3
hie=1*10^3
Rb1=((R11*R12)/(R11+R12))/1000
printf("\n The value of Rb1=%0.3f Kohm" ,Rb1)
Rb2=((R22*R21)/(R22+R21))/1000
printf("\n The value of Rb2=%0.3f Kohm" ,Rb2)
Av2=-((hfe*Rl*Rc)/(hie*(Rl+Rc)))
printf("\n The value of Av2=%0.3f " ,Av2)
Av=Av1*Av2
printf("\n The value of Av=%0.3f Kohm" ,Av)
```

Scilab code Exa 6.26 Find the overall voltage gain Av

```
//Determine (a) the overall voltage-gain ratio Av =
   vL=vs, and (b) the overall current-gain ratio Ai
   = iL=is.
//Example 6.26 page no 193
clear
clc
hfe=100
Rl=3*10^3              // k
Rc=3*10^3             // k
hie=1*10^3
Av2=-((hfe*Rl*Rc)/(hie*(Rl+Rc)))
printf("\n The value of Av2=%0.3f " ,Av2)
Rc1=10*10^3           // k
Re1=1*10^3            // k
Av1=-((hfe*Rc1*hie)/((Rc1+hie)*((hfe+1)*Re1+hie)))
printf("\n The value of Av1=%0.3f " ,Av1)
Av=Av1*Av2
printf("\n The value of Av=%0.3f " ,Av)
```

```
Ai1=-((hfe*Rc1)/(Rc1+hie))
printf("\n The value of Ai1=%0.3f ",Ai1)
Rc2=3*10^3          // k
Ai2=-((hfe*Rc2)/(Rc2+Rl))
printf("\n The value of Ai2=%0.3f ",Ai2)
Ai=Ai1*Ai2
printf("\n The value of Ai=%0.3f ",Ai)
```

Scilab code Exa 6.27 Find the overall voltage gain Av and overall current gain ratio

```
//Find (a) the overall voltage-gain ratio
//Av  vL=vS and (b) the overall current-gain ratio
    Ai  iL=iS.
//Example 6.27 page no 194
clear
clc
hfb1=-0.99
hfc2=-100
Rb=33.3*10^3
Re1=5*10^3
Re2=2*10^3
Rl=2*10^3
hic2=500
hib1=50
hic2=500
Av1=-((hfb1*Rb*hic2)/(hib1*(Rb+hic2)))
Av2=0.995
Av=Av1*Av2
printf("\n The value of Av1=%0.3f ",Av1)
printf("\n The value of Av1=%0.3f ",Av)
Ai1=-((hfb1*Re1*Rb)/((Re1+hib1)*(Rb+hic2)))
printf("\n The value of Ai1=%0.3f ",Ai1)
Ai2=-((hfc2*Re2)/(Re2+Rl))
printf("\n The value of Ai2=%0.3f ",Ai2)
```

```
Ai=Ai1*Ai2
printf("\n The value of Ai=%0.3f ",Ai)
```

Chapter 7

SMALL SIGNAL MIDFREQUENCY FET AND TRIODE AMPLIFIERS

Scilab code Exa 7.1 Determine the small signal equivalent circuit constants gm and rds

```
//determine
//the small-signal equivalent-circuit constants gm
   and rds. (b) Alternatively, evaluate gm from the
//transfer characteristic.
//Example 7.1 page no 207
clear
clc
Did=(3.3-0.3)*10^-3
Vgs=2
gm=Did/Vgs*1000
printf("\n The value of gm=%0.3f mS",gm)
Dvds=20-5
Did=(1.6-1.4)*10^-3
rds=Dvds/Did/1000
printf("\n The value of rds=%0.3f kOhm",rds)
Did=(2-1)*10^-3
```

```
Dvgs=-1.75-(-2.4)
gm=Did/Dvgs*1000                    //mS
printf("\n The value of gm=%0.3f mS",gm)
```

Scilab code Exa 7.3 Find the overall voltage gain Av and overall current gain ratio

```
//Find (a) Av    vds=vi; (b) Zin; (c) Zo looking
   back through the drain-source
//terminals, and (d) Ai    ii=iL.
//Example 7.3 page no 208
clear
clc
Rl=14*10^3
rds=40*10^3
Rf=5*10^6
gm=1*10^-3
Av=((Rl*rds*(1-Rf*gm))/(Rf*rds+Rl*rds+Rl*Rf))
printf("\n The value of Av=%0.3f ",Av)
Zin=(Rf/(1-Av))/1000
printf("\n The value of Zin=%0.3f kOhm",Zin)
Ai=(Av*Zin)/Rl*1000
printf("\n The value of Ai=%0.3f ",Ai)
```

Scilab code Exa 7.4 Find the overall voltage gain Av and overall current gain ratio

```

//Example 7.4 page no 209
clear
clc
R1=200*10^3
R2=800*10^3
```

```
Zin=(R1*R2/(R1+R2))/1000
printf("\n The value of Zin=%0.3f Kohm",Zin)
Rg=160*10^3
r1=5*10^3
vgs=Rg/(Rg+r1)
printf("\n The value of vgs=%0.3f vi",vgs)
Av=-1.88
Rl=2*10^3
Ai=(Av*(Rg+r1))/Rl
printf("\n The value of ai=%0.3f vi",Ai)
```

Scilab code Exa 7.7 Find the overall voltage gain Av and overall current gain ratio

```
//Example 7.7 page no 211
clear
clc
m=2*10^-3
Rg=30*10^3
Rd=2
Rl=4
Rg=160
r1=5
rds=30
Rs=3
Av=(-m*Rg*Rd*Rl)/((Rg+r1)*((Rd+Rl)*(rds+(m+1)*Rs+Rd*
    Rl)))*1000
printf("\n The value of Av=%0.3f ",Av)
```

Scilab code Exa 7.10 Find the overall voltage gain Av and overall current gain ratio and output impedance R0

```
//Find (a) the voltage-gain ratio Av   vL=vi , (b) the current-gain ratio Ai   iL=ii , and (c) the output impedance Ro.
//Example 7.10 page no 213
clear
clc
Rg=100        // k
ri=5
vgs=(Rg/(Rg+ri))
gm=0.0025
printf("\n The value of vgs=%0.3f vi",vgs)
rds=25
Rd=2              // k
Rl=2              // k
Req=(rds*Rd*Rl*10^3)/(2*Rl*Rd+rds*(Rl+Rd))
printf("\n The value of Req=%0.3f Kohm",Req)
Av=-2*gm*vgs*Req
printf("\n The value of Av=%0.3f ",Av)
Ai=((Av*(Rg+ri))/Rl)
printf("\n The value of Ai=%0.3f ",Ai)
R0=(Rd*rds)/(2*Rd+rds)
printf("\n The value of R0=%0.3f kOhm",R0)
```

Scilab code Exa 7.11 Find the overall voltage gain Av and overall current gain ratio and output impedance R0

```
//Find a current-source small-signal equivalent circuit for the CD FET amplifier.
//Example 7.11 page no 214
clear
clc
rds=30*10^3
Rs2=1.2*10^3
Rl=1*10^3         // k
gm=0.002
```

```
Rg=1*10^6         // k
Req=1/((1/rds)+(1/Rs2)+(1/Rl))
printf("\n The value of Req=%0.3f ",Req)
Av=((gm*Rg+1)*Req)/(Rg+(gm*Rg+1)*Req)
printf("\n The value of Av=%0.3f ",Av)
Ai=(Av*Rg/((1-Av)*Rl))
printf("\n The value of Ai=%0.3f ",Ai)
Rin=Rg/(1-Av)/10^6
printf("\n The value of Rin=%0.3f mOhm",Rin)
R0=1/(1/Rs2+1/rds+1/Rg+gm)
printf("\n The value of R0=%0.3f Ohm",R0)
```

Scilab code Exa 7.12 Find Idm

```
//determine the voltage gain of this amplifier
   circuit using SPICE methods.
//Example 7.12 page no 215
clear
clc
gm=1.5*10^-3
rds=75*10^3
Rd=3*10^3         // k
rds=75*10^3
vds=-(gm*rds*Rd)/(rds+Rd)
printf("\n The value of vds=%0.3f vgs",vds)
Vdsm=-1*vds       //V
idm=(gm+(Vdsm/rds))*1000
printf("\n The value of idm=%0.3f mA",idm)
```

Scilab code Exa 7.18 Find the perveance k and the amplification factor m

```
//(a) the perveance  and (b) the amplification
    factor .
//Example 7.18 page no 219
clear
clc
ip=15*10^-3       //mA
vp=100            //v
k=(ip/(vp^(3/2)))*10^6
vg=-4
printf("\n The value of k=%0.3f mA/v^3/2",k)
m=-(vp/vg)
printf("\n The value of m=%0.3f ",m)
```

Scilab code Exa 7.20 Evaluate the plate resistance

```
//to evaluate the plate resistance and (b) use(7.10)
     to find the transconductance.
//Example 7.20 page no 219
clear
clc
dvp=218-152
dip=(14.7-8.1)*10^-3
rp=dvp/dip/1000       // k
dvg=-2-(-6)
gm=dip/dvg*1000       //mS
printf("\n The value of rp=%0.3f kOhm",rp)
printf("\n The value of gm=%0.3f mS",gm)
```

Scilab code Exa 7.22 Calculate the voltage gain

```
//determine the voltage gain. (c) Calculate the
    voltage gain using small-signalanalysis
//Example 7.22 page no 220
```

```
clear
clc
Vpp=300                          //V
Vgq=4                            //V
Rl=11.6*10^3                     //
Vpm=34                            //V
Vgm=2
Av=-(2*Vpm/2*Vgm)
dvp=202-168
dip=(15-8)*10^-3
rp=dvp/dip/1000                  // k
dip=(15.5-6.5)*10^-3
dvg=-3-(-5)
gm=dip/dvg*1000                  //ms
m=21.87
Rl=11.6                          //
Av=-(m*Rl*10^3)/((Rl+rp)*10^3)       //Voltage gain
printf("\n The value of rp=%0.3f kOhm",rp)
printf("\n The value of gm=%0.3f mS",gm)
printf("\n The value of Av=%0.3f ",Av)
```

Chapter 8

FREQUENCY EFFECTS IN AMPLIFIERS

Scilab code Exa 8.6 Determine the low frequency voltage gain ratio if hie

```
//determine the low-frequency voltage-gain ratio if
    hie and hfe have median values.
//Example 8.6 page no 242
clear
clc
hie=1000    //
hfe=75          //
Av=50
Req=Av*(hie/hfe)      //
printf("\n The value of Req=%0.3f Ohm",Req)
Rl=10000    // k
Rc=Req*Rl/(Rl-Req)   // k
printf("\n The value of Rc=%0.3f Ohm",Rc)
hie=300       //
hfe=100              //
Re=1000            // k
wL=2*%pi*200
Ce=(hie+(hfe+1)*Re)/(wL*Re*hie)*10^6
printf("\n The value of Ce=%0.3f mF",Ce)
```

```
Av=(hfe*Req)/(hie+(hfe+1)*Re)
printf("\n The value of Av=%0.3f ",Av)
```

Scilab code Exa 8.8 Determine the low frequency gain the midfrequency gain and the low frequency cutoff point

```
//Determine (a) the low-frequency gain, (b) the midfrequency gain, and (c) the low-frequency cutoff point.
//Example 8.8 page no 244
clear
clc
hie2=1500     //
Rb2=5000     // k
Z01=10
C2=1*10^-6
Zin2=(hie2*Rb2/(hie2+Rb2))
printf("\n The value of Zin2=%0.3f Ohm",Zin2)
Av=7881.3
fl=1/(2*%pi*C2*(Zin2+Z01*10^3))
printf("\n The value of fl=%0.3f Hz",fl)
```

Chapter 9

OPERATIONAL AMPLIFIERS

Scilab code Exa 9.2 Evaluate the gain of this inverting amplifier

```
//derive an exact formula for the gain of a
   practical inverting op amp.
//Example 9.2 page no 268
clear
clc
Aol=-10^4
Rl=1            // k
Rf=10           // k
Rd=1            // k
Av=(Aol/(1+(Rl/Rf)*(1-Aol)+(Rl/Rd)))
printf("\n The value of Av=%0.3f ",Av)
```

Scilab code Exa 9.9 Find the regulated output vo in terms of VZ

```
//Find the regulated output vo in terms of VZ. (b)
   Given a specific Zener diode and the values of RS
    and R1
```

```
//Example 9.9 page no 272
clear
clc
Aol=-10^4
Rl=1
Rf=10
Rd=1
Av=(Aol/(1+(Rl/Rf)*(1-Aol)+(Rl/Rd)))
printf("\n The value of Av=%0.3f ",Av)
```

Scilab code Exa 9.12 Find the value of C

```

//Example 9.12 page no 274
clear
clc
R=10*10^3    //
f=100        //Hz
C=(0.1/(2*%pi*f*R))*10^9        //Capicitor
printf("\n The value of C=%0.3f  nF",C)
```

Scilab code Exa 9.25 Find the value of Av

```
//Use SPICE methods to simulate this amplifier
//Example 9.25 page no 281
clear
clc
R1=10*10^3  //
R2=20*10^3  //
R3=20*10^3  //
Av=-((R2*R3)/(R1*(R2+R3)))
printf("\n The value of Av=%0.3f  ",Av)
```

Chapter 10

Switched Mode Power Supplies

Scilab code Exa 10.1 Find the average values of input voltage and input current

```
//Find the average values of (a) input voltage and (
   b) input current.
//Example 10.1 page no 296
clear
clc
V2=12        //load
D=0.8        //duty cycle
V1=V2/D      //V
P0=20       //average power
I1=P0/V1
printf("\n The value of I1=%0.3f  A",I1)
```

Scilab code Exa 10.2 Determine the smallest value of duty cycle possible

```
//Determine the smallest value of duty cycle
   possible
//Example 10.2 page no 296
```

```
clear
clc
fs=30*10^3              //kHz.
Lc=50*10^-6             // Inductor H
Rl=7                    //Load
D=1-((2*fs*Lc)/Rl)
printf("\n The value of D=%0.3f  ",D)
```

Scilab code Exa 10.4 Determine the duty cycle and the output power

```
//Determine (a) the duty cycle and (b) the output
   power.
//Ts for the buck converter.
//Example 10.4 page no 296
clear
clc
V2=5            //V
V1=12           //V
D=V2/V1
Rl=5           //
V2=5           //V
p0=V2^2/Rl
printf("\n The value of D=%0.3f  ",D)
printf("\n The value of p0=%0.3f  ",p0)
```

Scilab code Exa 10.7 Find the maximum and minimum values of the inductor current

```
//Find the maximum and minimum values of the
   inductor current
//Example 10.7 page no 297
clear
clc
```

```
D=0.6        //Duty cycle
V1=24        //V
Rl=7
fs=30*10^3
L=50*10^-6
V2=D*V1
Imax=V2/Rl+((V1-V2)*D)/(2*fs*L)          //maximum
    values of the inductor current
Imin=V2/Rl-((V1-V2)*D)/(2*fs*L)          // minimum
    values of the inductor current
printf("\n The value of Imax=%0.3f A ",Imax)
printf("\n The value of Imin=%0.3f A",Imin)
```

Scilab code Exa 10.9 Example 10 page no 298

```
//Determine (a) the output voltage, (b) the load
    resistance, and (c) the load current.
//Example 10.9
//page no 298
clear
clc
V1=12
D=0.6
V2=V1/(1-D)       //output voltage
P0=60           //w Supplying power
Rl=V2^2/P0        //load resistance
I2=V2/Rl          //load current
printf("\n The value of V2=%0.3f V ",V2)
printf("\n The value of Rl=%0.3f ohm",Rl)
printf("\n The value of I2=%0.3f A ",I2)
```