Scilab Textbook Companion for Introductory Electronic Devices and Circuits – Conventional Flow Version by R. T. Paynter[1]

Created by
Nihal Bisen
B.Tech
Electronics Engineering
NIT Meghalaya
College Teacher
None
Cross-Checked by
None

July 31, 2019

[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: Introductory Electronic Devices and Circuits – Conventional Flow Version

Author: R. T. Paynter

Publisher: Prentice Hall

Edition: 7

Year: 2005

ISBN: 978-0131716414

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 2

Diodes

Scilab code Exa 2.1 current voltage

```
clc;
//ex2.1
R1=1000; //kohm;
VS=5; //Volt//voltage across voltage source
IT=0; //Ampere; because diode in reverse bias and
    does not allow conduction through diode
VD1=VS-(IT*R1); //apply kvl in the circuit
VR1=VD1-VS; //apply kvl in the circuit
disp( 'Volt',VD1*1,"VD1=");
disp( 'Ampere',IT*1,"IT=");
disp( 'Volt',VR1*1,"VR1=");
```

Scilab code Exa 2.2 circuit current and voltage

```
clc;
//ex2.2
VD1=0; //Volt//diode is forward bias for ideal diode
     total Rideal=0 so VD1=IT*Rideal=0V
```

```
R1=1000; //kilo ohm;
VS=5; //Volt //voltage across voltage source
IT=(VS/R1)-(VD1/R1);//Ampere;apply kvl in the
   circuit
VR1=IT*R1; //Volt//apply ohms law voltage across
   resistance
disp( 'Volt',VD1*1,"VD1=");
disp( 'mAmpere',IT*1000,"IT=");
disp( 'Volt',VR1*1,"VR1=");
```

Scilab code Exa 2.3 voltmeter reading

```
clc
//ex2.3
Vd=0.7;//volt
Vs=6;//volt
Vr1=Vs-Vd; //volt//Voltmeter's reading
disp( 'Volt',Vr1*1,"Vr1=");
```

Scilab code Exa 2.4 total current

```
clc;
//ex2.4
Vs=6; //volt
Vd=0.7;//volt
R1=10000;//ohm
It=(Vs-Vd)/R1; //Total circuit current using
   kirchoff's volatage law
disp('Ampere',It,"It=")
```

Scilab code Exa 2.5 circuite current

```
clc;
//ex2.5
Vs=5; //volt
Vd=0.7; //volt
R1=1200; //ohm
R2=2200; //ohm
It=(Vs-Vd)/(R1+R2); //Ampere//Apply KVL to circuit
disp('Ampere',It*1,"It=")
```

Scilab code Exa 2.6 Value of It

```
clc;
//ex2.6
Vs=4; //volt
Vd=0.7; //volt
R1=5100; //ohm
IT=(Vs-2*Vd)/R1; //Ampere//KVL int the circuit
disp('Ampere',IT*1,"IT=")
```

Scilab code Exa 2.7 percentage of error by using ideal diode

```
clc;
//ex2.7
//assume diode is ideal(Vf=0V)
Vs=10; //Volt
Rt=3030; //Ohm
IT=Vs/Rt;  //Ampere
//assume diode is practical(Vf=0.7V)
Vf=1.4; //Volt
Vs1=Vs-Vf; //Volt
IT1=Vs1/Rt; //Ampere
```

```
e=(-100*(IT1-IT))/IT1; //Percentage of error between
    two circuit current
disp( 'Ampere',IT*1,"IT=");
disp( 'Ampere',IT1*1,"IT1=");
disp( '%',e*1,"Percentage Error="); //The answers
    vary due to round off error
```

Scilab code Exa 2.9 average forward current

```
clc;
//ex2.9
Vs=50; //Volt
Vd=0.7; //volt
RL=200; //ohm
If=(Vs-Vd)/RL;  //Ampere//forward current in the
    circuit
Io=(20/100)*If+If; //Ampere//Average forward current
    rating 20% greater than calculated value of If
disp('mAmp',If*1000,"If="); //The answers vary due
    to round off error
disp('mAmp',Io*1000,"Io=") //The answers vary due to
    round off error
```

Scilab code Exa 2.10 min forward power dissipation rating

```
clc;
//ex2.10
Vss=10; //volt
Vf=0.7; //volt
R=100; //ohm
//total current through the circuit by using
    kirchhoff's voltage law
If=(Vss-Vf)/R; //Ampere
```

```
//power dissipation form diode for Vf and If
Pf=Vf*If; //Watt
PDmax=(20/100)*Pf+Pf; //Watt//forward power
    dissipation that is 20% greater than value of Pf
disp( 'mA',If*1000,"If=");
disp( 'mW',Pf*1000,"Pf=");
disp( 'mW',PDmax*1000,"PDmax=");
```

Scilab code Exa 2.11 forward power dissipation

```
clc;
//ex2.11
Pdmax=500; //miliwatt
Vf=0.7; //volt
Io=Pdmax/Vf; //Ampere//using P=V*I
Ifmax=(80/100)*Io; //Ampere//maximum forward current
     80% of IO
disp( 'mA',Io,"Io="); //The answers vary due to
    round off error
disp('mA',Ifmax,"Ifmax="); //The answers vary due to
     round off error
```

Scilab code Exa 2.12 voltage across diode

```
clc;
//ex2.12
Vb=0.7; //volt
If=[0.001 0.005]; //Ampere
Rb=5; //ohm
Vf1=Vb+If(1,1)*Rb; //Volt//VF=VB+If*Rb;
Vf2=Vb+If(1,2)*Rb; //Volt//VF=VB+If*Rb;
disp('mV',Vf1,"Vf1=");
disp('mV',Vf2,"Vf2=");
```

Scilab code Exa 2.13 Current Izm

```
clc;
Pdmax=0.5; //watt
Vz=6.8; //volt
Izm=Pdmax/Vz; //Ampere//Power(P)=V*I
disp('mA',Izm*1000,"Izm="); //The answers vary due
    to round off error
```

Scilab code Exa 2.14 derating factor and Pd rating

```
clc;
//ex2.14;
T=100; //degree celcious
Pdissi=4 //miliwatt
D=Pdissi*(T-75); //D IS Derating value in miliwatt
Pd=(500-D); //W
disp('mW',Pd,"Pd=");
```

Scilab code Exa 2.16 diode application

```
clc;
//ex2.16
Vz=20; //volt
Izm=0.15; //Ampere
Pdmax=Vz*Izm; //Watt//p=v*i
disp('W',Pdmax,"Pdmax=");
```

Scilab code Exa 2.17 `current limiting resistor`

```
clc;
Voutpk=8; //volt
Vf=1.8; //volt
If=0.02; //Ampere
Rs=(Voutpk-Vf)/If; //Ohm//v=r*i
disp('Ohm',Rs,"Rs=");
```

Chapter 3

Common Diode Applications Basic Power supply

Scilab code Exa 3.1 secondary current

```
clc;
//ex3.1
Np=1;
Ns=4;
Ip=1; //Ampere
Is=(Np/Ns)*Ip; //Ampere
disp('mA',Is*1000,"Is="); //The answers vary due to
   round off error
```

Scilab code Exa 3.2 peak load voltage

```
clc;
//ex3.2
Vprms=120; //volt
Vppk=Vprms/0.707; //volt
Np=5;
```

```
Ns=1;
Vspk=(Ns/Np)*Vppk; //volt
Vf=0.7; //volt
VLpk=Vspk-Vf //volt
disp('V',Vppk,"Vppk=");//The answers vary due to round off error
disp('V',Vspk,"Vspk="); //The answers vary due to round off error
disp('V',VLpk,"VLpk="); //The answers vary due to round off error
```

Scilab code Exa 3.3 peak load voltage for the circuit

```
clc;
//ex3.3
Vsrms=25; //volt
Vspk=Vsrms/0.707; //volt
Vf=0.7; //volt
VLpk=Vspk-Vf; //volt
disp('V',Vspk,"Vspk="); //The answers vary due to round off error
disp('V',VLpk,"VLpk="); //The answers vary due to round off error
```

Scilab code Exa 3.4 peak load current

```
clc;
//ex3.4
Vprms=120; //volt
Vppk=Vprms/0.707; //volt
Ns=1;
Np=3;
Vspk=(Ns/Np)*Vppk; //volt
```

```
Vf=0.7; //volt
VLpk=Vspk-Vf; //volt
RL=10000; //ohm
ILpk=VLpk/RL; //Ampere
disp('V',Vppk,"Vppk="); //The answers vary due to
   round off error
disp('V',Vspk,"Vspk="); //The answers vary due to
   round off error
disp('V',VLpk,"VLpk="); //The answers vary due to
   round off error
disp('mA',ILpk*1000,"ILpk="); //The answers vary due
    to round off error
```

Scilab code Exa 3.5 average voltage

```
clc;
//ex=3.5
Vprms=120; //volt
Vppk=Vprms/0.707; //volt
Ns=1;
Np=2;
Vspk=(Ns/Np)*Vppk; //volt
Vf=0.7; //volt
Vlpk=Vspk-Vf; //volt
Vave=Vlpk/3.14; //volt
disp('V',Vppk,"Vppk=");//The answers vary due to
   round off error.
disp('V',Vspk,"Vspk=");//The answers vary due to
   round off error.
disp('V',Vlpk,"Vlpk=");//The answers vary due to
   round off error.
disp('V',Vave,"Vave=");//The answers vary due to
   round off error
```

Scilab code Exa 3.6 average current

```
clc;
//ex3.6
Vave=26.8; //Volt
RL=20000; //Ohm
Iave=Vave/RL; //Ampere//from v=r*i
disp('mA',Iave*1000,"Iave=");
```

Scilab code Exa 3.7 dc load current

```
clc;
//ex3.7;
Vac=24;//volt
Vspk=Vac/0.707; //volt
Vlpk=Vspk-0.7; //volt
RL=20000; //Ohm
Ilpk=Vlpk/RL; //Ampere
Iave=Ilpk/3.14; //Ampere
disp('V',Vspk,"Vspk="); //The answers vary due to
    round off error
disp('V',Vlpk,"Vlpk="); //The answers vary due to
    round off error
disp('mili Amperes',Ilpk*1000,"Ilpk="); //The
    answers vary due to round off error
disp('Micro Amperes',Iave*1000000,"Ilpk="); //The
    answers vary due to round off error
```

Scilab code Exa 3.8 dc output voltage

```
clc;
//ex3.8
Vac=48; //volt
Vspk=Vac/0.707; //volt
Vf=0.7; //volt
Vlpk=Vspk-Vf; //volt
Vave=Vlpk/%pi; //volt
disp('V',-Vspk,"Vspk="); //The answers vary due to round off error
disp('V',-Vlpk,"Vlpk="); //The answers vary due to round off error
disp('V',-Vave,"Vave="); //The answers vary due to round off error
```

Scilab code Exa 3.9 `dc load voltage`

```
clc;
//ex3.8
Vac=30; //volt
Vspk=Vac/0.707; //volt
Vf=0.7; //volt
Vlpk=(Vspk/2)-Vf; //volt
Vave=(2*Vlpk)/%pi; //volt
disp('V',Vspk,"Vspk="); //The answers vary due to round off error
disp('V',Vlpk,"Vlpk="); //The answers vary due to round off error
disp('V',Vave,"Vave="); //The answers vary due to round off error
```

Scilab code Exa 3.10 `Ilpk and Iave`

```
 clc;
```

```
//ex3.10
Vlpk=20.5; //volt
RL=5100; //ohm
Ilpk=Vlpk/RL; //Ampere// from v=r*i
Vave=13.1;  //volt//from v=r*i
Iave=Vave/RL; //Ampere
disp('mA',Ilpk*1000,"Ilpk="); //The answers vary due to round off error
disp('mA',Iave*1000,"Iave="); //The answers vary due to round off error
```

Scilab code Exa 3.11 `dc load voltage and current`

```
clc;
//ex3.11
Vac=12; //volt
Vspk=Vac/0.707; //volt
Vf=0.7; //volt
Vlpk=Vspk-2*Vf; //volt
Vave=(2*Vlpk)/%pi; //volt
RL=120; //ohm
Iave=Vave/RL; //Ampere
disp('V',Vspk,"Vspk="); //The answers vary due to round off error
disp('V',Vlpk,"Vlpk="); //The answers vary due to round off error
disp('V',Vave,"Vave="); //The answers vary due to round off error
disp('mA',Iave*1000,"Iave="); //The answers vary due to round off error
```

Scilab code Exa 3.12 `dc load voltage`

```
clc;
//ex3.12
Vac=12; //volt
Vspk=Vac/0.707; //volt
Vf=0.7; //volt
Vlpk=(Vspk/2)-Vf; //volt
Vave=(2*Vlpk)/%pi; //volt
RL=120; //ohm
Iave=Vave/RL; //Ampere
disp('V',Vspk,"Vspk="); //The answers vary due to
   round off error
disp('V',Vlpk,"Vlpk="); //The answers vary due to
   round off error
disp('V',Vave,"Vave="); //The answers vary due to
   round off error
disp('mA',Iave*1000,"Iave="); //The answers vary due
    to round off error
```

Scilab code Exa 3.13 averagen voltage

```
clc;
//ex3.13
Vac=36; //Volt
Vspk=Vac/0.707; //Volt
Vf=0.7; //Volt
Vlpk=Vspk-2*Vf; //Volt
Vave=(2*Vlpk)/%pi; //Volt
disp('V',Vspk,"Vspk="); //The answers vary due to
   round off error
disp('V',Vlpk,"Vlpk="); //The answers vary due to
   round off error
disp('V',Vave,"Vave="); //The answers vary due to
   round off error
```

Scilab code Exa 3.14 surge current

```
clc;
//ex3.14
Vppk=170; //volt
Ns=1;
Np=2;
Vspk=(Ns/Np)*Vppk; //Volt//(N1/N2=Vp/Vs)
Rw=0.8; //ohm
Rb=5; //ohm
Isurge=Vspk/(Rw+Rb); //Ampere
disp('V',Vspk,"Vspk="); //The answers vary due to round off error
disp('A',Isurge,"Isurge="); //The answers vary due to round off error
```

Scilab code Exa 3.15 ripple output

```
clc;
//ex3.15
IL=0.02; //Ampere
t=[0.0167 0.00833]; //seceond
c=0.0005; // Farad
Vr1=(IL*t(1,1))/c; //peakvolt
Vr2=(IL*t(1,2))/c; //peakvolt
disp('mVpp',Vr1*1000,"Vr1=");
disp('mVpp',Vr2*1000,"Vr2="); ////The answers vary due to round off error
```

Scilab code Exa 3.16 `average voltage`

```
clc;
//ex3.16
Vac=24; //volt
Vspk=Vac/0.707; //volt
Vf=0.7; //volt
Vlpk=(Vspk/2)-Vf; //volt
Vdc=Vlpk; //volt
RL=1200; //ohm
IL=Vdc/RL; //Amperes //v=r*i
t=0.00833 //second
C=0.00047 //farad
Vr=(IL*t)/C; //volt
Vdc=Vlpk-(Vr/2); //volt
disp('V',Vdc,"Vdc="); //The answers vary due to
    round off error
```

Scilab code Exa 3.17 `circuit current`

```
clc;
//ex3.17
Vin=20; //volt
Vz=9.1; //volt
Rs=2200; //ohm
I=(Vin-Vz)/Rs; //Ampere
disp('mA',I*1000,"I="); //The answers vary due to
    round off error
```

Scilab code Exa 3.18 `load current`

```
clc;
//Ex3.18
```

```
Vz=9.1; //volt
RL=10000; //ohm
IL=Vz/RL; //Ampere fromV=R*I
disp('micro Amperes',IL*1000000,"IL="); //The answers vary due to round off error
```

Scilab code Exa 3.19 load current and zener current

```
clc;
//Ex3.19
IT=0.00495; //Ampere
Vz=9.1; //volt
RL=10000; //ohm
IL=Vz/RL; //Ampere//fromV=R*I
Iz=IT-IL; //Ampere/Iz=IT-IL;
disp('mA',Iz*1000,"Iz="); //The answers vary due to round off error
```

Scilab code Exa 3.20 minimum allowable value of RL

```
clc;
//ex3.20
Vin=20; //volt
Vz=3.3; //volt
Rs=1000; //ohm
I=(Vin-Vz)/Rs; //Ampere
IZK=0.003 //Ampere
Ilmax=I-IZK; //Ampere
RLmin=Vz/Ilmax; //ohm
disp('ohm',RLmin,"RLmin="); //The answers vary due to round off error
```

Scilab code Exa 3.21 `ripple at the load`

```
clc;
//Ex3.21
Vr=1.5; //Volt
Zl=5; //Ohm
RL=120; //Ohm
Rs=51; //Ohm
R1=(Zl*RL)/(Zl+RL); //Ohm
Vrout=(R1/(R1+Rs))*Vr; //Volt
disp('mVpp',Vrout*1000,"Vrout="); //The answers vary
    due to round off error
```

Scilab code Exa 3.22 `dc voltage Vrout and IL`

```
clc;
//ex3.22
Vac=36; //Volt
Vspk=Vac/0.707; //Volt
Vf=0.7; //Volt
Vpk=Vspk-2*Vf; //Volt
Vin=Vpk; //Volt
Rs=75; //Ohm
Vz=30; //Volt
Ir=(Vin-Vz)/Rs; //Amperes
t=0.00833 //second
C=0.0022 //Farad
Vr=(Ir*t)/C; //Volt
Vdc=30; //Volt
RL=300; //Ohm
ZZ=60 //Ohm
RL=300 //Ohm
```

```
Rs=75 //Ohm
Znet=(ZZ*RL)/(ZZ+RL); //Ohm
Il=Vz/RL; //Ampere
Vrout=(Znet/((Znet)+Rs))*Vr; //Volt
disp('V',Vdc,"Vdc="); //The answers vary due to
    round off error
disp('mVpp',Vrout*1000,"Vrout="); //The answers vary
     due to round off error
disp('mA',Il*1000,"Il="); //The answers vary due to
    round off error
```

Chapter 4

Common Diode Applications clippers clampers Voltage multiplier and Display

Scilab code Exa 4.1 `peak load voltage`

```
clc;
Vin=12; //volt
RL=5100; //ohm
Rs=1000; //ohm
VL=(RL/(RL+Rs))*Vin ; //volt //voltage divide rule
disp('Vpk',VL,"VL=");//The answers vary due to round
    off error
```

Scilab code Exa 4.2 `voltage at register`

```
clc;
VL=-0.7; //volt
Vin=-12; //volt
VRS=Vin-VL; //volt
```

```
disp('Vpk',VRS,"VRS=");//The answers vary due to
   round off error
```

Scilab code Exa 4.3 voltage at load

```
clc;
Vf=0.7; //volt
Vin=10; //volt
VRs=Vin-Vf; //volt
RL=1200; //ohm
Rs=220; //ohm
VL=-Vin*(RL/(RL+Rs)); //volt
disp('Vpk',VL,"VL=");//The answers vary due to round
    off error
```

Scilab code Exa 4.4 peak load voltage

```
clc;
Vin=8; //volt
RL=6200; //ohm
Rs=100; //ohm
VL=Vin*(RL/(RL+Rs)); //volt
disp('Vpk',VL,"VL=");//The answers vary due to round
    off error
```

Scilab code Exa 4.5 capacitor charge and discharge

```
clc;
Rd=10; //Ohm
C1=0.000001; //Farad
```

```
RL=10000; //Ohm
Tc=5*(Rd*C1);
Td=5*(RL*C1);
disp('seconds',Tc,"Tc=");//The answers vary due to
   round off error
disp('seconds',Td,"Td=");//The answers vary due to
   round off error
```

Chapter 6

Bipolar Junction Transistors

Scilab code Exa 6.1 `collector current`

```
clc;
B=300;
Ib=[0.00002 0.00005]; //Ampere
Ic1=B*Ib(1,1); //Ampere
Ic2=B*Ib(1,2); //Ampere
disp('mA',Ic1*1000,"Ic1=");
disp('mA',Ic2*1000,"Ic2=");
```

Scilab code Exa 6.2 `collector current emitter current`

```
clc;
B=200;
Ib=0.000125; //Ampere
Ic=B*Ib; //Ampere
Ie=Ib+Ic; //Ampere
disp('mA',Ic*1000,"Ic=");
disp('mA',Ie*1000,"Ie=");
```

Scilab code Exa 6.3 collector and base current

```
clc;
B=200;
Ie=0.015; //Ampere
Ib=Ie/(B+1); //Ampere
Ic=B*Ib; //Ampere
disp('micro Amperes',Ib*1000000,"Ic=");//The answers vary due to round off error
disp('mA',Ic*1000,"Ie=");//The answers vary due to round off error
```

Scilab code Exa 6.4 base and collector current

```
clc;
B=400;
Ic=0.05; //Amperes
Ib=Ic/B; //Amperes
Ie=Ic+Ib; //Amperes
disp('Amperes',Ib,"Ib=");//The answers vary due to round off error
disp('Amperes',Ie,"Ie=");//The answers vary due to round off error
```

Scilab code Exa 6.5 collector current

```
clc;
B=300;
Ie=0.03; //Ampere
```

```
Ib=0.0001; //Ampere
A=B/(B+1);
Ic1=A*Ie; //Ampere
Ic2=B*Ib //Ampere
disp('Amperes',Ic1,"Ic1=");//The answers vary due to
    round off error
disp('Amperes',Ic2,"Ic2=");//The answers vary due to
    round off error
```

Scilab code Exa 6.6 max base current

```
clc;
Icmax=0.5; //Ampere
Bmax=300;
Ibmax=Icmax/Bmax; //Ampere
disp('mA',Ibmax*1000,"Ibmax=");//The answers vary
   due to round off error
```

Chapter 7

DC Biasing Circuits

Scilab code Exa 7.1 `dc load line`

```
clc;
Vcc=12; //volt
Vceoff=12; //volt
Rc=2000; //ohm
Icsat=Vceoff/Rc; //Ampere//v=r*i
disp('mA',Icsat*1000,"Icsat=");//The answers vary
   due to round off error
T1=0:2:12; // T1 axes is for voltage axes
T2=6:-1:0 // T2 axes is for Ic mA And T2(max)=Icsat
   =6 mA
plot(T1,T2)
xlabel('Vce(V)')
ylabel('Ic(mA)')
```

Scilab code Exa 7.2 `dc load line`

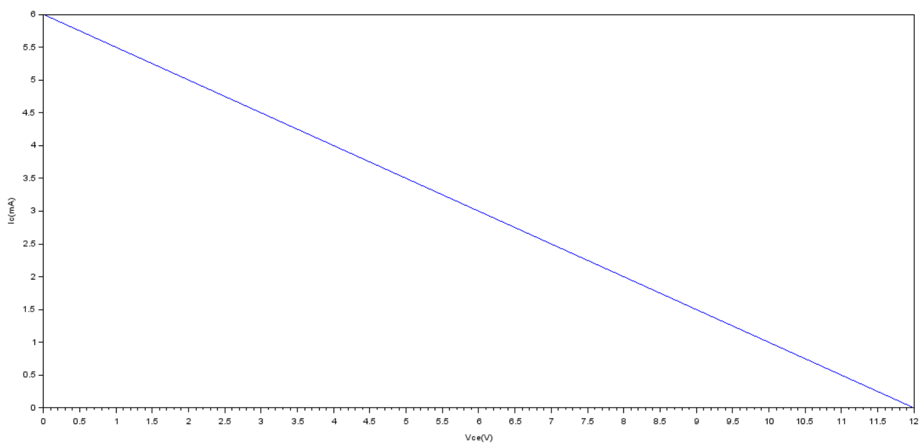


Figure 7.1: dc load line

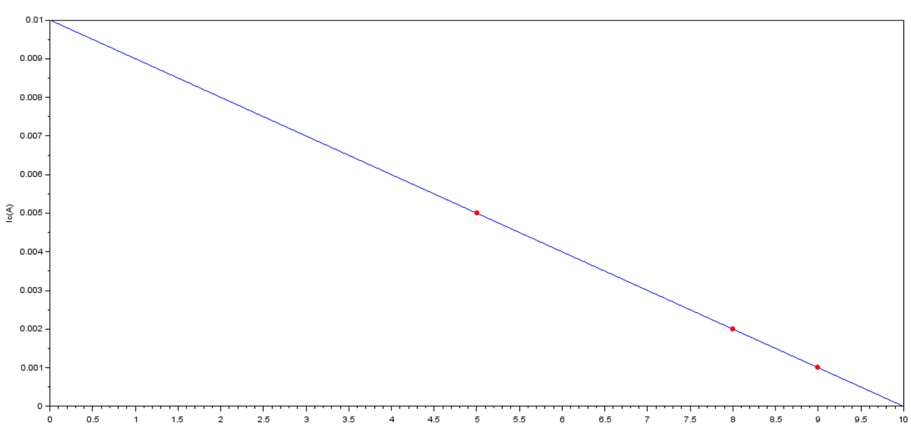


Figure 7.2: dc load line

```
clc;
Vcc=10; //volt
Rc=1000; //ohm
Icsat=Vcc/Rc; //Ampere
Vceoff=10; //Volt
Ic=[0.001 0.002 0.005] //Ampere
Vce=zeros(1,3); //Volt
for i=1:3
    Vce(1,i)=Vcc-Ic(1,i)*Rc; //volt
end
disp('V',Vce(1,1),"Vce1=");//The answers vary due to
    round off error
disp('V',Vce(1,2),"Vce2=");//The answers vary due to
    round off error
disp('V',Vce(1,3),"Vce3=");//The answers vary due to
    round off error

T1=0:1:10; // T1 axes is for voltage axes
T2=10:-1:0 // T2 axes is for Ic mA
plot(T1,T2)
plot((Vce(1,1),Ic(1,1))
xlabel('Vce(V)')
ylabel('Ic(mA)')
```

Scilab code Exa 7.3 `Q point values`

```
clc;
Vcc=8; //volt
Vbe=0.7; //volt
Rb=360000; //ohm
Ib=(Vcc-Vbe)/Rb; //Ampere
Hfe=100;
Ic=Hfe*Ib;//Ampere
Rc=2000; //ohm
Vce=Vcc-Ic*Rc; //volt
```

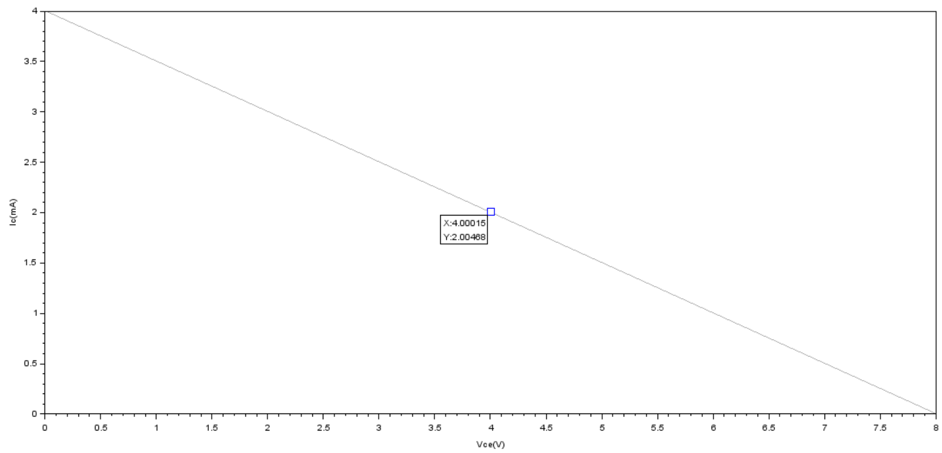


Figure 7.3: midpoint biased

```
disp('mA',Ic*1000,"Ic=");//The answers vary due to
   round off error
disp('V',Vce,"Vce=");//The answers vary due to round
    off error
```

Scilab code Exa 7.4 `midpoint biased`

```
clc;
Vcc=8; //volt
Rc=2000; //ohm
Icsat=Vcc/Rc; //Ampere
Vceoff=Vcc; //volt
Vcc=8; //volt
Vbe=0.7; //volt
Rb=360000; //ohm
Ib=(Vcc-Vbe)/Rb; //Ampere
Hfe=100;
Ic=Hfe*Ib;//Ampere
```

```
Rc=2000; //ohm
Vce=Vcc-Ic*Rc; //volt

T1=0:2:8;  // T1 axes is for voltage axes
T2=4:-1:0; //T2 axes is for Ic mA

plot(T1,T2)
xlabel('Vce(V)')
ylabel('Ic(mA)')
```

Scilab code Exa 7.5 Q Point

```
clc;
//A circuit is midpoint bised when the Q-point value of Vce is one half of Vcc.
//from example and 7.3
Vcc=8; //volt
Vbe=0.7; //volt
Rb=360000; //ohm
Ib=(Vcc-Vbe)/Rb; //Ampere
Hfe=100;
Ic=Hfe*Ib;//Ampere
Rc=2000; //ohm
Vce=Vcc-Ic*Rc; //volt
disp('V',Vce,"Vce=");//The answers vary due to round off error
//Here we get Vce = (Vcc/2)
//We can conclude that the circuit is midpoint
```

Scilab code Exa 7.6 effect of temprature

```
clc;
//for T=25' and Hfe=100
```

```
Ib=0.0000203; //Ampere
Ic=0.00203; //Ampere
Vce=3.94; //Volt
//for T=100' andHfe=150
Hfe=150;
Vcc=8; //volt
Rc=2000; //ohm
Ic=Hfe*Ib; //Ampere
Vce=Vcc-Ic*Rc; //volt
disp('mA',Ic*1000,"Ic=");//The answers vary due to
   round off error
disp('V',Vce,"Vce=");//The answers vary due to round
    off error
```

Scilab code Exa 7.7 `Q point vales`

```
clc;
Vcc=10; //volt
R1=18000; //ohm
R2=4700; //Ohm
Vb=(R2/(R1+R2))*Vcc; //volt //voltage divider rule
Ve=Vb-0.7; //volt
Re=1100; //ohm
Icq=Ve/Re; //Ampere//assumption Icq=Ie
Rc=3000; //Ohm
Re=1100; //Ohm
Vceq=Vcc-Icq*(Rc+Re); //Volt
disp('A',Icq,"Icq=");//The answers vary due to round
    off error
disp('V',Vceq,"Vceq=");//The answers vary due to
   round off error
```

Scilab code Exa 7.8 `base current`

```
clc;
Vcc=20; //volt
R2=1000; //ohm
R1=6800; //ohm
Vb=(R2/(R1+R2))*Vcc; //volt//voltage divider rule
Ve=Vb-0.7; //volt
Re=1000; //ohm
Ie=Ve/Re; //Ampere
Hfe=50;
Ib=Ie/(Hfe+1); //Ampere
disp('Amperes',Ib,"Ib=");//The answers vary due to
    round off error
```

Scilab code Exa 7.9 `Q point`

```
clc;
Vcc=20; //volt
R2=10000; //Ohm
R1=68000; //ohm
Vth=(R2/(R1+R2))*Vcc; //volt//by voltage divider
    rule Thevenin
Rth=(R1*R2)/(R1+R2); //ohm
Vbe=0.7; //Volt
Hfe=50;
Re=1100; //Ohm
Rc=6200; //Ohm
Icq=(Vth-Vbe)/((Rth/Hfe)+Re); //Ampere
Vceq=Vcc-Icq*(Rc+Re); //Volt
disp('mA',Icq*1000,"Icq=");//The answers vary due to
    round off error
disp('V',Vceq,"Vceq=");//The answers vary due to
    round off error
```

Scilab code Exa 7.10 Icq and Vceq

```
clc;
Vee=-12; //volt
Re=1500; //ohm
Icq=-(Vee+0.7)/Re; //Ampere
Vcc=12; //volt
Rc=750; //ohm
Vceq=Vcc-Icq*Rc+0.7; //volt
disp('mA',Icq*1000,"Icq=");//The answers vary due to
    round off error
disp('V',Vceq,"Vceq=");//The answers vary due to
   round off error
```

Scilab code Exa 7.11 Icsat and Vceoff

```
clc;
Vcc=12; //volt
Rc=750; //ohm
Re=1500;//ohm
Icsat=(2*Vcc)/(Rc+Re); //Ampere
Vceoff=2*Vcc; //volt
disp('mA',Icsat*1000,"Icsat=");//The answers vary
   due to round off error
disp('V',Vceoff,"Vceoff=");//The answers vary due to
    round off error
```

Scilab code Exa 7.12 Q points

```
clc;
Vcc=10; //volt
Vbe=0.7; //volt
Rb=180000; //ohm
```

```
Hfe=100;
Rc=1500; //Ohm
Ib=(Vcc-Vbe)/(Rb+(Hfe*Rc)); //Ampere
Icq=Hfe*Ib; //Ampere
Vceq=Vcc-Icq*Rc; //volt
disp('mA',Icq*1000,"Icq=");//The answers vary due to
    round off error
disp('V',Vceq,"Vceq=");//The answers vary due to
   round off error
```

Scilab code Exa 7.13 `Q points`

```
clc;
Vcc=16; //Volt
Vbe=0.7; //Volt
Rb=680000; //Ohm
Hfe=50;
Rc=6200; //Ohm
Re=1600; //Ohm
Ib=(Vcc-Vbe)/(Rb+((Hfe+1)*Re)); //Ampere
Icq=Hfe*Ib; //Ampere
Vceq=Vcc-Icq*(Rc+Re); //Volt
disp('mA',Icq*1000,"Icq=");//The answers vary due to
    round off error
disp('V',Vceq,"Vceq=");//The answers vary due to
   round off error
```

Chapter 8

Introduction to Amplifiers

Scilab code Exa 8.1 voltage gain

```
clc;
Vout=0.25; //volt
Vin=0.0004; //volt
Av=Vout/Vin; //Voltagegain
disp(' ',Av,"Av=");//The answers vary due to round
    off error
```

Scilab code Exa 8.2 output voltage

```
clc;
Vin=0.00024; //volt
Av=625; //Voltagegain
Vout=Av*Vin; //volt
disp('mV',Vout*1000,"Vout=");//The answers vary due
    to round off error
```

Scilab code Exa 8.3 `input voltage`

```
clc;
Zin=1500; //ohm
Rs=100; //Ohm
Vs=0.002; //Volt
Vin=Vs*(Zin/(Zin+Rs)); //Volt
disp('mV',Vin*1000,"Vin=");//The answers vary due to round off error
```

Scilab code Exa 8.4 `output voltage`

```
clc;
Vin=[0.002 0.00188]; //Volt
Av=500;
Vout1=Av*Vin(1,1); //Volt
Vout2=Av*Vin(1,2); //Volt
disp('V',Vout1,"Vout1=");//The answers vary due to round off error
disp('mV',Vout2*1000,"Vout2=");//The answers vary due to round off error
```

Scilab code Exa 8.5 `load voltage`

```
clc;
Vout=0.3; //volt
RL=1200; //Ohm
Zout=300; //ohm
VL=Vout*(RL/(RL+Zout)); //voltage divider rule
disp('mV',VL*1000,"Vl=");//The answers vary due to round off error
```

Scilab code Exa 8.6 efficiency

```
clc;
PL=0.24; //watt
Pdc=1.2; //watt
efficiency=(PL/Pdc)*100;
disp('%',efficiency,"efficiency=");//The answers
   vary due to round off error
```

Scilab code Exa 8.7 gain in dB

```
clc;
Pout=2; //watt
Pin=0.0001; //watt
ApdB=10*log10(Pout/Pin);
disp('dB',ApdB,"ApdB=");//The answers vary due to
   round off error
```

Scilab code Exa 8.8 power gain

```
clc;
ApdB=3;
Ap=10^(ApdB/10);
disp(' ',Ap,"Ap=");
```

Scilab code Exa 8.9 amplifier output gain

```
clc;
ApdB=3;
Ap=10^(ApdB/10);
Pout=Ap*0.05; //Watt
disp('mW',Pout*1000,"Pout=");//The answers vary due
   to round off error
```

Scilab code Exa 8.10 input power

```
clc;
ApdB=-3;
Ap=10^(ApdB/10);
Pout=0.05; //watt
Pin=Pout/Ap; //watt
disp('mW',Pin*1000,"Pin=");
```

Scilab code Exa 8.12 Output power

```
clc;
ApdB=50;
Ap=10^(ApdB/10);
Pin=0.001; //watt
Pout=Pin*Ap; //watt
disp('W',Pout,"Pout=");
```

Scilab code Exa 8.13 voltage gain

```
clc;
Vout=2; //volt
Vin=0.025; //volt
```

```
AvdB=20*log10(Vout/Vin);
disp('dB',AvdB,"AvdB=");//The answers vary due to
   round off error
```

Scilab code Exa 8.14 voltage gain

```
clc;
AvdB=6;
Av=10^(AvdB/20);
disp(' ',Av,"Av=");//The answers vary due to round
   off error
```

Scilab code Exa 8.15 Voltage gain

```
clc;
AvdB=-6;
Av=10^(AvdB/20);
disp(' ',Av,"Av=");//The answers vary due to round
   off error
```

Chapter 9

Common Emitter Amplifiers

Scilab code Exa 9.1 emitter resistance

```
clc;
R2=2200; //ohm
R1=10000; //ohm
Vcc=10; //volt
Vb=Vcc*(R2/(R1+R2)); //volt
Ve=Vb-0.7; //volt
Re=1000; //ohm
Ie=Ve/Re; //Ampere
re=0.025/Ie; //Ohm
disp('ohm',re,"re=");//The answers vary due to round
    off error
```

Scilab code Exa 9.3 voltage gain

```
clc;
Vout=12; //Volt
Vin=0.06; //Volt
Av=Vout/Vin;
```

```
disp('',Av,"Av=");//The answers vary due to round
    off error
```

Scilab code Exa 9.4 voltage gain

```
clc;
//step1
Vcc=20; //volt
R2=20000; //ohm
R1=150000; //ohm
Vb=20*(R2/(R2+R1)); //Volt
Ve=Vb-0.7; //volt
Re=2200; //ohm
Ie=Ve/Re; //Ampere
re=0.025/Ie; //ohm
Rc=12000; //ohm
RL=50000; //ohm
rc=(Rc*RL)/(Rc+RL); //ohm
Av=rc/re;
disp('',Av,"Av=");//The answers vary due to round
    off error
```

Scilab code Exa 9.5 Voltage gain

```
clc;
R2=4700; //Ohm
R1=18000; //ohm
Vcc=10; //volt
Vth=Vcc*(R2/(R1+R2)); //volt
Rth=(R1*R2)/(R1+R2); //ohm
Vbe=0.7; //volt
Hfe=30;
Re=1200; //ohm
```

```
Icq=(Vth-Vbe)/((Rth/Hfe)+Re); //Ampere
Ie=Icq; //Ampere
re=0.025/Ie; //Ohm
Rc=1500; //Ohm
RL=5100; //Ohm
rc=(Rc*RL)/(Rc+RL);//Ohm
Av=rc/re;
disp('',Av,"Av=");//The answers vary due to round
    off error
```

Scilab code Exa 9.6 `ac output voltage`

```
clc;
Vin=0.08; //Volt
Av=48.3;
Vout=Av*Vin; //Volt
disp('V',Vout,"Vout=");
```

Scilab code Exa 9.7 `output power`

```
clc;
Ai=20;
Av=48.3;
Ap=Ai*Av;
Pin=0.00008; //Watt
Pout=Ap*Pin; //Watt
disp('mW',Pout*1000,"Pout=");//The answers vary due
    to round off error
```

Scilab code Exa 9.8 `voltage gain`

```
clc;
Rc=3000; //Ohm
re=25 //Ohm
Av=Rc/re;
disp('',Av,"Av=");//The answers vary due to round
   off error
```

Scilab code Exa 9.9 input impedance

```
clc;
re=22.3; //Ohm
Hfe=200;
Zbase=Hfe*re; //Ohm
R1=18000; //Ohm
R2=4700; //Ohm
Req=(R1*R2)/(R1+R2); //Ohm
Zin=(Req*Zbase)/(Req+Zbase); //Ohm
disp('kohm',Zin/1000,"Zin=");//The answers vary due
   to round off error
```

Scilab code Exa 9.10 current gain

```
clc;
re=22.3; //Ohm
Hfe=200;
Zbase=Hfe*re; //Ohm
R1=18000; //Ohm
R2=4700; //Ohm
Req=(R1*R2)/(R1+R2); //Ohm
Zin=(Req*Zbase)/(Req+Zbase); //Ohm
rc=1150; //Ohm
RL=5000; //Ohm
Ai=Hfe*((Zin*rc)/(Zbase*RL));
```

```
disp(' ',Ai,"Ai=");//The answers vary due to round
    off error
```

Scilab code Exa 9.11 voltage gain

```
clc;
re=19.8; //Ohm
Hfe=200;
Zbase=Hfe*re; //Ohm
R5=15000; //Ohm
R6=2500; //Ohm
Req=(R5*R6)/(R5+R6);//Ohm
Zin=(Req*Zbase)/(Req+Zbase); //Ohm
R3=5000; //Ohm
rc=(R3*Zin)/(R3+Zin); //Ohm
Av=rc/re;
disp(' ',Av,"Av=");//The answers vary due to round
    off error
```

Scilab code Exa 9.12 Voltage gain for the two stage amplifier

```
clc;
R7=5000; //Ohm
RL=10000; //Ohm
rc=(R7*RL)/(R7+RL);//Ohm
re=17.4; //Ohm
Av2=rc/re;
Av1=53;
AvT=Av1*Av2;
disp('',AvT,"AvT=");//The answers vary due to round
    off error
```

Scilab code Exa 9.13 `Voltage gain`

```
clc;
Ve=1.37; //Volt
Re=910; //Ohm
re=300; //Ohm
Ie=Ve/(Re+re);//Ampere
re1=0.025/Ie; //Ohm
Rc=1500; //Ohm
RL=10000; //Ohm
rc=(Rc*RL)/(Rc+RL);//Ohm
Av=rc/(re1+re);
disp(' ',Av,"Av=");//The answers vary due to round
   off error
```

Scilab code Exa 9.14 `change in gain`

```
clc;
rc=1300; //Ohm
re=2*22.1; //Ohm
rE=300; //Ohm
Av1=rc/(re+rE);
Av2=4.04;
DelAv=Av2-Av1;
disp(' ',DelAv,"DelAv=");//The answers vary due to
   round off error
```

Scilab code Exa 9.15 `base impedance`

```
clc;
re=25; //Ohm
Hfe=200;
Zbase=Hfe*re; //Ohm
rE=200; //Ohm
Zbase=Hfe*(re+rE); //Ohm
disp('kohm',Zbase/1000,"Zbase=");//The answers vary
    due to round off error
```

Scilab code Exa 9.16 Input ipedance

```
clc;
R1=10000; //Ohm
R2=2200; //Ohm
Zbase1=5000; //Ohm
Req=(R1*R2)/(R1+R2); //Ohm
Zin1=(Req*Zbase1)/(Req+Zbase1);//Ohm
Zbase2=45000; //ohm
Zin2=(Req*Zbase2)/(Req+Zbase2);//Ohm
disp('kohm',Zin1/1000,"Zin=");//The answers vary due
    to round off error
disp('kohm',Zin2/1000,"Zin=");//The answers vary due
    to round off error
```

Scilab code Exa 9.17 voltage gain

```
clc;
Rc=8000; //Ohm
Zin1=1330; //Ohm
rc1=(Rc*Zin1)/(Rc+Zin1);//Ohm
re=25; //Ohm
Zin2=1730; //Ohm
rc2=(Rc*Zin2)/(Rc+Zin2);//Ohm
```

```
re=25; //Ohm
Av1=rc1/re;
Av2=rc2/re;
disp(' ',Av1,"Av1="); //The answers vary due to round
    off error
disp(' ',Av2,"Av2="); //The answers vary due to round
    off error
```

Scilab code Exa 9.18 `Input impedance and Voltage gain`

```
clc;
Hfemin1=110;
Hfemax1=140;
Hfe=(Hfemin1*Hfemax1)^0.5;
Hiemin2=600; //Ohm
Hiemax2=800; //Ohm
Hie=(Hiemin2*Hiemax2)^0.5; //Ohm
rc=460; //Ohm
Av=(Hfe*rc)/Hie;
disp(' ',Av,"Av="); //The answers vary due to round
    off error
```

Chapter 10

Other BJT Amplifiers

Scilab code Exa 10.1 `voltage and current`

```
clc;
R1=20000; //Ohm
R2=20000; //Ohm
Vcc=10; //Volt
Vb=Vcc*(R2/(R1+R2)); //Volt
Ve=Vb-0.7; //Volt
Re=5000; //Ohm
Ie=Ve/Re; //Ampere
Vceq=Vcc-Ve; //Volt
disp('V',Vb,"Vb=");//The answers vary due to round
    off error
disp('V',Ve,"Ve=");//The answers vary due to round
    off error
disp('A',Ie,"Ie=");//The answers vary due to round
    off error
disp('V',Vceq,"Vceq=");//The answers vary due to
    round off error
```

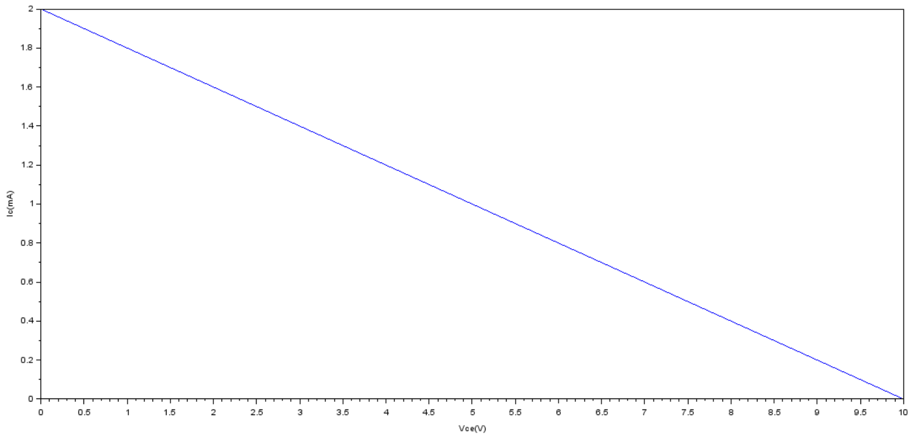


Figure 10.1: dc load line

Scilab code Exa 10.2 `dc load line`

```
clc;
Vcc=0.002; //Volt
Re=5000; //Ohm
Icsat=Vcc/Re; //Ampere
Vceoff=Vcc; //Volt
disp(' Amperes',Icsat,"Icsat=");
disp('Volt',Vceoff,"Vceoff=");
T1=0:2:10 //Here on X-axis T1=Vce=10V
T2=2:-0.4:0; //Here on the Y-Axis T2=Ic=2miliAmpere
plot(T1,T2)
xlabel('Vce(V)')
ylabel('Ic(mA)')
```

Scilab code Exa 10.3 `Voltage gain`

```
clc;
Re=2000; //Ohm
RL=5000; //Ohm
rE=(Re*RL)/(Re+RL); //Ohm
Ie=0.031; //Ampere
re=0.025/Ie; //Ohm
Av=rE/(rE+re);
disp(' ',Av,"Av=");//The answers vary due to round
    off error
```

Scilab code Exa 10.4 power gain

```
clc;
//power gain of circuit
Ai=2.7;
Av=0.994;
Ap=Ai*Av;
disp(' ',Ap,"Ap=");
```

Scilab code Exa 10.5 Input and base impedance

```
clc;
re=8.1; //Ohm
rE=1430; //ohm
hfc=220;
Zbase=hfc*(re+rE); //Ohm
R1=25000; //Ohm
R2=33000; //Ohm
Req=(R1*R2)/(R1+R2); //Ohm
Zin=(Zbase*Req)/(Zbase+Req);//Ohm
disp('kohm',Zin/1000,"Zin=");//The answers vary due
    to round off error
```

Scilab code Exa 10.6 output impedance

```
clc;
hic=4000;
hfc=200;
re=hic/hfc; //Ohm
R1=3000; //Ohm
R2=4700; //Ohm
Req=(R1*R2)/(R1+R2); //Ohm
Rs=600; //Ohm
Rth=(Req*Rs)/(Req+Rs);//Ohm
Re=390;//Ohm
R=(re+(Rth/hfc));//Ohm
Zout=(Re*R)/(Re+R);//Ohm
disp('Ohm',Zout,"Zout=");//The answers vary due to round off error
```

Scilab code Exa 10.7 Input impedance

```
clc;
hic=650; //Ohm
hfc=150;
re=hic/hfc; //Ohm
Re=2000; //Ohm
RL=8000; //Ohm
rE=(Re*RL)/(Re+RL); //Ohm
Zbase=hfc*(re+rE); //Ohm
R1=190000; //ohm
Zin1=(R1*Zbase)/(R1+Zbase);//Ohm//for emitter feedback
R1=30000; //Ohm
R2=39000; //Ohm
```

```
Req=(R1*R2)/(R1+R2); //Ohm
Zin2=(Zbase*Req)/(Zbase+Req);//Ohm //for voltage divider biased
disp('kOhm',Zin1/1000,"Zin1=");
disp('kOhm',Zin2/1000,"Zin2=");
```

Scilab code Exa 10.8 Input resistance

```
clc;
R2=120; //Ohm
R1=120; //Ohm
Vcc=10; //Volt
Vb=Vcc*(R2/(R1+R2));//Volt
Re=3300; //Ohm
Vbe=0.7; //Volt
Ie=(Vb-2*Vbe)/Re; //Amperes
hfc1=70;
hfc2=70;
RE=3300; //Ohm
Rin1=hfc1*hfc2*RE; //Ohm//hfe=70 for current (Icq)
disp('MegaOhm',Rin1/1000000,"Rin1=");//The answers vary due to round off error
```

Scilab code Exa 10.9 circuit gain and impedance

```
clc;
Re=3300; //Ohm
RL=1000; //Ohm
rE=(Re*RL)/(Re+RL); //Ohm
hic1=40000; //Ohm
hfc1=120;
hic2=3000; //Ohm
hfc2=150;
```

```
Zbase=hic1+hfc1*(hic2+(hfc2*rE));//Ohm
R1=120000;//Ohm
R2=120000; //Ohm
Req=(R1*R2)/(R1+R2);//Ohm
Zin=(Zbase*Req)/(Zbase+Req);//Ohm//input impedance
re1=hic1/hfc1;//Ohm
re2=hic2/hfc2;//Ohm
R1=120000;//Ohm
R2=120000;//Ohm
Req=(R1*R2)/(R1+R2);//Ohm
Rs=3300;//Ohm
Rth=(Req*Rs)/(Req+Rs);//Ohm
Zout=re2+(re1+(Rth/hfc1))/hfc2;//Ohm//output
    impedance
Ai=(hfc1*hfc2)*((Zin*rE)/(Zbase*RL));//current gain
disp('',Ai,"Ai=");Answer variation due to round of
    error
```

Scilab code Exa 10.10 gain and impedance

```
clc;
Vee=5; //Volt
Vbe=0.7; //Volt
Re=13000; //Ohm
Ie=0.000331 //Ampere
re=0.025/Ie; //Ohm
Zin=re; //Ohm
Rc=10000; //Ohm
Zout=Rc; //Ohm
RL=5100; //Ohm
rc=(RL*Rc)/(RL+Rc); //Ohm
Av=rc/re;
Ai=rc/RL;
disp('',Av,"Av=");
disp('',Ai,"Ai=");
```

```
disp('Ohm',Zin,"Zin=");//The answers vary due to
    round off error

disp('Ohm',Zout,"Zout=");//The answers vary due to
    round off error
```

Chapter 11

Power Amplifier

Scilab code Exa 11.1 `Output compliance`

```
clc;
Vceq=5.72; //Volt
PP1=2*Vceq; //Vpp(peak to peak voltage)
Icq=0.103; //Ampere
rc=25.7; //Ohm
PP2=2*Icq*rc; //Volt
disp('Vpp',PP1,"PP1="); //The answers vary due to
    round off error
disp('Vpp',PP2,"PP2="); //The answers vary due to
    round off error
```

Scilab code Exa 11.2 `total dc power`

```
clc;
Vcc=12; //Volt
R1=300; //Ohm
R2=100; //ohm
I1=Vcc/(R1+R2); //Ampere
```

```
Icq=0.103; //Ampere
Icc=Icq+I1; //Ampere
Ps=Vcc*Icc; //Watt
disp('W',Ps,"Ps=");//The answers vary due to round off error
```

Scilab code Exa 11.3 Ac load power

```
clc;
VL=10.6; //volt
RL=20; //Ohm
PL=VL^2/RL; //Watt
disp('W',PL,"PL=");//The answers vary due to round off error
```

Scilab code Exa 11.4 Ac load power

```
clc;
Vpk=20; //Volt
RL=75; //Ohm
PL=Vpk^2/(2*RL);//Watt
disp('W',PL,"PL=");//The answers vary due to round off error
```

Scilab code Exa 11.5 Ac load power

```
clc;
PP=36; //Vpp
RL=75; //Ohm
PLmax=PP^2/(8*RL); //Watt
```

```
disp('W',PLmax,"PLmax=");//The answers vary due to
    round off error
```

Scilab code Exa 11.6 Maximum efficiency

```
clc;
PP=5.29; //Vpp(Volt peak to peak))
RL=75; //Ohm
PL=PP^2/(8*RL);//Watt
Ps=1.6; //Watt
N=(PL/Ps)*100;
disp('%',N,"N=");//The answers vary due to round off
    error
```

Scilab code Exa 11.7 Maximum efficiency

```
Vcc=10; //Volt
R1=470; //Ohm
R2=110; //Ohm
I1=Vcc/(R1+R2); //Ampere
Icq=0.0976; //Ampere
Icc=Icq+I1; //Ampere
Ps=Vcc*Icc; //Watt
Vceq=8.63; //Volt
PP1=2*Vceq; //Volt
rc=80; //Ohm
PP2=2*Icq*rc; //Volt
Ns=1;
Np=4;
Vpp=(Ns/Np)*PP2; //Volt
RL=5;
PLmax=Vpp^2/(8*RL);//Watt//maximum load power
Ps=1.15 //Watt
```

```
H=(PLmax/Ps)*100;
disp('%',H,"H=");//The answers vary due to round off
    error
```

Scilab code Exa 11.8 End point values for its ac load line

```
clc;
Vcc=10; //volt
RL=10; //ohm
Icsat=Vcc/(2*RL); //Ampere
Vceoff=Vcc/2; //Volt
disp('mA',Icsat*1000,"Icsat=");//The answers vary
    due to round off error

disp('V',Vceoff,"Vceoff=");//The answers vary due to
    round off error
```

Scilab code Exa 11.9 Maximum load power

```
clc;
Vcc=12; //volt
PP=Vcc; //volt
RL=8; //ohm
PLmax=PP^2/(8*RL); //watt
disp('W',PLmax,"PLmax=");//The answers vary due to
    round off error
```

Scilab code Exa 11.10 Total power demand

```
clc;
```

```
Vcc=15; //Volt
R1=1000; //Ohm
R2=170; //Ohm
R3=1000; //Ohm
I1=Vcc/(R1+R2+R3); //Ampere
RL=10; //Ohm
Icave=Vcc/(2*3.14*RL);//Ampere
Icc=Icave+I1; //Ampere
Ps=Vcc*Icc; //Watt
disp('W',Ps,"Ps=");//The answers vary due to round
    off error
```

Scilab code Exa 11.11 `Maximum load power`

```
clc;
PP=15; //Vpp(peak to peak voltage Volt)
RL=10; //Ohm
PLmax=PP^2/(8*RL); //Watt
disp('W',PLmax,"PLmax=");//The answers vary due to
    round off error
```

Scilab code Exa 11.12 `Efficiency of Amplifier`

```
clc;
PL=2.81; //Watt
Ps=3.69; //Watt
N=(PL/Ps)*100;
disp('%',N,"N=");//The answers vary due to round off
    error
```

Scilab code Exa 11.13 Efficiency of Amplifier

```
clc;
Vppout=7.5; //Volt
RL=10; //Ohm
Iceq=0.119; //Ampere
Icave=Vppout/(2*3.14*RL); //Ampere
I1=0.00691; //Ampere
Icc=Icave+I1; //Ampere
Vcc=15; //Volt
Ps=Vcc*Icc; //Watt
PLmax=Vppout^2/(8*RL); //Watt
N=(PLmax/Ps)*100;
disp('%',N,"N=");//The answers vary due to round off
    error
```

Scilab code Exa 11.14 Pd value

```
clc;
Icq=0.001; //Ampere
Vceq=5.3; //Volt
Pd=Icq*Vceq; //Watt
disp('mW',Pd*1000,"Pd=");//The answers vary due to
   round off error
```

Scilab code Exa 11.15 Pd value

```
clc;
Vpp=12; //Volt
RL=8; //Ohm
Pd=Vpp^2/(40*RL); //Watt
disp('mW',Pd*1000,"Pd=");//The answers vary due to
   round off error
```

Chapter 12

Field Effect Transistor

Scilab code Exa 12.1 Drain current

```
clc;
Idss=0.003;
Vgs=-2;
Vgsoff=-6;
Id=Idss*(1-(Vgs/Vgsoff))^2;
disp('mA',Id*1000,"Id=");//The answers vary due to
   round off error
```

Scilab code Exa 12.2 Transconductance curve

```
clc;
Idss=0.003;
Vgs=[0 -1 -3 -5];
Vgsoff=-6;
Id=zeros(1,5);
Id(1,1)=Idss*(1-(Vgs(1,1)/Vgsoff))^2;
Id(1,2)=Idss*(1-(Vgs(1,2)/Vgsoff))^2;
```

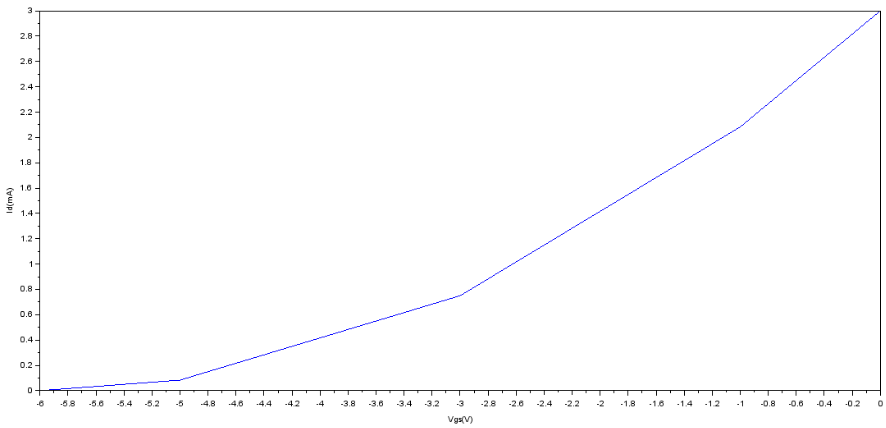


Figure 12.1: Transconductance curve

```
Id(1,3)=Idss*(1-(Vgs(1,3)/Vgsoff))^2;
Id(1,4)=Idss*(1-(Vgs(1,4)/Vgsoff))^2;
Vgs1=[0 -1 -3 -5 -6];
plot(Vgs1,Id*1000)
xlabel('Vgs(V)')
ylabel('Id(mA)')
```

Scilab code Exa 12.3 `Two transconduction plot`

```
clc;
Vgs1=[-6 -4 -2 0];
Id1=[0 0.556 2.222 5];
Vgs2=[-0.5 -0.4 -0.2 0];
Id2=[0 0.04 0.36 1];
plot(Vgs1,Id1)
xgrid
set(gca(),"auto_clear","off")
plot2d(Vgs2,Id2)
```

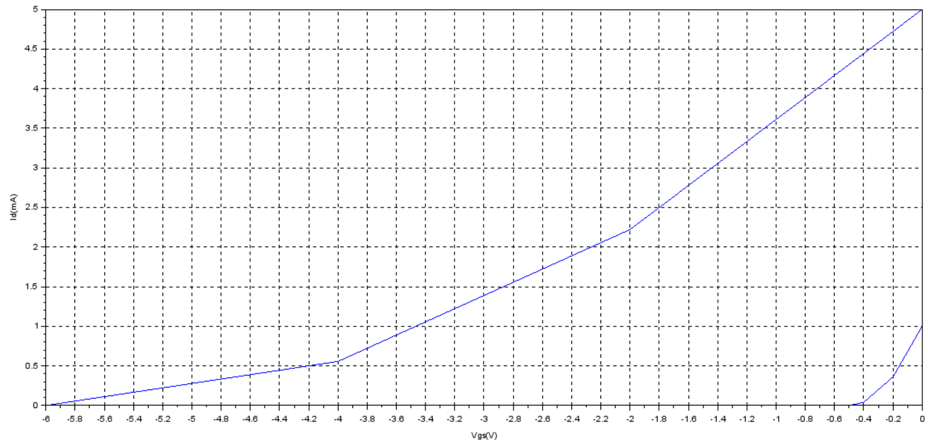


Figure 12.2: Two transconduction plot

```
xlabel('Vgs(V)')
ylabel('Id(mA)')
```

Scilab code Exa 12.4 Vgs Id and Vds determine

```
clc;
Vgs=-5;
Vgg=Vgs;
Idss=0.016;
Vgsoff=-8;
Id=Idss*(1-(Vgs/Vgsoff))^2;
Vdd=10;
Rd=2200;
VDS=Vdd-Id*Rd;
disp('V',Vgs,"Vgs=")
disp('mA',Id*1000,"Id=")
disp('V',VDS,"VDS=")
```

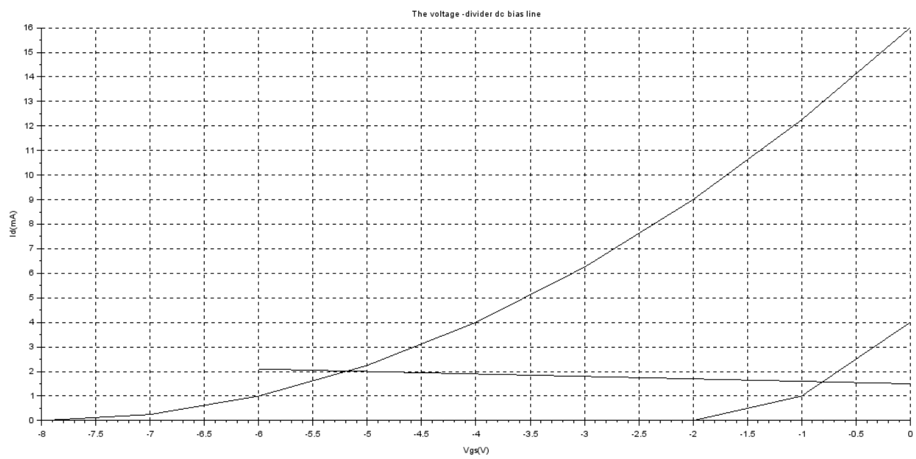


Figure 12.3: Plot dc bias line

Scilab code Exa 12.7 `Dc characteristics of the amplifier`

```
clc;
//from example 12.7 Idqmax and Idqmin
Idqmax=0.006;
Idqmin=0.0015;
Vdd=10;
Rs=500;
Rd=500;
Vdsqmax=Vdd-Idqmin*(Rs+Rd);
Vdsqmin=Vdd-Idqmax*(Rs+Rd);
disp('V',Vdsqmax,"Vsdqmax=")
disp('V',Vdsqmin,"Vsdqmin=")
disp('The value of Vdsq will fall between Vdsqmax
    and Vdsqmin')
```

Scilab code Exa 12.8 `Plot dc bias line`

```
clc;
R2=1500000;
R1=1500000;
Vdd=30;
Vg=Vdd*(R2/(R1+R2));
Rs=10000;
Id=Vg/Rs;
Vgsoff=-8;
Idss=0.016;
Vgs1=-8:1:0;
Id1=Idss*(1-(Vgs1/Vgsoff)).^2;
Vgsoff=-2;
Idss=0.004;
Vgs2=-2:1:0;
Id2=Idss*(1-(Vgs2/Vgsoff)).^2;
plot2d(Vgs1,Id1*1000)
xgrid
set(gca(),"auto_clear","off")
plot2d(Vgs2,Id2*1000)
set(gca(),"auto_clear","off")
Vgs3=-6:1:0;
Id3=((Vgs3.*-0.1)+1.5);
plot2d(Vgs3,Id3)
xlabel('Vgs(V)')
ylabel('Id(mA)')
xtitle('The voltage-divider dc bias line')
```

Scilab code Exa 12.9 Minimum And maximum Q point value

```
clc;
Idqmax=0.002;
Idqmin=0.0015;
Vgsmax=-5;
Vgsmin=-0.5;
Vdd=30;
```

```
R1=1500000;
R2=1500000;
Vg=Vdd*(R2/(R1+R2));
Vs=Vg-Vgsmax;
Rs=10000;
Idq1=Vs/Rs;
Idq2=(Vg-Vgsmin)/(Rs);
disp('mA',Idq1*1000,"Idq1=")
disp('mA',Idq2*1000,"Idq2=")
disp('Result Is verified', ," ")
```

Scilab code Exa 12.10 Minimum and maximum value of Vdsq

```
clc;
Vdd=30;
Rd=1100;
Rs=10000;
Idq=[0.0015 0.002];
Vdsqmax=Vdd-Idq(1,1)*(Rd+Rs);
Vdsqmin=Vdd-Idq(1,2)*(Rd+Rs);
disp('V',Vdsqmax,"Vsdqmax=")
disp('V',Vdsqmin,"Vsdqmin=")
```

Scilab code Exa 12.11 Value of Gm

```
clc;
Vgs1=-3;
Vgs2=-5;
Gm0=0.006;
Vgsoff=-8;
Gm1=Gm0*(1-(Vgs1/Vgsoff));
Gm2=Gm0*(1-(Vgs2/Vgsoff));
disp('uS',Gm1*1000000,"Gm1=")
```

```
disp('uS',Gm2*1000000,"Gm2=")
```

Scilab code Exa 12.12 Max and min value of voltage gain

```
Vgs1=-5;
Vgs2=-0.75;
Gm01=0.006;
Gm02=0.002;
Vgsoff1=-8;
Vgsoff2=-2;
Gm1=Gm01*(1-(Vgs1/Vgsoff1));
Gm2=Gm02*(1-(Vgs2/Vgsoff2));
RD=8200;
RL=100000;
rD=(RD*RL)/(RD+RL);
Avmax=rD*Gm1;
Avmin=rD*Gm2;
disp(' ',Avmax,"Avmax=")//The answers vary due to
   round off error
disp(' ',Avmin,"Avmin=")//The answers vary due to
   round off error
```

Scilab code Exa 12.13 Max and min gain voltage gain

```
clc;
rD=7580;
rS=2200;
Gm1=1/444;
Gm2=1/1000;
Avmax=rD/(rS+(1/Gm1));
Avmin=rD/(rS+(1/Gm2));
disp(' ',Avmax,"Avmax=")//The answers vary due to
   round off error
```

```
disp(' ',Avmin,"Avmin=")//The answers vary due to
   round off error
```

Scilab code Exa 12.14 Input Impedance

```
clc;
Hfe=200;
re=22.7;
R1=10000;
R2=2200;
Req=(R1*R2)/(R1+R2);
X1=Hfe*re;
ZinBJT=(Req*X1)/(Req+X1);
ZinJFET=(R1*R2)/(R1+R2);
disp('kOhm',ZinBJT/1000,"ZinBJT=")//The answers vary
    due to round off error
disp('kOhm',ZinJFET/1000,"ZinJFET=")//The answers
   vary due to round off error
```

Scilab code Exa 12.15 Voltage gain

```
RD=8200;
Zin=1290;
rD1=(RD*Zin)/(RD+Zin);
Gm=0.002;
AvBJT=Gm*rD1;
Zin=1800;
rD2=(RD*Zin)/(RD+Zin);
AvJFET=Gm*rD2;
disp(' ',AvBJT,"AvBJT=")//The answers vary due to
   round off error
disp(' ',AvJFET,"AvJFET=")//The answers vary due to
   round off error
```

Scilab code Exa 12.16 `Minimum and maximum value of Voltage gain Output voltage`

```
clc;
Vgs1=-0.5
Vgs2=-5;
Gm01=0.002;
Gm02=0.006;
Vgsoff1=-2;
Vgsoff2=-8;
Gm1=Gm01*(1-(Vgs1/Vgsoff1));
Gm2=Gm02*(1-(Vgs2/Vgsoff2));
Rs=5100;
RL=20000;
rS=(Rs*RL)/(Rs+RL);
Avmin=rS/(rS+(1/Gm1));
Avmax=rS/(rS+(1/Gm2));
disp(' ',Avmax,"Avmax=")//The answers vary due to round off error
disp(' ',Avmin,"Avmin=")//The answers vary due to round off error
Gm11=1/667;
Gm22=1/444;
Zoutmax=(Rs/Gm11)/(Rs+(1/Gm11));
Zoutmin=(Rs/Gm22)/(Rs+(1/Gm22));
disp('Ohm',Zoutmax,"Zoutmax=")//The answers vary due to round off error
disp('Ohm',Zoutmin,"Zoutmin=")//The answers vary due to round off error
R1=1000000;
R2=1000000;
Zin=(R1*R2)/(R1+R2);
disp('KOhm',Zin/1000,"Zin=")//The answers vary due to round off error
```

Scilab code Exa 12.17 `Min and Approximated value of Zout`

```
clc;
yos=0.00005;
rd=1/yos; //minimum value
Rd=1000;
Zout=(Rd*rd)/(Rd+rd);
disp('Ohm',Zout,"Zout=")//The answers vary due to
   round off error
```

Chapter 13

MOSFETs

Scilab code Exa 13.1 Transconductance curve

```
clc;
Vgs=-6:1:4;
Vgsoff=-6;
Idss=0.001;
Id=Idss*(1-(Vgs/Vgsoff)).^2;
plot(Vgs,Id*1000,'r')
xgrid
xlabel('Vgs(V)')
ylabel('Id(mA)')
```

Scilab code Exa 13.2 Drain current

```
Idon=0.01;
Vgson=10;
Vgsth=1.5;
k=Idon/(Vgson-Vgsth)^2;
Vdd=10;
```

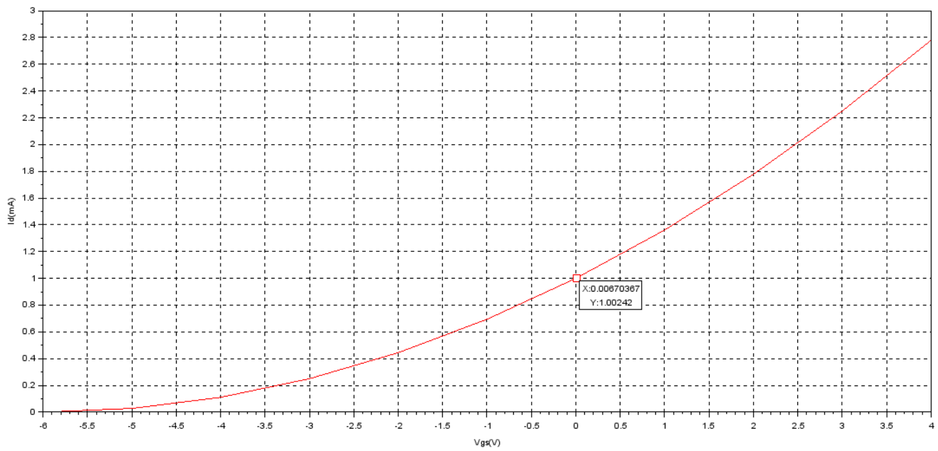


Figure 13.1: Transconductance curve

```
R2=1000000;
R1=1000000;
Vg=Vdd*(R2/(R1+R2));
Id=k*((Vg-Vgsth)^2);
disp('mA',Id*1000,"Id=")//The answers vary due to
    round off error
```

Scilab code Exa 13.3 `Id and Vds`

```
clc;
Vdd=20;
Id=0.01;
Rd=1000;
Vgs=Vdd-Id*Rd;
disp('V',Vgs,"Vgs=")//The answers vary due to round
    off error
```

Chapter 14

Amplifier Frequency Responce

Scilab code Exa 14.1 Bandwidth of the circuit

```
clc;
Fc1=30;
Fc2=275;
BW=Fc2-Fc1;
disp('kHz',BW,"BW=")//The answers vary due to round
    off error
```

Scilab code Exa 14.2 Geometric center frequency

```
clc;
fc1=30;
fc2=275;
f0=(fc1*fc2)^0.5; //geometric centre frequency
disp('kHz',f0,"f0=")//The answers vary due to round
    off error
```

Scilab code Exa 14.3 `ratio of f0 and fc1 fc2 and f0`

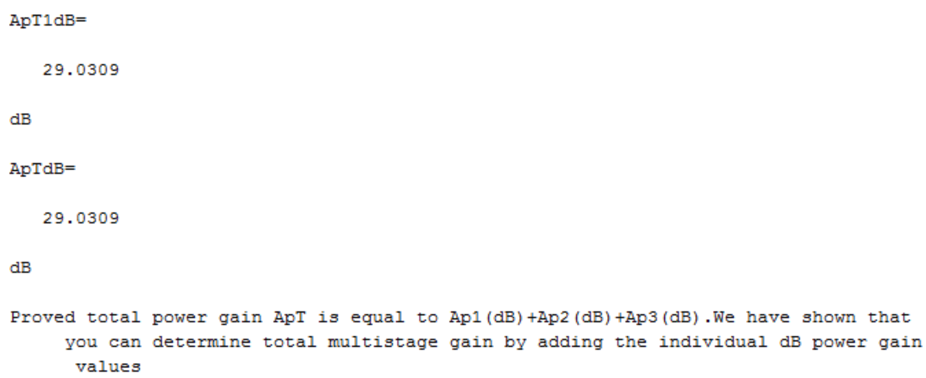
```
clc;
fc1=30;
fc2=275;
f0=90.8;
ratio1=f0/fc1;
ratio2=fc2/f0;
disp('Ratio of f0/fc1',ratio1,"ratio1=")//The answers vary due to round off error
disp('Ratio fof fc2/f0',ratio1,"ratio1=")//The answers vary due to round off error
```

Scilab code Exa 14.4 `Fc1 and bandwidth`

```
clc;
f0=60;
fc2=300;
fc1=(60)^2/(300);
BW=fc2-fc1;
disp('kHz',BW,"BW=")//The answers vary due to round off error
disp('kHz',fc1,"fc1=")//The answers vary due to round off error
```

Scilab code Exa 14.5 `fc2 and bandwidth`

```
clc;
f0=40;
fc1=8;
fc2=(f0)^2/(fc1);
BW=fc2-fc1;
```



```
ApT1dB=

   29.0309

dB

ApTdB=

   29.0309

dB

Proved total power gain ApT is equal to Ap1(dB)+Ap2(dB)+Ap3(dB).We have shown that
     you can determine total multistage gain by adding the individual dB power gain
      values
```

Figure 14.1: Value of fb1

```
disp('kHz',BW,"BW=")//The answers vary due to round
    off error
disp('kHz',fc2,"fc2=")//The answers vary due to
   round off error
```

Scilab code Exa 14.6 dB power gain of the amplifier

```
clc;
Pout=2;
Pin=0.0001;
ApdB=10*log10(Pout/Pin);
disp('dB',ApdB,"ApdB=")//The answers vary due to
   round off error
```

Scilab code Exa 14.7 Value of fb1

```
clc;
```

```
Ap1=100; //power gain at stage 1
Ap2=4;   //power gain at stage 2
Ap3=2;   //power gain at stage3
ApT=Ap1*Ap2*Ap3; //total power gain of a multistage
   amplifier
ApTdB=10*log10(ApT); //total power in dB
Ap1dB=10*log10(Ap1); //power gain at stage 1 in dB
Ap2dB=10*log10(Ap2); //power gain at stage 2 in dB
Ap3dB=10*log10(Ap3); //power gain at stage 3 in dB
ApT1dB=Ap1dB+Ap2dB+Ap3dB; ////total power in dB
disp('dB',ApT1dB,"ApT1dB=")//The answers vary due to
    round off error

disp('dB',ApTdB,"ApTdB=")//The answers vary due to
   round off error

if ApT1dB==ApTdB then
    disp('Proved total power gain ApT is equal to
       Ap1(dB)+Ap2(dB)+Ap3(dB).We have shown that
       you can determine total multistage gain by
       adding the individual dB power gain values')
end
```

Scilab code Exa 14.8 F1b

```
clc;
R1=18000;
R2=4700;
Hie=4400;
Req=(R1*R2)/(R1+R2);
Rin=(Req*Hie)/(Req+Hie);
Rs=600;
C=0.000001;
fB1=1/(2*3.14*(Rs+Rin)*C);
disp('Hz',fB1,"fB1=")//The answers vary due to round
```

```
    off error
```

Scilab code Exa 14.9 Value of Fc1

```
clc;
Rc=1500;
RL=5000;
C=0.00000022;
f1C=1/(2*3.14*(Rc+RL)*C);
disp('Hz',f1C,"f1C=")//The answers vary due to round
    off error
```

Scilab code Exa 14.10 f1E

```
clc;
R1=18000;
R2=4700;
Hie=600;
Req=(R1*R2)/(R1+R2);
Rth=(Req*Hie)/(Req+Hie);
hfc=201;
re=22;
Rout=re+(Rth/hfc);
Ce=0.00001;
f1E=1/(2*3.14*Rout*Ce);
disp('Hz',f1E,"f1E=")//The answers vary due to round
    off error
```

Scilab code Exa 14.11 Gain of the amplifier

```
clc;
Avmid=45;
fC1=2000;
f=500;
deltaAv=20*log10(1/(1+(fC1/f)^2)^0.5);
AvdB=Avmid+deltaAv;
disp('dB',AvdB,"AvdB=")//The answers vary due to round off error
```

Scilab code Exa 14.12 `Value of Cbe`

```
clc;
fT=300000000;
re=2.9;
//value of cbe
Cbe=1/(2*3.14*fT*re);
disp('Farad',Cbe,"Cbe=")//The answers vary due to round off error
```

Scilab code Exa 14.13 `Miler input and output capacitance`

```
clc;
Av=120;
Cbc=0.000000000006;
CinM=Av*Cbc;
CoutM=Cbc;
disp('Farad',CinM,"CinM=")//The answers vary due to round off error
disp('pFarad',CoutM*1000000000000,"CoutM=")//The answers vary due to round off error
```

Scilab code Exa 14.14 `Value of f2B`

```
clc;
hfe=150;
rC=4000;
hie=3000;
Cbe=0.000000000012
Cbc=0.000000000006;
Av=(hfe*rC)/hie;
CinM=Av*Cbc;
Rs=500;
Req=1000;
Rth=(Req*Rs)/(Req+Rs);
RX=(Rth*hie)/(Rth+hie);
f2B=1/(2*3.14*RX*(Cbe+CinM));
disp('kHz',f2B/1000,"f2B=")//The answers vary due to
    round off error
disp('The answers vary due to round off error', ," "
  )
```

Scilab code Exa 14.15 `Value of f2C`

```
clc;
CoutM=0.000000000006;
CL=0.000000000720;
rC=4000;
f2C=1/(2*3.14*rC*(CoutM+CL));
disp('kHz',f2C/1000,"f2C=")//The answers vary due to
    round off error
```

Scilab code Exa 14.16 `Lower input circuit cutoff frequency`

```
clc;
```

```
//high input impedance of JFET
R1=18000;
R2=4700;
Rin=(R1*R2)/(R1+R2);
Rs=600;
Cc1=0.000001;
f1G=1/(2*3.14*(Rs+Rin)*Cc1);
disp('Hz',f1G,"f1G=")//The answers vary due to round off error
```

Scilab code Exa 14.17 Value f1G

```
clc;
//high input impedance of JFET
R1=18000000;
R2=4700000;
Rin=(R1*R2)/(R1+R2);
Rs=600;
Cc1=0.000001;
f1G=1/(2*3.14*(Rs+Rin)*Cc1);
disp('Hz',f1G,"f1G=")//The answers vary due to round off error
```

Scilab code Exa 14.18 Overall value of fc1

```
clc;
//high input impedance of JFET
R1=1500000;
R2=650000;
Rin=(R1*R2)/(R1+R2);
Rs=1000;
Cc1=0.00000001;
f1G=1/(2*3.14*(Rs+Rin)*Cc1);
```

```
Rd=5000;
RL=10000;
Cc2=0.0000001;
f1D=1/(2*3.14*(Rd+RL)*Cc2);
disp('Hz',f1G,"f1G=")//The answers vary due to round off error
disp('Hz',f1D,"f1D=")//The answers vary due to round off error
```

Scilab code Exa 14.19 Input miller capacitance

```
clc;
Cgd=0.000000000004;
Gm=0.0025;
rD=5600;
CinM=Cgd*(Gm*rD+1);
disp('Farad',CinM,"CinM=")//The answers vary due to round off error
```

Scilab code Exa 14.20 f2G and f2D

```
clc;
Rin=454000;
Rs=1000;
Rth=(Rin*Rs)/(Rin+Rs);
Cgd=0.000000000004;
Gm=0.004;
rD=3325;
CinM=Cgd*(Gm*rD+1);
Cgs=0.000000000005;
Cg=Cgs+CinM;
Cg=0.000000000622;
f2G=1/(2*3.14*Rth*Cg);
```

```
CoutM=0.000000000004;
Cds=0.000000000002;
CL=0.000000000001;
Cd=CoutM+Cds+CL;
f2D=1/(2*3.14*rD*Cd);
disp('MHz',f2G/1000000,"f2G=")//The answers vary due
    to round off error
disp('MHz',f2D/1000000,"f2D=")//The answers vary due
    to round off error
```

Scilab code Exa 14.21 Cds Cgd and Cgs

```
clc;
Crss=0.000000000001;
Cgd=Crss;
Ciss=0.000000000005;
Cgs=Ciss-Crss;
Coss=0.000000000002;
Cds=Coss-Crss;
disp('Farad',Cgd,"Cgd=");
disp('Farad',Cds,"Cds=");
disp('Farad',Cgs,"Cgs=");
```

Scilab code Exa 14.22 fc2 for the two stage amplifier

```
clc;
fC2=500000;
fC2T=fC2*(2^0.5-1)^0.5;
disp('kHz',fC2T/1000,"fC2T=");
```

Scilab code Exa 14.23 `fc1 for the two stage amplifier`

```
clc;
fC1=5000;
fC1T=fC1/(2^0.5-1)^0.5;
disp('kHz',fC1T/1000,"fC1T=");
```

Chapter 15

Operational Amplifiers

Scilab code Exa 15.1 Output voltage polarity

```
clc;
V1=2;
V2=[4 0];
Vdiff1=V2(1,1)-V1;
Vdiff2=V2(1,2)-V2;
disp('V',Vdiff1,"Vdiff1=");
disp('V',Vdiff2,"Vdiff2=");
```

Scilab code Exa 15.2 Peak to peak output voltage

```
clc;
Av=150;
Vin=0.100;
Vout=Av*Vin;
V1=10;
V2=-10;
Vpk1=V1-1;
Vpk2=V2+1;
```

```
disp('V+',Vpk1,"Vpk1=");
disp('V-',Vpk2,"Vpk1=");
```

Scilab code Exa 15.3 `Maximum Allowable value of vin`

```
clc;
Av=200;
Vout=8;
Vin=Vout/Av;
V1=6;
V2=-6;
Vpk1=V1-2;
Vpk2=V2+2;
disp('V+',Vpk1,"Vpk1=");
disp('V-',Vpk2,"Vpk1=");
disp('mVpp',Vin*1000,"Vin=");
```

Scilab code Exa 15.4 `Maximum input and output voltage`

```
clc;
Av=121;
Vout=4;
Vin=Vout/Av;
V1=4;
V2=-4;
Vpk1=V1-2;
Vpk2=V2+2;
disp('V+',Vpk1,"Vpk1=");
disp('V-',Vpk2,"Vpk1=");
disp('mVpp',Vin*1000,"Vin=");
```

Scilab code Exa 15.5 `Maximum operating frequency`

```
clc;
slewrate=500000;
Vpk=8;
fmax=slewrate/(2*3.14*Vpk);
disp('kHz',fmax/1000,"fmax=");
```

Scilab code Exa 15.6 `Maximumn operating frequency`

```
clc;
slewrate=500000;
Vpk=0.001;
fmax=slewrate/(2*3.14*Vpk);
disp('Hz',fmax,"fmax=");
//The provided in the textbook is wrong
```

Scilab code Exa 15.7 `Complete analysis`

```
clc;
Rf=100000;
Rin=10000;
AcL=Rf/Rin;
Zin=Rin;
Acm=0.001;
CMRR=AcL/Acm;
Vin=1;
Vout=AcL*Vin;
slewrate=500000;
Vpk=5;
fmax=slewrate/(2*3.14*Vpk);
disp(' ',AcL,"AcL=");//The answers vary due to round
    off error
```

```
disp('  ',CMRR,"CMRR=");//The answers vary due to
   round off error

disp('Vpp',Vout,"Vout=");//The answers vary due to
   round off error

disp('kHz',fmax/1000,"fmax=");//The answers vary due
    to round off error
```

Scilab code Exa 15.8 Analysis of non inverting amplifier

```
clc;
Rf=100000;
Rin=10000;
AcL=(Rf/Rin)+1;
Acm=0.001;
CMRR=AcL/Acm;
Vin=1;
Vout=AcL*Vin;
slewrate=500000;
Vpk=5.5;
fmax=slewrate/(2*3.14*Vpk);
disp('  ',AcL,"AcL=");//The answers vary due to round
    off error

disp('  ',CMRR,"CMRR=");//The answers vary due to
   round off error

disp('Vpp',Vout,"Vout=");//The answers vary due to
   round off error

disp('kHz',fmax/1000,"fmax=");//The answers vary due
    to round off error
```

Scilab code Exa 15.9 Analysis of voltage follower

```
clc;
AcL=1;
Acm=0.001;
CMRR=AcL/Acm;
slewrate=500000;
Vpk=3;
fmax=slewrate/(2*3.14*Vpk);
disp('  ',AcL,"AcL=");//The answers vary due to round
    off error
disp('  ',CMRR,"CMRR=");//The answers vary due to
   round off error
disp('kHz',fmax/1000,"fmax=");//The answers vary due
    to round off error
```

Scilab code Exa 15.10 Bandwidth and AcL

```
clc;
funity=15000000;
Acl=500;
fc=funity/Acl;
BW=fc;
fc1=200000;
AcL=funity/fc1;
disp('kHz',fc/1000,"fc=");//The answers vary due to
   round off error
disp('',AcL,"AcL=");//The answers vary due to round
   off error
```

Scilab code Exa 15.12 Value of AcL

```
clc;
AoL=150000;
av=0.005;
AcL=AoL/(1+(av*AoL));
disp('',AcL,"AcL=");//The answers vary due to round
    off error
```

Scilab code Exa 15.13 Value of feedback

```
clc;
Rf=120000;
Rin=1500;
AcL=(Rf/Rin)+1;
av=1/AcL;
AoL=150000;
A=1+av*AoL;
disp('Feedback factor',A,"A=");//The answers vary
    due to round off error
```

Scilab code Exa 15.14 Amplifier input impedance

```
clc;
AcL=151;
av=1/AcL;
AoL=180000;
A=1+av*AoL;
Zin=5000000;
Zinf=Zin*A;
disp('ohm',Zinf,"Zinf=");//The answers vary due to
    round off error
```

Scilab code Exa 15.15 `Amplifier Output`

```
clc;
Zout=80;
avAoL=1180;
Zoutf=Zout/(1+avAoL);
disp('mohm',Zoutf*1000 ,"Zoutf=");//The answers vary
    due to round off error
```

Chapter 16

Additional Op Amp Applications

Scilab code Exa 16.1 `Output voltage`

```
clc;
Vin=4.999;
Vref=5;
Vdiff1=Vin-Vref;
AoL=150000;
Vout1=AoL*Vdiff1;
V=10;
VoutL1=-V+1;
//asume RL>10000 ohm
Vin=5.001;
Vref=5;
Vdiff2=Vin-Vref;
Vout2=AoL*Vdiff2;
VoutL2=9;
//again asume RL.1000
disp('Noninverting input at +4.999', ," ");
disp('mV',Vdiff1*1000,"Vdif1=");
disp('V',Vout1,"Vout1=");
disp('V',VoutL1,"VoutL1=");
```

```
disp('Noninverting input at +5.001', ," ");
disp('V',Vout2,"Vout2=");
disp('V',VoutL2,"VoutL2=");
disp('mV',Vdiff2*1000,"Vdif1=");
```

Scilab code Exa 16.2 Refrence voltage for comparator

```
clc;
V=5;
R2=30000;
R1=120000;
Vref=V*(R2/(R1+R2));
disp('V',Vref,"Vref=");
```

Scilab code Exa 16.4 Output voltage of summing amplifier

```
clc;
v1=3;
v2=6;
v3=4;
rf=10000;
r1=10000;
r2=10000;
r3=10000;
Vout=-rf*((v1/r1)+(v2/r2)+(v3/r3));
disp('V',Vout,"Vout=");
```

Scilab code Exa 16.5 output voltage

```
clc;
```

```
v1=10;
v2=8;
v3=7;
rf=1000;
r1=10000;
r2=10000;
r3=10000;
Vout=-rf*((v1/r1)+(v2/r2)+(v3/r3));
disp('V',Vout,"Vout=");
```

Scilab code Exa 16.6 Output voltage

```
clc;
rf=1000;
r1=1000;
r2=2000;
r3=4000;
v1=[10 0 10];
v2=[0 10 10];
v3=[10 0 10];
for i=1:3
Vout(1,i)=(rf/r1)*v1(1,i)+(rf/r2)*v2(1,i)+(rf/r3)*v3
   (1,i);
end
disp('V',Vout(1,1),"Vout(1,1)=");
disp('V',Vout(1,2),"Vout(1,2)=");
disp('V',Vout(1,3),"Vout(1,3)=");
```

Chapter 17

Tuned Amplifiers

Scilab code Exa 17.1 `Q of a tuned amplifier`

```
clc;
f0=1000000;
BW=40000;
Q=f0/BW;
disp('V',Q,"Q=");
```

Scilab code Exa 17.2 `Bandwidth`

```
clc;
f0=1000000;
BW=40000;
Q=f0/BW;
disp('V',Q,"Q=");
```

Scilab code Exa 17.3 `f0 fave and Q determine`

```
fc1=960000;
fc2=1440000;
BW=480000;
f0=ceil((fc1*fc2)^0.5);
fave=(fc1+fc2)/2;
Q=f0/BW;
disp('kHz',f0/1000,"f0=");
disp('kHz',fave/1000,"fave=");
disp('  ',Q,"Q=");//The answers vary due to round off error in f0
```

Scilab code Exa 17.4 Bandwidth of low pass filter

```
clc;
r1=33000;
c1=0.0000001;
fc=1/(2*3.14*r1*c1);
rf1=4700;
rf2=9100;
AcL=(rf1/rf2)+1;
disp('Hz',fc,"fc=");
disp('',AcL,"AcL");//The answers vary due to round off error in f0
```

Scilab code Exa 17.5 Bandwidth of filter

```
clc;
r1=10000;
r2=10000;
c1=0.000000015;
c2=0.000000033;
fc=floor(1/(2*3.14*(r1*r2*c1*c2)^0.5));
disp('Hz',fc,"fc=");
```

Scilab code Exa 17.6 `Complete frequency analysis`

```
clc;
r1=10000;
r2=10000;
c1=0.00000001;
c2=0.00000002;
fc2=ceil(1/(2*3.14*(r1*r2*c1*c2)^0.5));
r3=15000;
r4=30000;
c3=0.00000001;
c4=0.00000001;
fc1=1/(2*3.14*(r3*r4*c3*c4)^0.5);
BW=(fc2-fc1);
f0=(fc2*fc1)^0.5;
Q=(f0/BW);
disp('Hz',fc2,"fc2=");//The answers vary due to round off error
disp('Hz',fc1,"fc1=");//The answers vary due to round off error
disp('Hz',BW,"BW=");//The answers vary due to round off error
disp(' ',Q,"Q=");//The answers vary due to round off error
```

Scilab code Exa 17.7 `f0 value`

```
clc;
r1=10000;
r2=10000;
rf=40000;
```

```
req=(r1*r2)/(r1+r2);
c1=0.0000001;
c2=0.000000068;
f0=ceil(1/(2*3.14*((req*c1*c2*rf)^0.5)));
disp('Hz',f0,"f0=");
```

Scilab code Exa 17.8 Q and bandwidth

```
clc;
c1=0.0000001;
c2=0.000000068;
c=(c1*c2)^0.5;
rf=40000;
f0=137;
Q=(3.14*f0*rf*c);
BW=f0/Q;
disp(' ',Q,"Q=");
disp('Hz',BW,"BW=");
```

Scilab code Exa 17.9 Percentage of error

```
clc;
f0=12000;
BW=6000;
Q=2;
fc1=f0-BW/2;
fc2=f0+BW/2;
fc11=ceil(f0*((1+(1/((2*Q)^2)))^0.5)-BW/2);
fc22=f0*(1+(1/(2*Q)^2))^0.5+BW/2;
Fc1=((fc11-fc1)/fc11)*100;
Fc2=((fc22-fc2)/fc22)*100;
disp('%',Fc1,"Fc1=");//The answers vary due to round
    off error
```

```
disp('%',Fc2,"Fc2=");//The answers vary due to round
    off error
```

Scilab code Exa 17.10 Percentage of error and approximated values

```
clc;
f0=100;
Q=1.02;
BW=floor(f0/Q);
fc1=ceil(f0-BW/2);
fc2=floor(f0+BW/2);
fc11=floor(f0*((1+(1/((2*Q)^2)))^0.5)-BW/2);
fc22=floor((f0*(1+(1/((2*Q)^2)))^0.5)+BW/2);
Fc1=((fc11-fc1)/fc11)*100;
Fc2=((fc22-fc2)/fc22)*100;
disp('%',Fc1,"Fc1=");//The answers vary due to round
    off error
disp('%',Fc2,"Fc2=");//The answers vary due to round
    off error
```

Scilab code Exa 17.11 close loop voltage gain

```
clc;
rf=40000;
r2=10000;
AcL=rf/(2*r2);
disp('%',AcL,"AcL=");//The answers vary due to round
    off error
```

Scilab code Exa 17.12 f0 for tuned amplifier

```
clc;
L=0.001;
C=0.0000000001;
f0=1/(2*3.14*(L*C)^0.5);
disp('Hz',floor(f0/1000),"f0=");//The answers vary
   due to round off error
```

Scilab code Exa 17.13 `Q for the tank`

```
clc;
XL=3160;
Rw=25;
Q=XL/Rw;
disp(' ',Q,"Q=");//The answers vary due to round off
    error
```

Scilab code Exa 17.14 `loaded Q`

```
clc;
Q=126;
Rw=25;
Rp=(Q^2)*Rw;
XL=3160;
rc=20000;
QL=rc/XL;
disp(' ',ceil(Rp/1000),"Rp=");//The answers vary due
    to round off error
disp(' ',QL,"QL=");//The answers vary due to round
   off error
```

Scilab code Exa 17.15 `Bandwidth of the amplifier`

```
clc;
f0=503000;
QL=6.33;
BW=f0/QL;
disp('khz',BW,"BW=");//The answers vary due to round
    off error
```

Chapter 18

Oscillators

Scilab code Exa 18.1 `av value`

```
clc;
c1=0.0000000033;
c2=0.0000001;
L=0.000047;
cT=(c1*c2)/(c1+c2);
fr=1/(2*3.14*(L*cT)^0.5);
Xc1=117; //for fr value
Xc2=3.87;
av1=Xc2/Xc1;
av2=c1/c2;
disp('using equation 18.3',av1,"av1=");//The answers
    vary due to round off error
disp('using equation 18.4',av2,"av2=");//The answers
    vary due to round off error
```

Chapter 19

Solid State Switching Circuits

Scilab code Exa 19.1 Minimum high input voltage

```
clc;
vcc=12;
Rc=1200;
Icsat=vcc/Rc;
hfe=100;
Ib=Icsat/hfe;
Rb=47000;
vbe=0.7;
Vpk=(Ib*Rb)+vbe;
disp('V',Vpk,"Vpk=");//The answers vary due to round
    off error
```

Scilab code Exa 19.2 high and low output voltage

```
clc;
Vdd1=5;
Idss=0.005;
Rd1=1000;
```

```
Vout1=Vdd1-(Idss*Rd1);
Vdd=5;
Id=0;
Rd=1000;
Vout2=Vdd-(Id*Rd);
disp('V',Vout1,"Vout1=");//The answers vary due to
    round off error
disp('V',Vout2,"Vout2=");//The answers vary due to
    round off error
```

Scilab code Exa 19.3 `Output voltage`

```
clc;
Vdd=10;
Idss1=0.002;
Rd1=1000;
Rd2=100;
Vout1=Vdd-(Idss1*Rd1);
Vout2=Vdd-(Idss1*Rd2);
disp('V',Vout1,"Vout1=");//The answers vary due to
    round off error
disp('V',Vout2,"Vout2=");//The answers vary due to
    round off error
```

Scilab code Exa 19.4 `PW And T`

```
clc;
PW=2.5*0.000050;
T=6.5*0.000050;
disp('uS',PW*1000000,"PW=");//The provided in the
    textbook is wrong
disp('uS',T*1000000,"T=");//The provided in the
    textbook is wrong
```

Scilab code Exa 19.5 duty cycle

```
clc;
PW=0.000125;
T=0.000325;
dutycycle=(PW/T)*100;
disp('%',dutycycle,"dutycycle=");//The provided in
    the textbook is wrong
```

Scilab code Exa 19.6 fc and practical limit on frequency

```
clc;
tr=0.000000040;
fc=0.35/tr;
tf=0.000000030;
fmax=0.35/(100*tr);
disp('MHz',fc/1000000,"fc=");//The provided in the
    textbook is wrong
disp('kHz',fmax/1000,"fmax=");//The provided in the
    textbook is wrong
```

Scilab code Exa 19.7 UTP and LTP for the circuit

```
clc;
Rin=20000;
rf=100000;
Vout1=-12;
Vout2=12;
Vin=2.4;
```

```
UTP=-(Rin/rf)*Vout1;
LTP=-(Rin/rf)*Vout2;
Vrin=(Vin-Vout1)*(Rin/(Rin+rf));
disp('V',UTP,"UTP=");//The answers vary due to round
    off error
disp('V',LTP,"LTP=");//The answers vary due to round
    off error
disp('V',Vrin,"Vrin=");//The answers vary due to
   round off error
```

Scilab code Exa 19.8 UTP and LTP for non inverting schmit

```
clc;
Rin=3300;
rf1=11000;
rf2=33000;
Vout1=-11;
Vout2=11;
UTP=-(Rin/rf1)*(Vout1+0.7);
LTP=-(Rin/rf2)*(Vout2-0.7);
disp('V',UTP,"UTP=");//The answers vary due to round
    off error
disp('V',LTP,"LTP=");//The answers vary due to round
    off error
```

Scilab code Exa 19.9 UTP and LTP

```
clc;
rf2=1000;
rf1=2000;
req=(rf2/(rf1+rf2));
UTP=req*9;
LTP=req*-9;
```

```
disp('V',UTP,"UTP=");//The answers vary due to round
    off error
disp('V',LTP,"LTP=");//The answers vary due to round
    off error
```

Scilab code Exa 19.10 pulse width

```
clc;
r=1200;
c=0.0000001;
PW=1.1*r*c;
disp('ms',PW*1000000,"PW=");//The answers vary due
  to round off error
```

Scilab code Exa 19.11 values of VT

```
clc;
Vcon=6;
Vcc=12;
VT1=(1/2)*Vcon;
VT2=(1/3)*Vcc;
disp('V',VT1,"VT1=");//The answers vary due to round
    off error
disp('V',VT2,"VT2=");//The answers vary due to round
    off error
```

Scilab code Exa 19.12 value f0 and duty cycle

```
clc;
ra=3000;
```

```
rb=2700;
c1=0.000000033;
f0=(1.44/((ra+2*rb)*c1));
dutycycle=((ra+rb)/(ra+2*rb))*100;
PW=0.693*((ra+rb)*c1);
disp('kHz',f0/1000,"f0=");//The answers vary due to round off error
disp('%',dutycycle,"dutycycle=");//The answers vary due to round off error
disp('mS',floor(PW*1000000),"PW=");//The answers vary due to round off error
```

Chapter 20

Thyristors and Optoelectronics Devices

Scilab code Exa 20.1 Current surge

```
clc;
t=0.018;
I=50;
D=(I^2)*t;
if (D <= 145) then
    disp('device can handle this surge');
end
```

Scilab code Exa 20.2 duration of surge

```

clc;
D=60;  //I^2*t(rated) value
Is=100;
tmax=(D)/(Is)^2;
disp('ms',tmax*1000,"tmax=");//The answers vary due
   to round off error
```

Scilab code Exa 20.3 highhest surge current

```
clc;
D=60; //I^2*t(rated) value
ts=0.020;
Ismax=(D/ts)^0.5;
disp('A',Ismax,"Ismax=");//The answers vary due to
   round off error
```

Scilab code Exa 20.4 noise amplitude for false triggering

```
clc;
R2=2400;
R1=240;
Vdc=(1.25)*((R2/R1)+1);
disp('V',Vdc,"Vdc=");//The answers vary due to round
    off error
```

Scilab code Exa 20.5 Maximum peak voltage

```
clc;
n=0.8;
Vbb=18;
Vp=(n*Vbb+0.7);
disp('V',Vp,"Vp=");//The answers vary due to round
   off error
```

Scilab code Exa 20.6 `wavelength`

```
clc;
c=3*10^(17);
f=150*10^(12);
lemda=c/f;
disp('nm',lemda,"lemda=");
```

Chapter 21

Discrete and Integrated voltage Regulators

Scilab code Exa 21.1 `line regulation`

```
clc;
Vout=0.000010;
Vin=5;
linein=Vout/Vin;
disp('uV/V',linein*1000000,"linein=");//The answers
   vary due to round off error
```

Scilab code Exa 21.2 `load regulation`

```
clc;
vnl=5;
vfl=4.9998;
Il=0.020;
loadre=(vnl-vfl)/Il;
disp('uA/mA',loadre*100,"loadre=");//The answers
   vary due to round off error
```

Scilab code Exa 21.3 allowable input voltage

```
clc;
Vout=8;
Vd=40;
Vin=Vout+Vd;
disp('V',Vin,"Vin=");//The answers vary due to round
    off error
```

Scilab code Exa 21.4 regulated dc output

```
clc;
R2=2400;
R1=240;
Vdc=(1.25)*((R2/R1)+1);
disp('V',Vdc,"Vdc=");//The answers vary due to round
    off error
```

Scilab code Exa 21.5 dc average of the load voltage

```
Ton=0.000005;
Toff=0.000010;
Vin=24;
Vave=Vin*(Ton/(Ton+Toff));
disp('V',Vave,"Vave=");//The answers vary due to
  round off error
```