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

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Book Description

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

Exa Example (Solved example)

Eqn Equation (Particular equation of the above book)

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

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

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List of Scilab Codes

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Chapter 1

Circuit Analysis Port point of view

Scilab code Exa 1.2 Find the current i by superposition theorem

```
1  //Solved  Example  1.2
2  //Page  no  4
3  //Find  the  current  i2  by  superposition  theorem
4  clear
5  clc
6  printf("\n  Find  the  current  i2  by  superposition
       theorem")
7  R1=1                //ohm
8  R2=1                //ohm
9  R3=1                //ohm
10  Vs=10               //simWtv
11  Vb=10                  //v
12  a=0
13  V21=1/3*Vs//simWtv
14  i21=V21/R2
15  Is=3//A
16  temp=R1*R2/(R1+R2)//Temp=R1||R2
17  i32=Vb/(R3+temp)
18  i22=(R1/(R1+R2))*i32
```

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

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

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

Scilab code Exa 1.4 For the circuit find vab

```
1  //Solved Example 1.4
2  //Page no 6
3  //Findthe Thevenin equivalent voltage VTh and
       impedance ZTh
4  clear
5  clc
```

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

Scilab code Exa 1.5 For the circuit find vab

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

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

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

```
3  //Find the Norton equivalent current IN and
       admittance YN
4  clear
5  clc
6  printf(”\n Find the Norton equivalent current IN and
       admittance YN”)
7  Va=4.0//V
8  a=0.25//A/V
9  R1=2//ohm
10 R2=3//ohm
11 I=2
12 Zth=5
13 Ia=(Va/(R1+R2))+((R1*I)/(R1+R2))
14 Yn=1/Zth
15 printf(”\n Norton equivalent current IN   is = %.2f V
       ”,Ia)
16 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

```
1
2  //find the Thevenin equivalent for the network to
       the left of terminals a; b.
3  //Solved Example 1.7
4  //page no 19
5  clear
6  clc
7  printf(”\n find the The venin equivalent for the
       network to the left of terminals a; b.”)
8  V1=10//V
9  V2=15//V
10 R1=4//ohm
11 R2=6//ohm
12 I=(V1-V2)/(R1+R2)
```

```
13  printf("\n The value of I is =%0.2f A",I)
14  Vth=V1-I*R1
15  printf("\n The value of Thevenin Equivalent voltage=
        %0.2f V",Vth)
16  Zth=(R1*R2)/(R1+R2)
17  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

```
1
2  //find the Norton equivalent for the network to the
        left of terminals a; b.
3  //Solved Example 1.8 page no 19
4  clear
5  clc
6  printf("\n find the Norton equivalent for the
        network to the left of termin")
7  V1=10//V
8  V2=15//V
9  R1=4//ohm
10 R2=6//ohm
11 Iab1=V1/R1
12 Iab2=V2/R2
13 printf("\n Then by superpostion ")
14 In=Iab1+Iab2
15 Zth=(R1*R2)/(R1+R2)
16 Yn=1/Zth//Rth=Zth
17 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

```
1
2  //find the The venin impedance as the ratio of open
       -circuit voltage to short-circuit current
3  //Solved Example 1.9 page no 20
4  clear
5  clc
6  printf("\n find the The venin impedance as the
       ratio of open-circuit voltage to short-circuit
       current")
7  V1=10//V
8  V2=15//V
9  R1=4//ohm
10 R2=6//ohm
11 I=(V1-V2)/(R1+R2)
12 printf("\n The value of I is =%0.2f A",I)
13 Vth=V1-I*R1
14 Iab1=V1/R1
15 Iab2=V2/R2
16 printf("\n Then by superpostion ")
17 In=Iab1+Iab2
18 Zth=Vth/In
19 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

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

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

Scilab code Exa 1.12 Solve Problem using a SPICE method

```
 1  //Solve Problem 1.11 using a SPICE method
 2  //Solved Example 1.12 page no 21
 3  clear
 4  clc
 5  printf("\nSolve Problem 1.11 using a SPICE method")
 6  V1=1.231*(10^-2)      //V
 7  I1=1*(10^-3)          //A
 8  Z11=V1/I1             //Ohm
 9  printf("\n The value of Z11=%0.2f Ohm",Z11)
10  V1=2.308*(10^-3)      //V
11  I2=1*(10^-3)          //A
12  Z12=V1/I2             //Ohm
13  printf("\n The value of Z12=%0.3f Ohm",Z12)
14  V2=4.615*(10^-3)      //V
15  I1=1*(10^-3)          //A
16  Z21=V2/I1             //Ohm
17  printf("\n The value of Z21=%0.3f Ohm",Z21)
18  V2=4.615*(10^-3)       //V
19  I2=1*(10^-3)           //A
20  Z22=V2/I2              //Ohm
```

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

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

```
1  //Determine the h parameters for the two-port
       network
2  //Solved Example 1.13 page no 22
3  clear
4  clc
5  printf("\nDetermine the h parameters for the two-
       port network")
6  V2=0          //V
7  Ia=0          //A
8  //h11=V1/I1
9  h11=10        //ohm
10  //Here I2=-I1
11  //Therefor h21=I2/I1 h21=-1
12  h21=-1 //ohm
13  Ia=V2/6      //A
14  I1=0         //A
15  V1=V2-10*(0.3)  //V
16  //h12=V1/V2
17  h12=0.5 //Ohm
18  I2=1.3  //A
19  V2=6     //V
20  h22=I2/V2   //Ohm
21  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

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

15

```
2  //Solved Example 1.15 page no 23
3  clear
4  clc
5  printf("\nFind the voltage-gain ratio V2/V1")
6  //Let V=V2/V1
7  RL=2000
8  h11=100 //ohm
9  h12=0.0025 //ohm
10 h21=20 //ohm
11 h22=0.001 //mS
12 V=1/(h12-(h11/h21)*((1/RL)+h22))
13 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

```
1
2  //Find (a) the average value of the current and (b)
       the rms value of the current..
3  //Solved Example 1.19 page no 25
4  clear
5  clc
6  printf("\nFind (a) the average value of the current
       and (b) the rms value of the current.")
7  T=1
8  I0=(1/T)*(4*(T/2)+1*(T/2))//A
9  printf("\nI0=%0.1f A",I0)
10 I=(2*(1/T)*((4^2)*(T/2)+(1^2)*(T/2)))^(1/2)//A
11 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

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

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

17

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

Scilab code Exa 2.3 find the Vl

```
1
2  //find  the  Vl
3  //Solved  Example  Ex2.3  page  no  48
4  clear
5  clc
6  printf("\n find  the  value  of  Vl")
7  Rl=100            // k
8  Rs=10             // k
9  Vl=(Rl/(Rl+Rs))
10 printf("\n The  value  of  Vl = %0.4 f  vs",Vl)
```

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

```
1
2  //In  the  circuit  D1  and  D2  are  ideal  diodes.  Find
        iD1  and  iD2.
3  //Solved  Example  Ex2.5  page  no  50
4  clear
```

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

Scilab code Exa 2.7 Find iD and vD analytically

```
 1  //Find iD and vD analytically
 2  //Solved Example Ex2.7 page no 51
 3  clear
 4  clc
 5  printf(")\n Find iD and vD analytically")
 6  vs=0.1  //cos wtV
 7  Vb=2//V
 8  printf(")\n (100/200)*(2+0.1cos wt) V")
 9  Rth=(100^2)/200            // k
10  printf(")\n Rth= %d ohm",Rth)
11  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

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

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

Scilab code Exa 2.11 Find the value of Rl

```
 1
 2  //Solved Example Ex2.11 page no 54
 3  clear
 4  clc
 5  Rs=200//
 6  R1=200//
 7  Rl=50// k
 8  vs=400 //sin wt V
 9  vth=(R1/(R1+Rs))*vs
10  printf("\n vth =%d sin wt V",vth)
11  Rth=((R1*Rs)/(R1+Rs))
12  printf("\n Rth =%d ohm",Rth)
13  id=-2*10^(-6)
14  Rl=Rl*(10^3)
15  vD=vth-(id)*(Rth+Rl)
16  printf("\n vD =%0.1f V",vD)
```

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

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

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

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

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

Scilab code Exa 2.15 find the average value of vL

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

Scilab code Exa 2.26 Find the value of R2 and Rth

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

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

Scilab code Exa 2.30 Find the value of Vz

```
1
2 // Solved Example Ex2.30 page no 65
3 clear
4 clc
5 Vz =8.2         //V
6 Rl =9           // k
7 iL=Vz/Rl        //mA
8 printf("iL = %0.3 f A",iL)
9 iZ =1
10 Vb =13.2
11 Rs =((Vb -Vz)/(iZ+iL))
12 printf(" \n Rs = %0.3 f ohm",Rs)
13 Vb =11.7
14 iZ =((Vb -Vz)/Rs)-iL
15 printf(" \n iZ = %0.3 f",iZ)
```

Scilab code Exa 2.31 Find the maximum allowable current iZ

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

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

Chapter 3

CHARACTERISTICS OF BIPOLAR JUNCTION TRANSISTORS

Scilab code Exa 3.1 Find Ib and Ie

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

Scilab code Exa 3.2 Find the collector current

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

Scilab code Exa 3.3 Find Icq and Ieq

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

Scilab code Exa 3.4 Find beta Icq and Ieq

26

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

Scilab code Exa 3.5 Find the required value of RB

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

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

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

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

Scilab code Exa 3.7 Find Vceq

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

Scilab code Exa 3.8 Find Rc and beta

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

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

Scilab code Exa 3.9 Find the Q point collector current ICQ

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

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

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

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

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

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

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

```
1 //Find the value of RB that just results in
      saturation if (a) the capacitor is present, and
2 //(b) the capacitor is replaced with a short circuit
      .
3 //Solved Example Ex3.19 page no 91
4 clear
5 clc
6 b=50
7 Vbeq=0.3   //V
8 Vcc=12//v
9 Vs=2//v
10 Rc=4//Kohm
11 Rs=100//Kohm
12 Vce=0.2
13 Icq=(Vcc-Vce)/Rc
14 printf("\n   Icq = %0.2f   mA",Icq)
15 Rb=((Vcc-Vbeq)/(Icq/b))
16 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

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

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

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

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

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

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

```
11  printf("\n   Icq = %0.2f   mA",Icq)
12  Rb=(b*Re/10)/1000
13  printf("\n   Rb = %0.2f   Kohm",Rb)
14  Vbb=Vbeq+Icq*(1.1*Re)/1000
15  printf("\n   Vbb = %0.2f   V",Vbb)
16  R1=Rb/(1-Vbb/Vcc)
17  printf("\n   R1 = %0.2f   Kohm",R1)
18  R2=Rb*(Vcc/Vbb)
19  printf("\n   R2 = %0.2f   Kohm",R2)
```

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

```
1  // Find the value of . (c) Determine the value of RB
       .
2  //Solved Example Ex3.32 page no 99
3  clear
4  clc
5  Vcc=12              //v
6  Vbeq=0.7            //v
7  Re=1*10^3           // k
8  Icq=6*10^3          //mA
9  Ibq=50*10^-3        //mA
10 b=Icq/Ibq
11 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

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

Scilab code Exa 4.5 Find VGG RS and RD

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

Scilab code Exa 4.8 Determine appropriate values of RS and RD

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

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

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

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

Scilab code Exa 4.11 Find VGSQ IDQ and VDSQ

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

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

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

Scilab code Exa 4.14 find IDQ and VGSQ

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

Scilab code Exa 4.18 find VDSQ1 IDQ1 VGSQ1 VGSQ2 and VDSQ2

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

Scilab code Exa 4.19 Find Vgsq1 Vgsq2 Vdsq1 Vdsq2 Idq2

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

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

Scilab code Exa 4.20 Find Vgsq

```
1  //Find  VGSQ
2  //Example  4.20  page  no  128
3  clear
4  clc
5  Vdd=15              //V
6  R2=40               // k
7  R1=60               // k
8  Vgsq=(R2/(R2+R1))*Vdd
9  printf("\n  Vgsq=%0.2f  V"  ,Vgsq)
```

Scilab code Exa 4.23 Find Vdsq Vgsq and Idq

```
1  //determine  (a)  VGSQ,  (b)  IDQ,  and  (c)  VDSQ.
2  //Example  4.23  page  no  130
3
4  clear
5  clc
6  Idss=10             //mA
7  Vgsq=-1.34          //V
8  Vp0=4               //V
9  Rs=2                // k
10  Vdd=15             //V
11  Rd=500             // k
12  Idq=Idss*((1+(Vgsq/Vp0))^2)
13  Vdsq=Vdd-Idq*10^-3*(Rs*10^3+Rd)
14  printf("\n  Idq=%0.2f  mA"  ,Idq)
15  printf("\n  Vdsq=%0.2f  V"  ,Vdsq)
```

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

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

Scilab code Exa 4.26 Calculate the plate efficiency of the amplifier

```
1  //Calculate the plate efficiency of the amplifier
2  //Example 4.26 page no 130
3
4  clear
5  clc
6  Ip=(1/20)          //mA
7  Rl=10              // k
8  Vpp=2.4            //v
9  n=(((Ip)*Rl)/Vpp)
10 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

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

Scilab code Exa 5.6 Find ICQ and VCEQ

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

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```
7   Rb=25*10^3                  // k
8   b=50//Beta
9   Re=2*10^3            // k
10  Icq=((Vee-Vbeq)/((Rb/b)+((b+1)/b)*Re))*1000
11  printf("\n The value of Icq=%0.3f mA" ,Icq)
12  Vcc=18          //v
13  Rc=6            // k
14  Re=2//*10^3     // k
15  Vceq=Vcc+Vee-(Rc+((b+1)/b)*Re)*Icq          //v
16  printf("\n For beta=100")
17  printf("\n The value of Vceq=%0.3f V" ,Vceq)
18  printf("\n For beta=100")
19  b=100
20  Re=2*10^3
21  Icq=((Vee-Vbeq)/((Rb/b)+((b+1)/b)*Re))*1000
22  printf("\n The value of Icq=%0.3f mA" ,Icq)
23  Re=2//*10^3
24  Vceq=Vcc+Vee-(Rc+((b+1)/b)*Re)*Icq
25  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

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

```
13  printf("\n The value of Ieq=%0.3f mA" ,Ieq)
14  Icq=(b/(b+1))*Ieq
15  printf("\n The value of Icq=%0.3f mA" ,Icq)
16  Ibq=Icq/b
17  printf("\n The value of Ibq=%0.3f mA" ,Ibq)
18  Vee=5
19  Re=3//*10^3
20  Vceq=Vcc+Vee-(Ieq*Re)-(Icq*Rc)
21  printf("\n The value of Vceq=%0.3f V" ,Vceq)
22  printf("\n For beta=100")
23  b=100
24  printf("\n The value of Ieq=%0.3f mA" ,Ieq)
25  Icq=(b/(b+1))*Ieq
26  printf("\n The value of Icq=%0.3f mA" ,Icq)
27  Ibq=Icq/b
28  printf("\n The value of Ibq=%0.3f mA" ,Ibq)
29  Vee=5
30  Re=3//*10^3
31  Vceq=Vcc+Vee-(Ieq*Re)-(Icq*Rc)
32  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

```
1   //Example 5.9 page no 147
2   clear
3   clc
4   Vcc=15
5   Vee=4
6   Vbeq=0.7
7   Rb=500
8   Sb=((Vcc-Vbeq)/Rb)*10^3
9   printf("\n The value of Sb=%0.3f " ,Sb)
10  Icq=(Sb*(100-50))/1000
11  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

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

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

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

```
 3  clear
 4  clc
 5  B=50//beta
 6  Vee=5
 7  Vbeq1=0.7
 8  T2=125
 9  Re=3*10^3
10  Icbo1=0.5//*10^-6
11  Icq2=(((B+1)/B)*((Vee-Vbeq1+0.002*(T2-25))/Re)+(2^((
       T2-25)/10))*Icbo1*10^-6)*10^3
12  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

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

Scilab code Exa 5.25 Find Vdsqmax and Vdsqmin

```
1  //(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
2  //desirability of this bias arrangement.
3  //Example 5.25 page no 156
4  clear
5  clc
6  Vdd=15
7  Idqmax=5.5
8  Idqmin=1.3
9  Rd=2.5            // k
10 Vdsqmax=Vdd-Idqmax*Rd
11 Vdsqmin=Vdd-Idqmin*Rd
12 printf("\n The value of Vdsqmax=%0.3f V" ,Vdsqmax)
13 printf("\n The value of Vdsqmin=%0.3f V" ,Vdsqmin)
```

Scilab code Exa 5.26 Find the Range of Vdsq

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

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

Scilab code Exa 5.28 Find the range of Idq

```
1  //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
2  // and R2 = 7M. (c) Discuss the significance of the
       results of parts a and b.
3  // Example 5.28 page no 159
4  clear
5  clc
6  Vdd =24
7  Idqmax =4
8  Idqmin =2.8
9  Rs =2          // M
10  Rd =1          // M
11  Vdsqmax = Vdd - Idqmax *( Rs + Rd )
12  Vdsqmin = Vdd - Idqmin *( Rs + Rd )
13  printf (" \n The value of Vdsqmax=%0.3 f V" , Vdsqmax )
14  printf (" \n The value of Vdsqmin=%0.3 f V" , Vdsqmin )
```

Chapter 6

SMALL SIGNAL MIDFREQUENCY BJT AMPLIFIERS

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

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

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

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

Scilab code Exa 6.8 determine the voltage gain Av

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

Scilab code Exa 6.18 Find Ai and Av

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

Scilab code Exa 6.19 Find Ai and iL

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

Scilab code Exa 6.22 Find the overall voltage gain Av

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

Scilab code Exa 6.24 Find the overall voltage gain Av

```
1  //Example 6.24 page no 191
2  clear
3  clc
4  R11=90*10^3
5  R12=100*10^3
6  R22=90*10^3
```

```
 7  R21 =10*10^3
 8  Av1 =0.9879
 9  hfe =100
10  Rl =5*10^3
11  Rc =5*10^3
12  hie =1*10^3
13  Rb1 =((R11*R12)/(R11+R12))/1000
14  printf("\n The value of Rb1=%0.3f Kohm" ,Rb1)
15  Rb2 =((R22*R21)/(R22+R21))/1000
16  printf("\n The value of Rb2=%0.3f Kohm" ,Rb2)
17  Av2 = -((hfe*Rl*Rc)/(hie*(Rl+Rc)))
18  printf("\n The value of Av2=%0.3f " ,Av2)
19  Av = Av1*Av2
20  printf("\n The value of Av=%0.3f Kohm" ,Av)
```

Scilab code Exa 6.26 Find the overall voltage gain Av

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

```
17  Ai1=-((hfe*Rc1)/(Rc1+hie))
18  printf("\n The value of Ai1=%0.3f " ,Ai1)
19  Rc2=3*10^3            // k
20  Ai2=-((hfe*Rc2)/(Rc2+Rl))
21  printf("\n The value of Ai2=%0.3f " ,Ai2)
22  Ai=Ai1*Ai2
23  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

```
1  //Find (a) the overall voltage-gain ratio
2  //Av     vL=vS and (b) the overall current-gain ratio
        Ai     iL=iS.
3  //Example 6.27 page no 194
4  clear
5  clc
6  hfb1=-0.99
7  hfc2=-100
8  Rb=33.3*10^3
9  Re1=5*10^3
10 Re2=2*10^3
11 Rl=2*10^3
12 hic2=500
13 hib1=50
14 hic2=500
15 Av1=-((hfb1*Rb*hic2)/(hib1*(Rb+hic2)))
16 Av2=0.995
17 Av=Av1*Av2
18 printf("\n The value of Av1=%0.3f " ,Av1)
19 printf("\n The value of Av1=%0.3f " ,Av)
20 Ai1=-((hfb1*Re1*Rb)/((Re1+hib1)*(Rb+hic2)))
21 printf("\n The value of Ai1=%0.3f " ,Ai1)
22 Ai2=-((hfc2*Re2)/(Re2+Rl))
23 printf("\n The value of Ai2=%0.3f " ,Ai2)
```

```
24  Ai = Ai1 * Ai2
25  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

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

```
16  Dvgs=-1.75-(-2.4)
17  gm=Did/Dvgs*1000                        //mS
18  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

```
1  //Find (a) Av    vds=vi; (b) Zin; (c) Zo looking
        back through the drain−source
2  //terminals, and (d) Ai    ii=iL.
3  //Example 7.3 page no 208
4  clear
5  clc
6  Rl=14*10^3
7  rds=40*10^3
8  Rf=5*10^6
9  gm=1*10^-3
10 Av=((Rl*rds*(1-Rf*gm))/(Rf*rds+Rl*rds+Rl*Rf))
11 printf("\n The value of Av=%0.3f ",Av)
12 Zin=(Rf/(1-Av))/1000
13 printf("\n The value of Zin=%0.3f kOhm",Zin)
14 Ai=(Av*Zin)/Rl*1000
15 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

```
1
2  //Example 7.4 page no 209
3  clear
4  clc
5  R1=200*10^3
6  R2=800*10^3
```

```
 7  Zin =(R1*R2/(R1+R2))/1000
 8  printf(”\n The value of Zin=%0.3f Kohm”,Zin)
 9  Rg =160*10^3
10  r1 =5*10^3
11  vgs=Rg/(Rg+r1)
12  printf(”\n The value of vgs=%0.3f vi”,vgs)
13  Av = -1.88
14  Rl =2*10^3
15  Ai =(Av*(Rg+r1))/Rl
16  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

```
 1  //Example 7.7 page no 211
 2  clear
 3  clc
 4  m=2*10^-3
 5  Rg =30*10^3
 6  Rd =2
 7  Rl =4
 8  Rg =160
 9  r1 =5
10  rds =30
11  Rs =3
12  Av =(-m*Rg*Rd*Rl)/((Rg+r1)*((Rd+Rl)*(rds+(m+1)*Rs+Rd*
        Rl)))*1000
13  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

```
1  //Find (a) the voltage−gain ratio Av    vL=vi, (b)
       the current−gain ratio Ai    iL=ii, and (c) the
       output impedance Ro.
2  //Example 7.10 page no 213
3  clear
4  clc
5  Rg=100        // k
6  ri=5
7  vgs=(Rg/(Rg+ri))
8  gm=0.0025
9  printf("\n The value of vgs=%0.3f vi",vgs)
10 rds=25
11 Rd=2                // k
12 Rl=2                // k
13 Req=(rds*Rd*Rl*10^3)/(2*Rl*Rd+rds*(Rl+Rd))
14 printf("\n The value of Req=%0.3f Kohm",Req)
15 Av=-2*gm*vgs*Req
16 printf("\n The value of Av=%0.3f ",Av)
17 Ai=((Av*(Rg+ri))/Rl)
18 printf("\n The value of Ai=%0.3f ",Ai)
19 R0=(Rd*rds)/(2*Rd+rds)
20 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

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

```
 9  Rg =1*10^6           // k
10  Req =1/((1/ rds )+(1/ Rs2 )+(1/ Rl ))
11  printf ("\n The value of Req=%0.3 f ",Req)
12  Av =((gm*Rg +1)*Req )/(Rg+(gm*Rg +1)*Req)
13  printf ("\n The value of Av=%0.3 f ",Av)
14  Ai =(Av*Rg /((1 - Av)*Rl))
15  printf ("\n The value of Ai=%0.3 f ",Ai)
16  Rin =Rg/(1 - Av)/10^6
17  printf ("\n The value of Rin=%0.3 f mOhm",Rin)
18  R0 =1/(1/Rs2 +1/rds +1/Rg+gm)
19  printf ("\n The value of R0=%0.3 f Ohm",R0)
```

Scilab code Exa 7.12 Find Idm

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

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

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

Scilab code Exa 7.20 Evaluate the plate resistance

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

Scilab code Exa 7.22 Calculate the voltage gain

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

```
 3  clear
 4  clc
 5  Vpp=300                              //V
 6  Vgq=4                                //V
 7  Rl=11.6*10^3                         //
 8  Vpm=34                                //V
 9  Vgm=2
10  Av=-(2*Vpm/2*Vgm)
11  dvp=202-168
12  dip=(15-8)*10^-3
13  rp=dvp/dip/1000                      // k
14  dip=(15.5-6.5)*10^-3
15  dvg=-3-(-5)
16  gm=dip/dvg*1000                      //ms
17  m=21.87
18  Rl=11.6                              //
19  Av=-(m*Rl*10^3)/((Rl+rp)*10^3)       //Voltage gain
20  printf("\n The value of rp=%0.3f kOhm",rp)
21  printf("\n The value of gm=%0.3f mS",gm)
22  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

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

```
19  Av=(hfe*Req)/(hie+(hfe+1)*Re)
20  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

```
1  //Determine (a) the low−frequency gain, (b) the
       midfrequency gain, and (c) the low−frequency
       cutoff point.
2  //Example 8.8 page no 244
3  clear
4  clc
5  hie2=1500     //
6  Rb2=5000      // k
7  Z01=10
8  C2=1*10^-6
9  Zin2=(hie2*Rb2/(hie2+Rb2))
10 printf("\n The value of Zin2=%0.3f Ohm",Zin2)
11 Av=7881.3
12 fl=1/(2*%pi*C2*(Zin2+Z01*10^3))
13 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

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

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

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

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

Scilab code Exa 9.12 Find the value of C

```
 1
 2  //Example  9.12  page  no  274
 3  clear
 4  clc
 5  R =10*10^3      //
 6  f =100          //Hz
 7  C =(0.1/(2*%pi*f*R) ) *10^9          //Capicitor
 8  printf ( " \ n  The  value  of  C=%0.3 f    nF" , C )
```

Scilab code Exa 9.25 Find the value of Av

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

Chapter 10

Switched Mode Power Supplies

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

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

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

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

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

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

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

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

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

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

Scilab code Exa 10.9 Example 10 page no 298

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