Scilab Textbook Companion for Op Amps and Linear Integrated Circuits by J. M. Fiore[1]

Created by
Sadhvi Sharma
Electronics and Communication
Electronics Engineering
Shri Mata Vaishno Devi University
College Teacher
None
Cross-Checked by
K. V. P. Pradeep

June 2, 2016

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

Book Description

Title: Op Amps and Linear Integrated Circuits

Author: J. M. Fiore

Publisher: Cenage Learning, India

Edition: 1

Year: 2009

ISBN: 9788131512340

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

Exa Example (Solved example)

Eqn Equation (Particular equation of the above book)

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

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

Contents

List of Scilab Codes

Chapter 1

Introductory Concepts and Fundamentals

Scilab code Exa 1.1 Decibel power gain

```
//Chapter 1
//Decibel Power gain
//page 14
//Example no 1-1
//Given
clc;
clear;
G=800;
G1=10*log10(G);
printf("\n The decibel power gain ,G= %.2f dB\n",G1);
    // Result
```

Scilab code Exa 1.2 Loss in dB

```
// Chapter 1
//Loss expressed
```

```
//page 14
//Example no 1-2
//Given
clc;
G=1/10000;
G1=10*log10(G);
printf("\n The decibel power gain = %.0f dB\n",G1);
    // Result
```

Scilab code Exa 1.3 Ordinary power gain

```
// Chapter 1
//Ordinary power gain
//page 15
//Example no 1-3
//Given
clc;
G1=23;        //in dB
G=10^(G1/10);
printf("\n The ordinary power gain is %.4f  \n",G);
      // Result
Pin=10^-3;        //in mW
Pout=Pin*G;
printf("\n The output power is %.4f mW \n",Pout);
    // Result
```

Scilab code Exa 1.4 Total dB gain

```
// Chapter 1
// Total gain
//page 15
//Example no 1-4
//Given
```

```
clc;
G1=10;        //in dB
G2=16;        //in dB
G3=14;        //in dB
Gt=G1+G2+G3;  //total gain
printf("\n The ordinary power gain %.0f \n",Gt);
   // Result
```

Scilab code Exa 1.5 Gain

```
// Chapter 1
//Ordinary Gain
//page 16
//Example no 1-5
//Given
clc;
Ao=2;         //in Volt
Ai=50;         // in milliVolt
Ai1=0.05;        //input in Volt
Av=Ao/Ai1;
printf("\n The ordinary power gain %.0f \n ",Av); //
    Result
Av1=20*log10(Av);
printf("\n The power gain is %.2f dB\n",Av1);//
   Result
```

Scilab code Exa 1.6 Output gain

```
// Chapter 1
//Amplifier Gain
//page 17
//Example no 1-6
//Given
```

```
clc;
G1=26;       //in dB
Vin=0.01;   //in volt
G=10^(G1/20);
printf("\n The ordinary power gain %.2f \n",G);   //
   Result
Vout=Vin*G;
printf("\n The output voltage is %.4f  V\n",Vout);
      // Result
```

Scilab code Exa 1.7 Power in dBW

```
// Chapter 1
//Power vin dBW
//page 17
//Example no 1-7
//Given
clc;
P=120;       //in Watt
P1=10*log10(P);
printf("\n The ordinary power gain %.1f dBW \n",P1);
              //Result
```

Scilab code Exa 1.8 Output power in dBW and dBm

```
// Chapter 1
//Output power in dBW
//page 18
//Example no 1-8
//Given
clc;
clear;
P=0.200;       //in Watt
```

```
P1=10*log10(P/1);
printf("\n The ordinary power gain %.0f dBW \n",P1); // Result
P=200;        //in mW
P1=10*log10(P/1);
printf("\n The ordinary power gain %.0f dBm \n",P1); // Result
```

Scilab code Exa 1.9 Output power in watts

```
// Chapter 1
//Output power in Watt
//page 18
//Example no 1-9
//Given
clc;
P1=12;        // in dBw
Ref=1;    // in mW
P=10^(P1*Ref/10);
printf("\n The ordinary power gain %.1f mW \n",P);      // Result
```

Scilab code Exa 1.10 Value in dBV

```
// Chapter 1
//Output power
//page 18
//Example no 1-10
//Given
clc;
V=2;        // in V
Ref=1;    // in V
V1=20*log10(V/Ref);
```

```
printf("\n The value in dBV is %.2f dBV\n",V1);//
    Result
```

Scilab code Exa 1.11 Output signal in dBV

```
// Chapter 1
//Output signal
//page 19
//Example no 1-11
//Given
clc;
clear;
Vin=-42;   // in dBV
Av=35;       //in dBV
Vout=Vin+Av;
printf("\n The output signal is %.0f dBV \n",Vout);
    // Result
```

Scilab code Exa 1.12 The gain of amplifier in dB

```
// Chapter 1
// Gain of the amplifier
//page 19
//Example no 1-12
//Given
clc;
Pin1=20;      //in dBm
Pin=-10;         //in dBW
Pout=25;         //in dBW
G=Pout-Pin;
printf("\n The gain of amplifer is %.0f dB",G);//
    Result
```

Scilab code Exa 1.13 Gain lost at 10 Hz

```
// Chapter 1
//Gain lost
//page 23
//Example no 1-13
//Given
clc;
clear;
fc=40;  //in Hz
f=10;   //in Hz
Av=-10*log10(1+(fc^2)/(f^2));
printf("\n Gain lost is %.1f dB",Av);// Result
```

Scilab code Exa 1.14 Phase Response

```
// Chapter 1
//Phase response
//page 14
//Example no 1-14
//Given
clc;
fc=120;           // in Hz
fc1=1200;        // in Hz
fc2=12;          // in Hz
w1=atan(fc/fc2);
printf("\n W1 = %.1f degrees one decade below fc\n "
   ,w1*180/%pi);// Result
w2=atan(fc/fc1);
printf("\n W2 = %.2f degrees one decade below fc\n",
   w2*180/%pi);// Result
```

Scilab code Exa 1.15 Gain and phase values at 1600000 Hz

```
// Chapter 1
//page 15
//Example no 1-15
//Given
clc;
f=1.6*10^6;           //in Hz
fc=150*10^3;              //in Hz
Av=-10*log10(1+(f^2)/(fc^2));
printf("\n The Gain is %.1f dB \n ",Av);// Result
w=-(%pi/2)+atan(fc/f);
printf("\n Phase value is  %.1f degree",w*180/%pi);
   // Result
```

Scilab code Exa 1.16 The rise time for Lag network

```
// Chapter 1
//Rise time
//page 29
//Example no 1-16
//Given
clc;
//f2=0.35/Tr;
f2=100*10^3;           //in kHz
Tr=0.35/f2;
printf("\n The rise time for 90 degree lag network
   is %.7f sec",Tr);// Result
```

Scilab code Exa 1.17 Bode gain plot

```
//Chapter 1
//page 30
//Example no 1-17
//figure 1.15
//Given
clc;
clear;
Avmidband=26;
f=(100:.5:40000+.5);

Av=[Avmidband*ones(200+.5:.5:10000-.5)];
for i=0:6/200:6
Av=[Avmidband-i Av]
end
for i=0:12/40000:12
Av=[Av Avmidband-i]
end
for i=0:6/20000:6
Av=[Av Avmidband-12-i]
end
x=ones(Av)
clf
gainplot(f,x)
plot(f,Av)
title('Gainplot for complete amplifier')
```

Scilab code Exa 1.18 Find current in the circuit

```
// Chapter 1
//page 34
//Example no 1-18
//figure 1.19
//tail current
```

```
//Given
clc;
Vcc=20;        //in Volt
Rc=3000;           //in Ohm
Rb=5000;           //in ohm
Rt=2000;           //in Ohm
Vee=10;          //in Volt
It=(Vee-0.7)/Rt;
printf("\n It =%.5f Amp\n ",It);// Result
//Ie1=Ie2=It/2
Ic=It/2;
Vc=Vcc-Ic*Rc;
printf("\n Collector voltage is %.3f V\n ",Vc);//
   Result
B=100;         //Assumumption
Ib=Ic/B;
printf("\n Ib %.8f Amp\n ",Ib);// Result
Vb=-Ib*Rb;
printf("\n Base Voltage %.5f V\n ",Vb);// Result
```

Scilab code Exa 1.19 Find input output voltage gains

```
//Chapter 1
//page 40
//Example no 1-19
//Determine single ended  output
//figure 1.20
//Given
clc;
Vcc=15;        //in Volt
Rc=8000;           //in Ohm
re=30;           //in ohm
Rt=10000;           //in Ohm
Vee=8;           //in Volt
It=(Vee-0.7)/Rt;
```

```
printf("\n It =%.5f Amp \n",It);// Result
Ie=It/2;
re1=(26*10^-3)/Ie;
printf("\n re1 =%.1f \n",re1);// Result
//for single ended output gain
Av=Rc/(2*(re1+re));
printf("\n Single output gain is %.1f \n",Av);//
    Result
printf("\n The diferential output gain is twice Av i
    .e. %.0f ",2*Av);// Result
```

Chapter 2

Operational Amplifier Internals

Scilab code Exa 2.2 Square up circuit

```
//chapter 2
//figure 2.13
//frequency counter

clc;clear;
t=(0:0.1:100)';

k = input('Enter the reference voltage between 0 to
    0.8=');


f=0.1;
x3=1*sin(2*f*t);

x4=squarewave(2*f*t-k,50-10*k*%pi)
figure;

plot2d1(t,x3);
plot2d1(t,x4);
xlabel('time n--->');
ylabel('amplitude--->');
```

```
title('squre wave at cutt reference voltage');
```

Chapter 3

Negative Feedback

Scilab code Exa 3.1 Closed loop gain and break frequency

```
//Chapter 3
//Closed loop gain
//page 75
//Example no 3-1
//figure 3.4
clc;
clear;
Aol=200;
f2_ol=10000;        // in Hz
B=0.04;
Asp=Aol/(1+B*Aol);
printf("\n Asp %.2f \n ",Asp);              //Result
printf("\n Approximately Asp =1/B equal to %.0f \n"
    ,1/B);//result
S=Aol/Asp;
printf("\n S =%.0f \n",S);
f2_sp=f2_ol*S;
printf("\nf2_sp %.0f Hz",f2_sp);          //Result
```

Scilab code Exa 3.2 Design the amplifier

```
//Chapter 3
//page 76
//Example no 3-2
//figure 3.7
clear;
clc;
Asp1=20
Asp=10^(Asp1/20);
printf("\n Asp =%.0f\n",Asp);//Result
//Rf/Ri=Asp-1;
printf("\n Rf/Ri=%.0f \n",Asp-1);//Result
printf("Rf must be 9 times larger than Ri. \n There
    are many possibilities  ");//Result
```

Scilab code Exa 3.3 Input Output impedance

```
//Chapter 3
//page 82
//Example no 3-3
clc;
clear;
Zin_ol=300*10^3;          //in Ohms
Zout=100;          //in Ohms
Aol=50000;
Zout_ol=100;
Asp=100;
S=Aol/Asp;
printf("\n S = %.0f",S);//Result
Zin_sp=S*Zin_ol;
printf("\n Zin_sp = %.0f Ohm",Zin_sp);//Result
Zout_sp=Zout_ol/S;
printf("\n Zout_sp = %.1f Ohm",Zout_sp);//Result
```

Scilab code Exa 3.4 Amplifier current gain

```
//Chapter 3
//Output current of circuit
//page 88
//Example no 3-4
clc;
clear;
R1=9000;          // in Ohm
R2=1000;          //in Ohm
B=R2/(R1+R2);
printf("\n B is %.2f\n",B);//Result
//Aps=1/B;
Aps=(R1+R2)/R2;
printf("\n Aps = %.0f \n ",Aps);//Result
```

Chapter 4

Basic Op Amp Circuits

Scilab code Exa 4.1 Input Impedance and gain

```

clear;
clc;
close;
//page no 98
//figure 4.2
Rf=10*10^3;      ///In Ohms
Ri=1*10^3;      ///In Ohms
Av=1+(Rf/Ri);
disp(Av,"Gain of Circuit is")
```

Scilab code Exa 4.2 Design an amplifier

```
clc;
clear;
close;
//page no 98
//figure 4.3
```

```
Av1=26;//in dB
Av=20;
//Zi=47*10^3  //in ohms
Ri=1*10^3;      ///In Ohms
//we know Av=1+(Rf/Ri)
Rf=Ri*(Av-1);
disp(Rf,"Value of Rf(ohm) when Ri is 1k");
Ri=2*10^3;      ///In Ohms
Rf=Ri*(Av-1);
disp(Rf,"Value of Rf(ohm) when Ri is 1k")
Ri=5*10^2;      ///In Ohms
Rf=Ri*(Av-1);
disp(Rf,"Value of Rf(ohm) when Ri is 1k")
```

Scilab code Exa 4.3 Design a voltage follower

```

clc;
clear;
close;
//pagec no 99
//figure 4.4
Av=1;
//Av=1+(Rf/Ri)
//Rf/Ri=Av-1=0
disp("Rf/Ri=0 ");
disp("Rf is replaced by short circuiting wire and Ri
    can have any theoretical value")
disp("When Ri is infinite it can be deleted from
    circuit");
```

Scilab code Exa 4.4 Input Impedance and Vout

```
clc;
clear;
close;
//pagec no 100
Rf=14*10^3;//in ohm
Ri=2*10^3;//in ohm
Av1=1+(Rf/Ri);
disp(Av1,"Av1 is");
Av3=20*log10(Av1);
disp(Av3,"Av1 in dB is");

Rf=18*10^3;//in ohm
Ri=2*10^3;//in ohm
Av2=1+(Rf/Ri);
disp(Av2,"Av2 is");
Av4=20*log10(Av2);
disp(Av4,"Av2 dB is ");
Avt=Av3+Av4;
disp(Avt,"Total Gain dB Av1+Av2 is");
vin=-30;//in dB
vout=Avt+vin;
disp(vout,"Vout in dB ");
```

Scilab code Exa 4.5 Input Impedance and output voltage

```
clc;
clear;
close;
//pagec no 102
Ri=5*10^3;// in ohm
Rf=20*10^3;// in ohm
vin=100*10^-3;//In volt
Av=-(Rf/Ri);
vout=vin*Av;
disp("Volt",vout,"Vout is ");
```

```
disp("(i.e. negative sign means inverted)");
```

Scilab code Exa 4.6 Design an inverting amplifier

```
clc;
clear;
close;
//pagec no 103
Ri=15*10^3;
zin=Ri;
Av=-10;//inverting amplifier gain
//Av=-(Rf/Ri)
Rf=Ri*-Av;
disp("ohm",Rf,"Value for Rf ");
```

Scilab code Exa 4.7 Minimum and maximum gain

```
clc;
clear;
close;
//pagec no 103
//capacitors are used to remove higher frequencies
Rf=200*10^3;//In Ohm
Ri=15*10^3; //In Ohm
Av=-(Rf/Ri);
Av1=20*log10(-Av);
disp(Av,"Maximum gain is ");
disp(Av1,"Maximum gain in dB is ");
Av2=0;// divider action makes Ri infinite
disp(Av2,"Minimum gain in dB is ");
```

Scilab code Exa 4.8 Design the circuit

```
clc;
clear;
close;
//pagec no 105
//Figure 4.6
Iin=50*10^-6;          //In Ampere
Vout=4;        //In Volt
Rf=Vout/Iin;
disp("ohm",Rf,"Transresistance of Circuit is");
```

Scilab code Exa 4.9 Load current

```
clc;
clear;
close;
//pagec no 107
//Figure 4.13
Ri=20*10^3;        //In Ohm
Vin=0.4;           //In Volt
Rl=1*103;//In ohm
gm=1/Ri;           //unit-micro*Siemens
Iload=gm*Vin;
disp("A",Iload,"Load current is");
//maximum current is 20microAmp in Op Amp
Vout=(Ri+Rl)*Iload;
disp("V",Vout,"V max ");
```

Scilab code Exa 4.10 calculate Ri

```
clc;
clear;
```

```
close;
//figure 4.15
//pagec no 107
//Figure 4.15
Iload=100*10^-6;        //In Amp
Vin=10;      //In Volt
gm=Iload/Vin;
Ri=1/gm;
disp("ohm",Ri,"Value of Ri")
```

Scilab code Exa 4.11 Load Current

```
clc;
clear;
close;
//pagec no 111
//Figure 4.17
Iin=5*10^-6;          //In Ampere
Ri=33*10^3;      //In Ohm
Rf=1*10^3;          //In Ohm
Rload=10*10^3;          //In Ohm
Ai=1+(Ri/Rf);           //for inverting current
   amplifier
Iout=Ai*Iin;
disp("A",Iout,"I out ");
Vmax=Iout*Rload+Iin*Ri;
disp("V",Vmax,"Vmax is");
disp("(No problem)")
```

Scilab code Exa 4.12 Design the amplifier

```
clc;
clear;
```

```
close;
//pagec no 111
//Figure 4.18
Ai=50;
Rl=200*10^3;            //In Ohm
//Ai=1+(Ri/Rf)
Rf=1*10^3;            //In Ohm(Assumption)
Ri=Rf*(Ai-1);
disp("ohm",Ri,"Ri for Rf 1000ohm");
Rf=2*10^3;            //In Ohm(Assumption)
Ri=Rf*(Ai-1);
disp("ohm",Ri,"Ri for Rf 2000ohm");
Rf=0.5*10^3;            //In Ohm(Assumption)
Ri=Rf*(Ai-1);
disp("ohm",Ri,"Ri for Rf 500ohm");
Imax=13.5/Rl;
disp("A",Imax,"Resulting current");
disp("A",Imax/50,"Maximum allowable input current ")
    ;
```

Scilab code Exa 4.13 Output of summing amplifier

```
clc;
clear;
close;
//pagec no 113
//Figure 4.20
//Noninverting Amplifier
Rf=10*10^3;            //In Ohm(Assumption)
//Channel 1
Ri1=4*10^3;            //In Ohm(Assumption)
Vi1=1;        //In Volt
Av1=-Rf/Ri1;
Vo1=Av1*Vi1;
disp("V",Vo1,"Vout1");
```

```
//Channel 2
Ri2=2*10^3;            //In Ohm(Assumption)
Vi2=-2;        //In Volt
Av2=-Rf/Ri2;
Vo2=Av2*Vi2;
disp("V",Vo2,"Vout2");
//Channel 3
Ri3=1*10^3;            //In Ohm(Assumption)
Vi3=0.5;        //In Volt
Av3=-Rf/Ri3;
Vo3=Av3*Vi3;
disp("V",Vo3,"Vout1")
disp("V",Vo1+Vo2+Vo3,"Total output via summation  is
    ")
```

Scilab code Exa 4.14 Determine the output of non inverting summer

```
clc;
clear;
close;
//pagec no 116
//Figure 4.22
//Noninverting Amplifier
V1=1;        //In Volt
V2=-0.2;        //In Volt
//to draw graph of V3
step=0.5;
t=0:step:10*%pi;

V3=2*sin(100*t);       //In Volt
R1=20*10^3;     //In ohm
R2=20*10^3;     //In ohm
R3=20*10^3;     //In ohm
Rf=20*10^3;     //In ohm
Ri=5*10^3;     //In ohm
```

```
//Vout=(1+(Rf/Ri))*(V1+V2+V3)/3;
Vout=(1+(Rf/Ri))*(V1+V2)/3;       //for DC componet in
    Vin
Voutac=(1+(Rf/Ri))*(V3)/3;        //for ac componet in
    Vin
disp("Output Voltage is 3.33 V peak sine wave riding
    on 1.33 V DC");
plot(Voutac+Vout);
xtitle("Output","t","V")
```

Scilab code Exa 4.15 Design the difference amplifier

```
clc;
clear;
close;
//pagec no 118
//Figure 4.27
Ri=10*10^3;       //In ohm
Av=26;        //In dB
Av1=10*log10(Av);
Rf1=Av1*Ri;
//Rf1=20*Ri1;
//Ri1+20*Ri1=Ri;
//Ri1=Ri-Rf1;
Ri1=Ri/21;
Rf1=20*Ri1;
disp("ohm",Rf1,"Rf1 is")
```

Chapter 5

Practical limitation of Op Amps circuits

Scilab code Exa 5.1 Upper break frequency

```
//Chapter 5
//page 135
//Example no 5-1
clc;
clear;
G=20;          //in dB
A=10^(G/20);           //Ordinary gain
GBW=1*10^6;            //in Hz (from datasheet)
f2=GBW/A;
printf("Uper break frequency %.0f Hz",f2);
```

Scilab code Exa 5.2 Frequency response

```
//Chapter 5
//page 135
//Example no 5-2
```

```
//Given
clc;
clear;
Rf=10000;        //in Ohm
Ri=2000;         //in Ohm
Av=-Rf/Ri;
printf("\n Av  = %.0f ",Av);//Result
Av1=20*log10(-Av);
printf("\n Av in %.0f bB",Av1);//Result
//for noise gain
An=1+Rf/Ri;
printf("\n Anoise =%.0f ",An);   //Result
```

Scilab code Exa 5.3 Minimum acceptable funity

```
//clear//
//Example5.3:Finimum acceptable frequency
//Page 138
//figure 5.5
clear;
clc;
Rf=20000;        //in Ohms
Ri=500;          //in Ohms
f2=50*10^3;          //In Hz
Anoise=1+(Rf/Ri);
disp(Anoise,"Anoise");
funity=Anoise*f2;
disp("Hz",funity,"funity");

disp("For this application 741 would not be fast
   enough, therefore 411 would be fine");
```

Scilab code Exa 5.4 System gain and upper break frequency

```
//clear//
//Example5.4:System gain and upper break frequency
//Page 140
//figure 5.6
clear;
clc;
//STAGE 1
disp("Stage 1");
Rf1=14000;        //in Ohms
Ri1=2000;           //in Ohms
Av1=1+(Rf1/Ri1);
disp(Av1,"Av");
Anoise1=1+(Rf1/Ri1);
disp(Anoise1,"Anoise");
GBW=1*10^6;            //in Hz (from Datasheet)
f1=GBW/Anoise1;
disp(f1,"f2");

//STAGE 2
disp("Stage 2");
Rf2=20000;        //in Ohms
Ri2=10000;           //in Ohms
Av2=-(Rf2/Ri2);
disp(Av2,"Av");
Anoise2=1+(Rf2/Ri2);
disp(Anoise2,"Anoise");
GBW=1*10^6;            //in Hz (from Datasheet)
f2=GBW/Anoise2;
disp(f2,"f2");

//STAGE 3
disp("Stage 3");
Rf3=12000;        //in Ohms
Ri3=4000;           //in Ohms
Av3=1+(Rf3/Ri3);
disp(Av3,"Av");
Anoise3=1+(Rf3/Ri3);
disp(Anoise3,"Anoise");
```

```
GBW=1*10^6;          //in Hz (from Datasheet)
f3=GBW/Anoise3;
disp(f3,"f2");

//SYSTEM
Av=Av1*Av2*Av3;
disp(Av,"Av");

disp("Dominant break frequency here is 125kHz");
GBW=f1*64;
disp(GBW,"Gain bandwidth product is");
```

Scilab code Exa 5.5 System gain and upper break

```
//clear//
//Example5.5:System gain and upper break frequency
//Page 142
clear;
clc;
Anoise=10;
funity=4*10^6;          //in Hz
f2=funity/Anoise;
disp(f2,"f2");
n=3;
f2_system=f2*(2^(1/n)-1)^0.5;
disp(f2_system,"f2_system");
```

Scilab code Exa 5.6 Upper break requency

```
//clear//
//Example5.6:design a circuit with upper break
    frequency
//Page 142
```

```
clear;
clc;
Av1=26;       //in dB
Av=20;        //ordinary gain
f2=500*10^3;      //in Hz

funity=f2*Av;     //(Anoise=Av for non inverting terminal)
disp("Hz",funity,"funity")
//411 has funity =4MHZ ,therefore atleast 2 stages would be required
//Stage 1
f411=4*10^6;                //in hz
Av1=f411/f2;
 disp(Av1,"Av");
//To achive gain of 20 second stage should have gain of atleast Av2=2.5
Av2=2.5;
f2=f411/Av2;
disp("Hz",f2,"f2");
```

Scilab code Exa 5.7 Does slewing occur

```
//clear//
//Example5.7:"is 741's power bandwith atleast 3kHz""
//Page 148
//figure 5.6
clear;
clc;
slewrate=0.5/10^-6;          // in V/S
Vp=12;        //in Volts
fmax=slewrate/(2*%pi*Vp);
disp("Hz",fmax,"Fmax");
//Result
```

Scilab code Exa 5.8 Minimum acceptable slew rate

```
//clear//
//Example5.8:"minimum acceptable rate for 741""
//Page 149
//figure 5.6
clear;
clc;
fmax=20000;      //in Hz
Vp=10;       //in Volts
slewrate=fmax*(2*%pi*Vp);
disp("V/S",slewrate,"Slew rate ");
///Result in V/S
```

Scilab code Exa 5.9 Calculate new offset

```
//clear//
//Example5.9:"Typical offset voltage""
//Page 157
//figure 5.9
clear;
clc;
Rf=10000;        // in Ohm
Ri=1000;         //in ohm
Roff=0;          //in ohm
Anoise=1+Rf/Ri;
disp(Anoise,"Anoise");
Vos=0.5*10^-3;       //in Volt
Ios=10*10^-9;        //in Amp
Ib=800*10^-9;        //in Amp
Vout=(Vos*Anoise)+(Ib*Roff*Anoise+Ib*Rf);
disp("V",Vout,"Vout");
```

```
Roff=Ri*Rf/(Rf+Ri);
Vout=(Vos*Anoise)+(Ios*Rf);
disp("V",Vout,"Vout_offset");
//result
```

Scilab code Exa 5.10 Output voltage typically

```

//clear//
//Example5.10:"Output voltage""
//Page 158
//figure 5.24
clear;
clc;
Rf=20000;          // in Ohm
Ri=5000;           //in ohm
Av=-Rf/Ri;
Vin=3*10^-3;            //in Volt
Vout=Av*Vin;
disp("V",Vout,"Vout");

//411 typical apecs
Vos=0.8*10^-3;          //in Volt
Ios=25*10^-12;           //in Amp
Ib=50*10^-12;           //in Amp
Anoise=1+Rf/Ri;
Roff=0;
Vout=(Vos*Anoise)+(Ib*Roff*Anoise+Ib*Rf);
disp("V",Vout,"Vout");
//Result
```

Scilab code Exa 5.11 Output drift

```
//clear//
//Example5.11:"Output Drift""
//Page 161
//figure 5.23
clear;
clc;
Roff=909;           //in Ohm
Rf=10000;           //in Ohm
Anoise=11;
DT=55;      //degree Celsius
DVbyDT=5*10^-6;      //     V/C
DInoisebyDT=200*10^-12;              //  A/C
Vdrift=(DVbyDT*DT*Anoise)+(DInoisebyDT*DT*Rf);
disp("V",Vdrift,"Vdrift");
Av=Anoise;
Vdriftin=Vdrift/Av;
disp("V",Vdriftin,"Vdriftinput");
```

Scilab code Exa 5.12 Output Voltage

```
//Example5.12:"Output "
//Page 163
clear;
clc;
Av=20;          //in dB
Vin=-60;        //in dBV
CMRR=-90;       //in dB
//for differential input
Vout=Av+Vin;
disp("dBV",Vout,"Vout for differential mode input");
//for common mode input
Vout1=Vout+CMRR;
disp("dBV",Vout1,"Vout for common mode signal");
//This signal is so small that it is overshadowed by
```

```
noise
```

Scilab code Exa 5.13 Ripples in output

```
//Example5.13:"How much Ripples is seen in output"
//Page 164
clear;
clc;
PSRR=86;          //in dB
Vripple=0.5;          //in Volt
Psrr=10^(PSRR/20);
disp(Psrr,"PSRR ordinary value");
Vout=Vripple/Psrr;
disp("Vpp",Vout,"Vout_ripple ")
//result//
```

Scilab code Exa 5.14 Output noise voltage

```
//Example5.14:"Output noise voltage""
//Page 167
//figure 5.29
clear;
clc;
Rf=99000;         // in Ohm
Ri=1000;          //in ohm
Rs=100;           //in ohm
Av=1+Rf/Ri;
disp(Av,"Av ordinary value");
disp(20*log10(Av),"Av dB value");
Anoise=Av;            //for non inverting amplifier
Rnoise=Rs+Rf*Ri/(Rf+Ri);
disp("Ohm",Rnoise,"Rnoise");

```

```
T=300;        //Given in degree cel.
K=1.38*10^-23;        //Boltzmann's constant
Vind=4*10^-9;         //In V/Hz
Iind=0.6*10^-12;       //in A/Sqrtof Hz
eth=(4*K*T*Rnoise)^0.5;        //sqared the
etot=((Vind^2)+(Iind*Rnoise)^2 +eth^2)^0.5;
disp("V/(Hz)^0.5",etot,"etotal");

funity=10*10^6;       //in Hz
f2=funity/Anoise;
disp("Hz",f2,"f2");
BWnoise=f2*1.57;
disp("Hz",BWnoise,"BWnoise");

en=etot*(BWnoise)^0.5;
disp("V",en,"en");

en_out=en*Anoise;
disp("V",en_out,"en_out");

//for a nominal output signal of 1V RMS signal to noise ratio is
signal=1;             //in V
Noise=en_out;
S_N=signal/Noise;

disp(S_N,"Signal to Noise ratio ");             // answer in book is approxmately
disp(20*log10(S_N),"S/N in dB");
//Result
```

Chapter 6

Specialised Op Amps

Scilab code Exa 6.1 Output signal

```
//Example6.1:"Output signal""
//Page 176
//figure 6.4
clear;
clc;
R1=20000;        //in Ohm
R2=400;          //in Ohm
Vinp=0.006;           //in V  (Vinp=Vin+)
Vinm=-0.006;           //in V    Vinp=Vin_)
Vh=0.010;          //in V
Vad=Vinm*(1+R1/R2)-Vinp*R1/R2;            //-------1 equation Va=0.606mV approx
disp("V",Vad,"Va");
//for common mode
Vac=Vh*(1+R1/R2)-Vh*R1/R2;
disp("V",Vac,"Va");
Rf=50000;        //in Ohm
Ri=10000;          //in Ohm
Av=Rf/Ri;
disp(Av,"Av");
Va=-0.606;        //V
```

```
Vb=-Va;
Voutd=Av*(Vb-Va);
disp("V",Voutd,"Desired differential input signal is
    Vb-Va=");
Vout=(Vinp-Vinm)*(Rf/Ri)*(1+2*(R1/R2));
disp("V",Vout,"By using equation 6.1 given in book
    Vout =(Vinp-Vinm)*(Rf/Ri)*(1+2*(R1/R2))=");
CMRR=10^5;
Av=505;
Vincm=10*10^-3;
Voutcm=Vincm*Av/CMRR;
disp("V",Voutcm,"Vout(cm)")
```

Scilab code Exa 6.2 Instrumentation amplifier

```
//Example6.2:"Designing the Circuit""
//Page 180
//figure 6.9
clear;
clc;
Av=10;
Rg=(49.4*10^3)/(Av-1);
disp("Ohm",Rg,"Rg")
```

Scilab code Exa 6.3 Power bandwidth

```
//Example6.3:"Determine the Power Bandwidth""
//Page 183
//figure 6.14
clear;
clc;
Vp=10;        //in V
Vcc=15;            //in V
```

```
Rf=50000;          //in Ohm
Ri=2000;           //in Ohm
Rset=3*10^6;             //in Ohm
Iset=(Vcc-0.5)/Rset;
disp("A",Iset,"Iset")
Anoise=1+Rf/Ri;
disp(Anoise,"Anoise");
funity=200000;        //in Hz
f2=funity/Anoise;
disp("Hz",f2,"f2");
SR=0.11/10^-6;     //in V/S
fmax=SR/(2*%pi*Vp);
disp("Hz",fmax,"fmax");
//Result//
```

Scilab code Exa 6.4 bandwidth required

```
//Example6.4:"Determine the approx Bandwidth""
//Page 191
clear;
clc;
Refresh=60;
Height=1024;
Width=1024;
Pixelrate=Refresh*Height*Width;
disp("pixels per second",Pixelrate,"Pixelrate");
Tr=1/Pixelrate;
f2=0.35/(0.3*Tr);
disp("Hz",f2,"f2");
//Result//
```

Scilab code Exa 6.5 Voltage controlled amplifier

```
//Example6.5:"OTA use"
//Page 191
//figure 6.22
clear;
clc;
Vp=5;              //in V
Vm=-Vp;
Rcontrol=22000;        //In Ohm
Vd=0.7;            //in V
Iabc=(Vp-Vm-Vd)/Rcontrol;
disp("A",Iabc,"Iabc");
//Using voltage divider
Loss=470/(33000+470);
disp(Loss,"Loss");
Vpp=0.050;             //in V
Vinmax=Vpp/Loss;
disp("V",Vinmax,"Vinmax");
gm=0.010;              //in S
Iout=Vpp*gm;
disp("A",Iout,"Iout");
//maximum output
Rf=22000;              //in Ohm
Vout=Iout*Rf;
disp("V",Vout,"Vout");
//result//
```

Scilab code Exa 6.6 Design an amplifier

```
//Example6.6:"design an Amplifier "
//Page 197
//figure 6.27
clear;
clc;
Av=-20;
Ri=50000;          //in Ohm
```

```
fc=100;        //in Hz
//Av=-Rf/Ri
Rf=-Av*Ri;
disp("Ohm",Rf,"Value of Rf");
Rb=2*Rf;
disp("Ohm",Rb,"Value of Rb");
C=1/(2*%pi*Ri*fc);
disp("F",C,"Value of C");
//Result//
```

Scilab code Exa 6.7 Design a non inverting amplifier

```
//Example6.7:" design a non-inverting amplifer "
//Page 205
clear;
clc;
Av=20;              //in dB
Av1=10^(Av/20);              //ordinary gain
Rf=1500;                //in Ohm (Assumption)
//Av=1+Rf/R  we know
R=Rf/(Av1-1);
disp("Ohm",R,"R");
//Result//
```

Chapter 7

Nonlinear circuits

Scilab code Exa 7.1 Point at which led flashes

```
// Chapter7
//Example-7.1
//Figure 7.11
//page 216
clear;
clc;
R=10*10^6;             //in Ohm
C=10*10^-9;            //in Farad
T=R*C;             //discharge Time
printf("\n T %.1f S\n",T);
Vled=2.5;          //in V
Vsat=13;               //in V
Rl=500;            //in Ohm
Iled=(Vsat-Vled)/Rl;
printf("\n Iled %.3f A\n",Iled);
//result//
```

Scilab code Exa 7.2 Capacitor voltage and time constant

```
// Chapter7
//Example-7.2
//Figure 7.24
//page 222
clear;
clc;
R2=1.5*10^3;              //in Ohm
R1=10*10^3;               //in Ohm
Vcc=15;            //in V
Vpm=1;             //in V                    (=Vp_)
C=10*10^-9;              //in Farad

Vofst=Vcc*R2/(R1+R2);
printf("\n Voffset %0.2f V",Vofst);
Vc=Vofst+Vpm;
printf("\n Vc %0.2f V",Vc);
Rl=10*10^6;               //in Ohm
T=Rl*C;              //discharge Time
printf("\n T %0.2f S",T);
Vinp=1.96;
Vinm=5.96;
Vind=Vinp-Vinm;
printf("\n Vin_diff =%0.0f V \n ",Vind);
//Graph
t=(0:0.01:5)';
f=1;           //1kHz
Vin=2*sin(f*%pi*t);
Vin1=Vin^2-1;
Vout=Vin1+2.96;
clf;
plot(t,Vout,t,Vin1)
xtitle("Green Input  signal & Blue Output signal","t
   ","Vin");//result
xgrid;
```

Scilab code Exa 7.3 Sketch Vout

```
// Chapter7
// Page.No−226
// Example7_3
//page 226
// Output waveform of zener limits Diodes
// Given
clc;
clear;
Rf=20*10^3;            //in Ohm
Ri=10*10^3;            //in Ohm
Av=-Rf/Ri;
Vin=4;           //in V
Vout=Av*Vin;
printf("\n Vout = %0.0f V(peak)",Vout);
Vzener=5.1;            //in V

Vlimit=(Vzener+0.7);
printf("\n Vlimit +_%.1f V",Vlimit);
//graph

T0=4;
t=-5.99:0.01:6;
t_temp=0.01:0.01:T0/4;
s=length(t)/length(t_temp);
dx=[];
x=[];
for i=1:s
    if modulo(i,2)==1  then
        dx=[dx -ones(1,length(t_temp))];
        x=[x .1*t_temp($:-1:1)];
    else
        dx=[dx ones(1,length(t_temp))];
        x=[x .1*t_temp];
    end
end
clf();
```

```
k=-(-80*2*x)-8;    //function for output plot
x1=[]              //function for clipped output
for c=1:length(x)
    if k(c) < -5.8 then
        x1(c)=-5.8;
    else
        if k(c)<5.8 then
        x1(c)=k(c);
    else
        x1(c)=5.8
        end
    end
end
plot(t-1.5,-80*x+4,t-1.5,k,t-1.5,x1);
xtitle("Input(Blue) / Output (Green/Red for
   clipped ) waveform");

xgrid;
```

Scilab code Exa 7.4 Sketch the transfer curve

```
// Chapter7
// Page.No-229
// Example7_4
// Sketch the Transfer Curve
// Given
clc;
clear;
Vz=3.9;            //in V
Rf=20000;              //in Ohm
Ri=5000;             //in Ohm
Ra=10000;              //in Ohm
Vbreak=Vz+0.7;
printf("\n Vbreak +_ %.2f V",Vbreak);

```

```
Av=-Rf/Ri;
printf("\n Av %.2f ",Av);

Av2=(-Rf*Ra/(Rf+Ra))/Ri;
printf("\n Av2 %.2f ",Av2);
//Graph
t=-4:0.001:4;
L=length(t);
for i=1:L
    if t(i)<-1.15
        x1(i)=Av2*t(i)+3.0705;


   elseif  t(i)<1.15
        x1(i)=Av*t(i) ;


       elseif t(i)>1.15
         x1(i)=Av2*t(i)-3.0705 ;
       end ;
end;
clf;
plot2d1(t,x1);
xtitle('Transfer Characteristics','Vin','Vout')
xgrid;
```

Scilab code Exa 7.5 Draw the transfer curve

```
// Chapter7
// Page.No-231
// Example_7_5
// Sketch the Transfer Curve
// Given
clc;
clear;
```

```
Vz1=1;          //in V
Vz2=2.2;          //in V
Rf=12000;            //in Ohm
Ri=10000;            //in Ohm
R2=15000;            //in Ohm
R1=20000;            //in Ohm
Vbreak1=Vz1+0.7;
printf("\n Vbreak1_in +_ %.2f V",Vbreak1);
Vbreak2=Vz2+0.7;
printf("\n Vbreak2_in +_ %.2f V",Vbreak2);

Av=-Rf/Ri;
printf("\n Av %.1f ",Av);
Av1=-Rf*(Ri+R1)/(R1*Ri);
printf("\n Av1 %.1f ",Av1);

Av2=-Rf*(Ri*R1+R1*R2+R2*Ri)/(R1*Ri*R2);
printf("\n Av2 %.1f ",Av2);
Vbreak1_out=Av*Vbreak1
Vbreak2_out=Vbreak1_out+Av2*(Vbreak2-Vbreak1);
printf("\n Vbreak1_out %.2f V ",Vbreak1_out);
printf("\n Vbreak2_out %.2f V",Vbreak2_out);
//graph
t=-5:0.01:5;
L=length(t);
for i=1:L
    //if t(i)<  then
    //end
    if t(i)<-2.9 then
        x1(i)=Av2*t(i)-3;
     elseif t(i)<-1.15 then
        x1(i)=Av1*t(i)-0.67;
    elseif t(i)<1.15 then
        x1(i)=Av*t(i) ;
    elseif t(i)<2.9 then
        x1(i)=Av1*t(i)+0.67 ;
    elseif t(i)>2.9 then
        x1(i)=Av2*t(i)+3;
```

```
    end;
end;
clf;
plot2d1(t,x1);
xtitle('Transfer Characteristics','Vin','Vout')
```

Scilab code Exa 7.6 Temperature tranducer response characteristics

```
// Chapter7
// Page.No-232
// Example_7_6
// Sketch the Transfer Curve
// Given
clc;
clear;
Vz1=1;           //in V
Vz2=2.2;           //in V
Rf=10000;            //in Ohm
Ri=10000;            //in Ohm

Vzp=3-0.7;
printf("\n Vz+in  %.2f V",Vzp);
Vzm=-(4-0.7);
printf("\n Vz_in  %.2f V",Vzm);
//Ra||Rf=8k
Ra=8000*Rf/(Rf-8000);
Av2=0.8;
Av1=1;
//graph
t=-50:0.001:50;
L=length(t);
for i=1:L
        if t(i)<-40 then
        x1(i)=0.8*t(i)-8;
     elseif t(i)<30+0.01 then
```

```
        x1(i)=1*t(i);

    elseif t(i)>30 then
        x1(i)=0.8*t(i)+5.5;
    end;
end;
clf;
plot2d1(t,x1);
xtitle('Transfer Characteristics','Vin','Vout')
```

Scilab code Exa 7.7 Sketch output waveform

```
// Chapter7
// Page.No-241
// Example7_4
// Sketch the output waveform
// Given
clc;
clear;
Vi=5;           //in V
Vsat=13;           //in V
R2=2000;           //in Ohm
R1=20000;           //in Ohm
Vupper=Vsat*R2/R1;
Vlower=-Vsat*R2/R1;
printf("\n Vupperthreshold %.1f V",Vupper);
printf("\n Vlowerthreshold %.1f V",Vlower);
t=(0:0.1:20)';
f=0.1;
x3=1*sin(2*f*%pi*t);
A=asin(Vupper);
k=atan(imag(A),real(A))


x4=squarewave(2*f*%pi*t-2*f*%pi*k,50)
```

```
plot(t,x3,t,x4);
//plot2d1();
xlabel('time n——>');
ylabel('Vout——>');
title('Input(Blue) / Output(Green)');
xgrid(color("grey"));
```

Scilab code Exa 7.8 Determine the Output voltage

```
// Chapter7
// Page.No−250
// Example7_8
// Determine the output voltage
//Figure 7.56
// Given
clc;
clear;
Vin=1;            //in V
T=300;             //in Kelvin
Ri=50000;              //in Ohm
Is=30*10^-9;                    //in Amp
//Vout=−0.0259*ln(Vin/RiIs)
Vout=-0.0259*log1p(Vin/(Ri*Is))
printf("\n Vout when Vin=1V %.4f V\n",Vout);
//for Vin=0.5V
Vin1=0.5;           //in V
Vout1=-0.0259*log1p(Vin1/(Ri*Is))
printf("\n Vout when Vin=0.5V %.4f V\n",Vout1);
//for Vin=2V
Vin2=2;            //in V
Vout2=-0.0259*log1p(Vin2/(Ri*Is))
printf("\n Vout when Vin=2V %.4f V",Vout2);
```

Scilab code Exa 7.9 Output Voltage

```
// Chapter7
// Page.No-253
// Example_7_9
// Determine  the output voltage
//Figure 7.62
// Given
clc;
clear;
K=0.1;
t=(0:0.01:0.5)';
Vin=2*sin(2*60*%pi*t);
Vout=K*Vin^2;

plot(t,Vout,t,Vin)
xtitle(" Input(Green)  signal &  Output (Blue)signal
   ","t","V");//result
```

Chapter 8

Voltage regulation

Scilab code Exa 8.1 Output

```
// Chapter8
// Page.No-263
// Example8_1
// Figure 8.4
// Output of Voltage and Current
// Given
clear;clc;
R1=5000;                 //In Ohm
R2=20000;                 //In Ohm
R3=10000;                 //In Ohm
Vz=3.9;             //In V
Vl=Vz*(R2+R3)/R3;
printf("\n Output Load Voltage Vl is = %.2f V\n",Vl)
   ; // Result
Iz=(Vl-Vz)/R1;
printf("\n Output Zener Current Iz is = %.5f A \n",
   Iz); // Result
```

Scilab code Exa 8.2 The power dissapation

```
// Chapter8
// Page.No-264
// Example8_2
// Figure 8.4
// Power dissipation for Q1
// Page.No-264
// Example_8_2
// Figure 8.4
// Given
clear;clc;
Vl=11.7;              //in V
Rl=20;             //in Ohm
Il=Vl/Rl;
printf("\n Output Load Current Il is = %.3f A \n",Il); // Result
Vc=20; Ve=11.7;       //in V
Vce=Vc-Ve;
printf("\n Output Load Voltage Vce is = %.2f V\n",Vce); // Result
Pd=Il*Vce;
printf("\n Power dissiption Pd is = %.2f W \n",Pd); // Result
Ib=0.020;                       //in Amp
B=Il/Ib;
printf("\n Beta is = %.2f  \n",B); // Result
Pl=Il*Vl;
printf("\n Power dissiption across load ,Pl is = %.3f W \n",Pl); // Result
Vin=20;               //in V
Pin=Il*Vin;           //Iin=Il
printf("\n Input Power dissiption ,Pin is = %.2f W \n",Pin); // Result
n=Pl/Pin;
printf("\n Efficiency   is = %.3f or %.1f  percent \n",n,n*100); // Result
```

Scilab code Exa 8.3 Value of R2

```
// Chapter8
// Value of R2
// Page.No-272
// Example8_3
// Given
clear;clc;
Vm=1.25;                //in V
Vout=15;                //in V
R1=240;               //in Ohm
R2=R1*((Vout/Vm)-1);
printf("\n Value for R2 is = %.2f Ohm\n",R2); //Result
```

Scilab code Exa 8.4 12 V Regulator

```
// Chapter8
// 12V Voltage Regulator
// Page.No-279
// Example8_4
//Figure 8.17
// Given
clear;clc;
Vref=7.15;                //in V
Vout=12;                //in V
Ilimit=0.050;               //in Amp
R2=10000;               //in Ohm
R1=Vout*R2/Vref-R2;
printf("\n Value of R1 is = %.f Ohm\n",R1); //Result
Vsense=0.65;                //in V
```

```
Rsc=Vsense/Ilimit;
printf("\n Value of current sense resistor is = %.f
   Ohm\n",Rsc); // Result
R3=R1*R2/(R1+R2);
printf("\n Value of minimum drift resistor is = %.f
   Ohm\n",R3); // Result
```

Scilab code Exa 8.5 2V to 5V supply

```
// Chapter8
// Design  a contineously adjusted supply b/w 2V to
    5 V
// Page.No-279
// Example8_5
//Figure 8.15.1
// Given
clear;clc;
Vref=7.15;              //in V
Vout=5;              //in V
//(R1b+R2)/R2=Vref/Vout;
printf("\n For maximum case (R1b+R2)/R2 is = %.2f \n
    ",Vref/Vout); // Result
R2=1;               // In Ohm (Assumption)
R1b=Vref/Vout-1;
printf("\n For R2=1 Ohm R1b:R2 is = %.2f:%.0f \n",
    R1b,R2); // Result
Voutm=2;             // in V
printf("\n For maximum case (R1a+R1b+R2)/R2 is = %.3
    f \n",Vref/Voutm); // Result
R1a=Vref/Voutm-1-0.43;
printf("\n For R2=1 Ohm R1b:R2 is = %.3f:%.0f \n",
    R1a,R2); // Result
R1a=10000;              //in Ohm          (Assumption)
R2=R1a/2.145;
printf("\n Value of R2 is = %.f Ohm\n",R2); //
```

```
Result
//Similarly
R1b=R2*0.43;
printf("\n Value of R1b is = %.f Ohm\n",R1b); // Result
//Ilimit=Vsense/rsc;
Vsense=0.65;               //in V
Ilimit=1;              //in Amp
Rsc=Vsense/Ilimit;
printf("\n Value of current sense resistor is = %.f Ohm\n",Rsc); // Result
R1=6000;                 //in Ohm
R3=R1*R2/(R1+R2);
printf("\n Value of minimum drift resistor is = %.f Ohm\n",R3); // Result
Ic=1;                  //in Amp
Ib=0.150;              //in Amp
B=Ic/Ib;
printf("\n Value of B minimum  = %.2f \n",B); // Result
```

Scilab code Exa 8.6 Step down Voltage regulator

```
// Chapter8
// Design  a step down regulator
// Page.No-288
// Example8_6
//Figure 8.27
// Given
clear;clc;
Vout=12;              //in V
R2=10000;            //in Ohm          (Assumption)
R1=R2*(Vout-1);
printf("\n Value of R1 is = %.f Ohm\n",R1); // Result
```

```
Isw=0.75;                   //in Amp
R3=0.11/Isw;
printf("\n Value of R3 is = %.2f Ohm\n",R3); // Result
Iout=0.200;             //in Amp
Df=0.2;
delI =2*Iout*Df;
printf("\n Value of del I is = %.3f Amp\n",delI); // Result
F=50000;               //in Hz
Vin=20;             //in V
L1=Vout*(Vin-Vout)/(delI*Vin*F);
printf("\n Value of L1 is = %.4f H\n",L1); // Result
Vripple=0.040;          //in V
C2=Vout*(Vin-Vout)/(8*F^2*Vin*Vripple*L1);
printf("\n Value of C2 is = %.6f F\n",C2); // Result
//C2 is ste a standard of 33microF or 47microF
```

Scilab code Exa 8.7 Heat sink rating

```
// Chapter8
// Determine appropiate heat sink rating
// Page.No-296
// Example8_7
//Figure 8.34
// Given
clear;clc;
Tj=150;              // in degree C
Ta=40;             // in degree C
Qjc=3.0;             // in  C/W
Qcs=1.6;             // in  C/W
PD=6;              //in W
Qsa=(Tj-Ta)/PD - Qjc-Qcs;
printf("\n Value of Qsa = %.2f C/W\n",Qsa); // Result
```

Chapter 9

Oscillators and Frequency Generators

Scilab code Exa 9.1 frequency of oscillation

```
// Chapter9
// Frequency  of oscillation
// Page.No-306
// Example9_1
//Figure 9.8
// Given
clear;clc;
R=50000;              //in Ohm
C=0.01*10^-6;              //in F
f=1/(2*%pi*R*C);
printf("\n The frequency of oscillation  = %.0f Hz\n
   ",f); // Result
```

Scilab code Exa 9.2 Maximum and minimum frequency of oscillation

```
// Chapter9
```

```
// Maximum and minimum Frequency  of oscillation
// Page.No−307
// Example9_2
//Figure 9.9
// Given
clear;clc;
// for minimium frequency
R=11100;                  //in Ohm
C=0.1*10^-6;                 //in F
f=1/(2*%pi*R*C);
printf("\n The mimimum frequency of oscillation  = %
    .1f Hz\n",f); // Result
// for maximum frequency
R=1100;                   //in Ohm
C=0.1*10^-6;                 //in F
fm=1/(2*%pi*R*C);
printf("\n The maximum frequency of oscillation  = %
    .0f Hz\n",fm); // Result
printf("\n For C=0.001microF, the range is from %.1f
     Hz to %.0f Hz\n  ", f*10,fm*10);//Result
printf("\n For C=0.0001microF, the range is from %.1
    f Hz to %.0f Hz\n  ", f*100,fm*100);//Result
Rf=10000+2700;                //in ohm
Ri=5600;                      //in Ohm
Av=1+Rf/Ri;
printf("\n Gain ,Av is %.2f \n  ", Av);//Result
```

Scilab code Exa 9.3 Frequency of oscillation

```
// Chapter9
//  Frequency  of oscillation
// Page.No−310
// Example_9_3
//Figure 9.12−9.14
// Given
```

```
clear;clc;
R=1000;                 //in Ohm
C=0.1*10^-6;                 //in F
f=1/(2*%pi*1.732*R*C);
printf("\n The mimimum frequency of oscillation  = %
   .0f Hz\n",f); // Result
//Vo=(R+Xc)*I1-R*I2
W=1/((6^0.5)*C*R);
printf("\n The frequency = %.0f Hz\n",W); // Result
//Vo/V3=1+(6*Xc/R)+(5*Xc/R^2)+(Xc/R)^3;
Vr=1-(5/((W*C*R)^2));                 //Vr=Vo/V3
printf("\n The Vo/V3 is = %.0f \n",Vr); // Result
printf("\n The gain of ladder network is B= V3/Vo =
   1/%.0f \n",Vr); // Result
```

Scilab code Exa 9.4 Value of Ri

```
// Chapter9
//  value of Rf
// Page.No-313
// Example9_4
//Figure 9.15
// Given
clear;clc;
C=0.1*10^-6;                 //in F
R=1000;                 //in Ohm
Av=-29;
Rf=-Av*R;
printf("\n The value for Rf is = %.0f Ohm\n",Rf); //
    Result
f=1/(2*%pi*6^0.5*R*C);
printf("\n The  frequency ,fo  = %.0f Hz\n",f); //
   Result
```

Scilab code Exa 9.5 Output frequency and amplitude

```
// Chapter9
//  Output Frequency and Amplitudes
// Page.No−318
// Example9_5
//Figure 9.21
// Given
clear;clc;
Vsat=13;                   //in V
R2=10000;                      //in ohm
R3=20000;                      //in ohm
R=33000;                      //in ohm
C=0.01*10^-6;                  //in Farad
Vup=Vsat*R2/R3;
printf("\n Value of Vupperthreshold  is = %.1f V\n",
   Vup); // Result
//dv/dt=Vsat/RC=k
k=Vsat/R/C;
printf("\n dv/dt = %.0f V/S\n",k); // Result
T=Vsat/k;
printf("\n T = %.5f S\n",T); // Result

f=1/T/2;
printf("\nf = %.0f Hz\n",f); // Result
```

Scilab code Exa 9.6 Square wave generator

```
// Chapter 9
// 2kHZ Square Wave generator
// Page.No−323
// Example9_6
```

```
//Figure 9.23
// Given
clear;clc;
R1=10000;                    //in Ohm
R2=R1/0.859;                    //in Ohm
fo=2000;                 //in Hz

printf("\n R2 is %.0f Ohm\n",R2); // Result
C=1/(2*R1*fo);
printf("\n C is %.9f F\n",C); // Result
```

Scilab code Exa 9.7 Output frequency

```
// Chapter 9
// determine Output frequency
// Page.No-327
// Example9_7
//Figure 9.28
// Given
clear;clc;
Vp=12;              //in V
R1=4700;                //in Ohm
R2=2000;                //in Ohm
R3=20000;                //in Ohm
C=1.1*10^-9;                //in Farad
Vc=Vp*(R3/(R2+R3));
printf("\n The control Voltage is  = %.2f V\n",Vc);
   // Result
fo=2*(Vp-Vc)/(Vp*R1*C);
printf("\n Output frequency  = %.0f Hz\n",fo); //
   Result
```

Scilab code Exa 9.8 Maximum and minimum frequency

```
// Chapter 9
// determine Output frequency
// Page.No-328
// Example9_8
//Figure 9.29
// Given
clear;clc;
Vp=12;            //in V
R1=4700;              //in Ohm
R2=2000;              //in Ohm
R3=20000;              //in Ohm
C=1.1*10^-9;              //in Farad
Vc=Vp*(R3/(R2+R3));
//for minimum Vc
Vcmin=Vc-0.5;
printf("\n The control Voltage is  = %.2f V\n",Vcmin
    ); // Result
fo=2*(Vp-Vcmin)/(Vp*R1*C);
printf("\n Output frequency  = %.0f Hz\n",fo); //
    Result
//for maximum Vc
disp("For minimum frequency Use maximum Vc");
Vcmin1=Vc+0.5;
printf("\n The control Voltage is  = %.2f V\n",
    Vcmin1); // Result
fo=2*(Vp-Vcmin1)/(Vp*R1*C);
printf("\n Output frequency  = %.0f Hz\n",fo); //
    Result
```

Scilab code Exa 9.9 Free running frequency

```
// Chapter 9
// determine Output frequency
// Page.No-333
// Example9_9
```

```
//Figure 9.37
// Given
clear;clc;
Vp=6;             //in V
R1=4000;                //in Ohm
C=330*10^-12;                //in Farad
C2=270*10^-12;                //in Farad
fo=0.3/(R1*C);
printf("\n Free runing  frequency  = %.0f Hz\n",fo);
    // Result
fl=8*fo/Vp;
printf("\n Lock Range  = %.0f Hz\n",fl); // Result
fc=sqrt(2*%pi*fl/(3600*C2))/(2*%pi);
printf("\n Capture Range  = %.0f Hz\n",fc); //
   Result
```

Scilab code Exa 9.10 Timing resistor and capacitor

```
// Chapter 9
// determine Output frequency
// Page.No-336
// Example9_10
//Figure 9.40
// Given
clear;clc;
R=10000;                //in Ohm
printf("\n Value of Assumed resistance is  = %.0f
   Ohm\n",R); // Result

Tout=100*10^-6;
C=Tout/(1.1*R);
printf("\n Value of Capacitance is  = %.11f F\n",C);
    // Result
printf("\n The nearst value would be 10nF");
```

Scilab code Exa 9.11 Square wave generator

```
// Chapter 9
// determine Output frequency
// Page.No-340
// Example9_11
// Given
clear;clc;
f=2000;          ///in Hz
DC=0.8;
T=1/f;
Thigh=DC*T;
printf("\n T high is  = %.6f Sec\n",Thigh); //
    Result
Tlow=T-Thigh;
printf("\n T low is  = %.6f Sec\n",Tlow); // Result
//assumption
Rb=10000;              //in Ohm
//Tlow=0.69RC
C1=Tlow/(0.69*Rb);
printf("\n Value of Capacitance C is  = %.10f F\n",
    C1); // Result
//Thigh=0.69(Ra+Rb)
Ra=Thigh/(0.69*C1)-Rb;
printf("\n Value of resistance Ra is  = %.0f Ohm\n",
    Ra); // Result
```

Scilab code Exa 9.12 range of output frequency

```
// Chapter 9
// determine Output frequency
// Page.No-344
```

```
// Example_9_12
//Figure 9.47
// Given
clear;clc;
R=110000;                //in Ohm
C=0.1*10^-6;                //in Farad
//
disp("When C=0.1microF")

fomin=0.15/(R*C);
printf("\n For low range with lowest  frequency  =
   %.1f Hz\n",fomin); // Result
//
R1=10000;                //in Ohm
fomax=0.15/(R1*C);
printf("\n For low range with highest  frequency  =
   %.1f Hz\n",fomax); // Result
//
disp("When C=0.01microF")
R=110000;                //in Ohm
C=0.01*10^-6;                //in Farad
fomin=0.15/(R*C);
printf("\n For low range with lowest  frequency  =
   %.1f Hz\n",fomin); // Result
//
R1=10000;                //in Ohm
fomax=0.15/(R1*C);
printf("\n For low range with highest  frequency  =
   %.1f Hz\n",fomax); // Result
//
disp("When C=0.001microF")
R=110000;                //in Ohm
C=0.001*10^-6;                //in Farad
fomin=0.15/(R*C);
printf("\n For low range with lowest  frequency  =
   %.1f Hz\n",fomin); // Result
//
R1=10000;                //in Ohm
```

```
fomax=0.15/(R1*C);
printf("\n For low range with highest  frequency  =
   %.1f Hz\n",fomax); // Result
```

Chapter 10

Integrators and Differentiators

Scilab code Exa 10.1 vout and lower frequency range

```
//chapter 10
//Vout and lower frequency
//page no. 354
//Example10_1
//Figure 10.7
//Given
clc;
clear;
t=0;
Ri=10000;                //in Ohm
C=10^-8;                //in farad
Rf=100000;                //in Ohm
//Vout(t)=-1/(Ri*C)*int(Vi(t))dt
Flow=1/(2*%pi*Rf*C);
printf("\n Flow is %.0f Hz",Flow);
```

Scilab code Exa 10.2 Output

```
//chapter 10
//Vout
//page no. 356
//Example10_2
//Figure 10.7
//Given
clc;
clear;
step=0.1;
t=0:step:10;
disp("Answer is coming interm of t so solution is
   done by graph");
//x=1;
//f=5000;
x0=-1.6;x1=0:0.1:10;
Vin=sin(t);

xtitle('Sin(x)','t')
X=integrate('sin(t)','t',x0,x1);
Ri=10000;             //in Ohm
C=10^-8;             //in farad
Rf=100000;            //in Ohm
Vout=-0.318*X;
clf;
plot(t,Vin,t,Vout);
xtitle('Input(Blue) / Output(Green)','t','V');
```

Scilab code Exa 10.3 Output of the circuit

```
//Chapter 10
//Sketch the output Waveform
//page no. 358
//Example10_3
//Figure 10.7
//Given
```

```
clc;
clear;
T0=4;
t=-5.99:0.01:6;
t_temp=0.01:0.01:T0/4;
s=length(t)/length(t_temp);
dx=[];
x=[];
for i=1:s
    if modulo(i,2)==1  then
        dx=[dx -ones(1,length(t_temp))];
        x=[x .1*t_temp($:-1:1)];
    else
        dx=[dx ones(1,length(t_temp))];
        x=[x .1*t_temp];
    end
end
clf();
subplot(1,2,2)
plot(50*t,10*x-0.5,8)
xtitle("Output Waveform","Microsecond","V");
t=-30:0.01:30;
subplot(1,2,1);
plot('onn',10*t,[2*squarewave(2*t/(%pi),50)])
xtitle("Input Waveform","Microsecond","V");
```

Scilab code Exa 10.4 Integrator connected to accelerometer

```
//chapter 10
//Vout
//page no. 359
//Figure 10.11a
//Given
clc;
clear;
```

```
Rf=400000;                //in Ohm
C=20*10^-9;                //in farad
flow=1/(2*%pi*Rf*C);
printf("\n Flow = %.1f Hz",flow);
Ri=15000;                //in Ohm
//integration
function Vin=f(t),Vin=.6,endfunction
exact=-2.5432596188;
I=intg(0,10^-3,f)

Vout=-1*I/Ri/C;
printf("\n Vout(t) = %.1f V",Vout);//Result

//Graph
t=(0:0.001:6);
V=Vout*ones(1:0.001:4);

for i=0.001:0.001:1-.001
    V=[Vout*(1-i) V Vout*(1-i)]
end

V=[V zeros(5.001:0.001:6)]
V=[2 V 0]
clf;
plot(t,V)
xgrid;
xtitle('Integrator output','$t$',"$Voltage$")
```

Scilab code Exa 10.5 Range for differentiation

```
//Chapter 10
//range of Differentiation & Sketch the output
    Waveform
//page no. 365
//Example10_5
```

```
//Figure 10.19
//Given
clc;
clear;
Ri=100;                 //in Ohm
Ci=10^-8;                 //in farad
Rf=5000;                 //in Ohm
Cf=10^-10;                 //in farad
fhf=1/(2*%pi*Rf*Cf);
fh_in=1/(2*%pi*Ri*Ci);
printf("\n Fhigh(f dbk)=%.0f Hz",fhf);
printf("\n Fhigh(in)=%.0f Hz",fh_in);
//graph is drawn taking function sin(t)
t=[0:0.01:15];
Vi=sin(t);
plot(2*Vi);
plot(diff(-1.885*100*Vi));
xtitle("Partial Differentiator of sin(t)","t","V");

xgrid;
```

Scilab code Exa 10.6 Output Waveform

```
//Chapter 10
//Sketch the output Waveform
//page no. 368
//Example10_6
//Figure 10.19
//Given
clc;
clear;
Rf=5000;                 //in Ohm
C=10^-8;                 //in farad

f=4000;                 //in KHz
```

```
T=1/f;
printf("\n T = %.6f second",T);
S=6/(125*10^-6);
printf("\n Slope = %.0f V/S",S);
//graph
step=1;
t=0:step:1;
Vin=S*t;
dy=diff(S*t/step); //approximate differentiation of sine function

Vout=-Rf*C*dy;
printf("\n Vou(t) = %.1f V",Vout);

T0=4;
t=-5.99:0.01:6;
t_temp=0.01:0.01:T0/2;
s=length(t)/length(t_temp);
dx=[];
x=[];
for i=1:s
    if modulo(i,2)==1  then
        dx=[dx -ones(1,length(t_temp))];
        x=[x .5*t_temp($:-1:1)];
    else
        dx=[dx ones(1,length(t_temp))];
        x=[x .5*t_temp];
    end
end
//figure

subplot (1,1,1)
plot(t,3-6*x,'b',t,2.4*dx,'r')
xtitle('Input(b) and Output(r)','t',"V")
```

Scilab code Exa 10.7 Sketch the output wave form

```
//Chapter 10
//Sketch the output Waveform
//page no. 370
//Example10_7
//Figure 10.23
//Given
clc;
clear;
f=4;                //in KHz
T=1/f;
S=5*10^6;
step=1;
t=0:step:1;
Vin=S*t;
printf("\n Vin(t) = %.0f*t",S);
Rf=5000;                //in Ohm
C=10^-8;                //in farad
dy=diff(S*t/step); //approximate differentiation of sine function
Vout=-Rf*C*dy;
printf("\n Vou(t) = %.0f V",Vout);
t=(0:0.1:5*%pi)';
plot(t,3*squarewave(t));
xtitle("Output Wave form","t","V");
xtitle('Input(b) and Output(r)','t');
```

Scilab code Exa 10.8 LVDT

```
//Chapter 10
//Sketch the output Waveform
//page no. 370
//Example10_8
//Figure 10.24a
```

```
//Given
clc;
clear;
Ri=250;            //in Ohm
Ci=0.5*10^-6;            //in farad
Rf=40000;            //in Ohm
Cf=2*10^-9;            //in farad
fhf=1/(2*%pi*Rf*Cf);
fh_in=1/(2*%pi*Ri*Ci);
printf("\n Fhigh(f dbk)=%.0f Hz",fhf);
printf("\n Fhigh(in)=%.0f Hz",fh_in);
//

S=10;            //in V/S
step=1;
disp(S,"For slope")
t=0:step:1;
Vin=10*t;
dy=diff(S*t/step); //approximate differentiation of sine function
Vout=-Rf*Ci*dy;
printf("\n Vout(t) = %.1f V",Vout);
//
Slope=-4/0.2;            //in V/S
step=1;
disp(Slope,"For slope")
t=0:step:1;
Vin=10*t;
dy=diff(Slope*t/step); //approximate differentiation of sine function
Vout2=-Rf*Ci*dy;
printf("\n Vout(t) = %.1f V",Vout2);
//graph
t=(0:0.0001:1.5);
V=Vout*ones(0:0.0001:.2);
V=[V zeros(.2+.0001:0.0001:.5-.0001)];
V=[V Vout2*ones(.5:0.0001:.7)];
V=[V zeros(.7+.0001:0.0001:1-.0001)];
```

```
V=[V Vout*ones(1:0.0001:1.2)];
V=[V zeros(1.2+.0001:.0001:1.5)]
clf;
plot(t,V)

xtitle('Differentiator output','$t$',"$Voltage$")
```

Chapter 11

Active filters

Scilab code Exa 11.1 Butterworth low pass filter

```
// Chapter 11
// Design a low pass Butterworth filter
// Page.No-397
// Example11_1
//Figure 11.13 and 11.14
// Given
clear;clc;
L=1.414;                //Alpha
Ri=1;              //in Ohm
Rf=2-L;
printf("\n The value of Rf is = %.3f Ohm\n",Rf); //
   Result
Av=1+Rf/Ri;
printf("\n The pass band gain of  = %.3f \n",Av); //
    Result
fc=1000;                //in Hz
W=2*%pi*fc;
printf("\n The critical frequency is = %.0f radians
   per seconds\n",W); // Result
R=1/W;
printf("\n The Resistor required is  = %.6f Ohm\n",R
```

```
); // Result
C1=2/L;
printf("\n The capacitor1 required is = %.3f F\n",
    C1); // Result
C2=L/2;
printf("\n The capacitor2 required is = %.3f F\n",
    C2); // Result
```

Scilab code Exa 11.2 Design second order bessel filter

```
// Chapter 11
// Design a second order high pass Bessel's filter
// Page.No-404
// Example11_2
//Figure 11.25
// Given
clear;clc;
L=1.732;                    // Aplha = DAMPING
Kf=1.274;
R1=L/2;
printf("\n The Resistor required is = %.3f Ohm\n",
    R1); // Result
R2=2/L;
printf("\n The Resistor required is = %.3f Ohm\n",
    R2); // Result
F3db=5000;                  //in Hz
Fc=F3db/Kf;
printf("\n The critical frequency is = %.0f Hz\n",Fc
    ); // Result
Wc=2*%pi*Fc;
printf("\n The Wc is = %.0f radians per seconds\n",
    Wc); // Result
R1n=R1/Wc;
printf("\n The value of scaled Resistor R1 is = %.7
    f Ohm\n",R1n); // Result
```

```
R2n=R2/Wc;
printf("\n The value of scaled Resistor R2 is  = %.7
   f Ohm\n",R2n); // Result
```

Scilab code Exa 11.3 Fifth order system

```
// Chapter 11
// Design a filter to remove subsonic tones
// Page.No-406
// Example11_2
//Figure 11.29
// Given
clear;clc;
f3db=20;              //In Hz
W3db=2*%pi*f3db;
printf("\n The desired break frequency, W3db is = %
   .1f radians per second\n",W3db); // Result
disp("Stage 1");
kf=1.557;
Wc=W3db/kf;
printf("\n The Wc is = %.1f radians per second\n",Wc
   ); // Result
Rscaled=1/80.7;   //Rscaled value
R=1000*Rscaled;       //Practical Value
printf("\n The scaled Resistor required is  = %.3f
   Ohm\n",R); // Result
C=1*10^-6;            //Assumed Value
printf("\n The assumed capacitor  is  = %.6f Farad\n
   ",C); // Result
disp("Stage 2");
Alpha=1.775;
R1=Alpha/2;
printf("\n The Resistor R1 required is  = %.4f Ohm\n
   ",R1); // Result
R2=2/Alpha;
```

```
printf("\n The Resistor R2 required is = %.3f Ohm\n",R2); // Result
kf1=1.613;
Wc1=W3db/kf1;
printf("\n The required critical frequency ,Wc is = %.1f radians per second\n",Wc1); // Result
//we will scale the resistor
R1s=R1/Wc1;
R2s=R2/Wc1;
printf("\n The scaled resistor R1 is = %.4f Ohm\n",R1s); // Result
printf("\n The scaled resistor R2 is = %.4f Ohm\n",R2s); // Result
printf("\n The assumed capacitor is = %.6f Farad\n",C); // Result
//for practical values of resistor and capacitor multiplying by 10^6
R1m=R1s*10^6;
R2m=R2s*10^6;
printf("\n The practical value of resistor R1 is = %.0f Ohm\n",R1m); // Result
printf("\n The practical value of resistor R2 is = %.0f Ohm\n",R2m); // Result
printf("\n The assumed capacitor is = %.6f Farad\n",C); // Result

disp("Stage 3");
Alpha=1.091;
R21=Alpha/2;
R22=2/Alpha;
kf2=1.819;
Wc2=W3db/kf2;
printf("\n The required critical frequency ,Wc is = %.1f radians per second\n",Wc2); // Result
//Scale resistor by Wc to achive tuning frequency
R21s=R21/Wc2;
R22s=R22/Wc2;
printf("\n The scaled resistor R1 is = %.5f Ohm\n",
```

```
    R21s); // Result
printf("\n The scaled resistor R2 is  = %.4f Ohm\n",R22s); // Result
//for practical values of resistor and capacitor multiplying by 10^6
R21m=R21s*10^6;
R22m=R22s*10^6;
printf("\n The practical value of  resistor R1 is  = %.0f Ohm\n",R21m); // Result
printf("\n The practical value of  resistor R2 is  = %.0f Ohm\n",R22m); // Result
printf("\n The assumed capacitor  is  = %.6f Farad\n",C); // Result
```

Scilab code Exa 11.4 Crossover network

```
// Chapter 11
// crossover network
// Page.No-412
// Example11_4
//Figure 11.32
// Given
clear;clc;
L=1.414;                //Alpha
fc=800;             //In Hz
Rf=2-L;
printf("\n The value of Rf is = %.3f Ohm\n",Rf); // Result
Wc=2*%pi*fc;
printf("\n The critical frequency is = %.0f radians per seconds\n",Wc); // Result
R=1/Wc;
printf("\n The value of scaled Resistor R1 is  = %.7f Ohm\n",R); // Result

```

```
printf("\n The value of scaled Resistor and
    capacitor is = %.0f Ohm and 10nF \n",R*10^8); //
     Result
```

Scilab code Exa 11.5 Band pass filter

```
// Chapter 11
// Band pass Filter
// Page.No-418
// Example11_5
// Given
clear;clc;
f2=1200;                    //in Hz
f1=800;                     //in Hz
BW=f2-f1;
printf("\n The Bandwidth is %.3f Hz\n",BW); //
    Result
fo=(f1*f2)^0.5;
printf("\n  fo is %.0f Hz\n",fo); // Result
Q=fo/BW;
printf("\n  Q is %.2f \n",Q); // Result
Av=-2*Q*Q;
printf("\n Av is %.0f \n",Av); // Result
fut=10*Av*fo;
printf("\n funity is %.0f Hz\n",fut); // Result
R2=2*Q;
printf("\n R2 is %.1f Ohm\n",R2); // Result
R1b=Q/(2*Q*Q-1);
printf("\n R1b is %.4f Ohm\n",R1b); // Result
W=2*%pi*fo;
printf("\n The  frequency is = %.0f radians per
    seconds\n",W); // Result
C=1/W;
printf("\n C is %.7f F\n",C); // Result
//practical component value
```

```
printf("\n R and C are %.0f Ohm and %.8f F\n",R2*10,
    C/10); // Result
```

Scilab code Exa 11.6 Band pass filter with center frequency

```
// Chapter 11
// Band pass Filter
// Page.No-424
// Example_11_6
// Given
clear;clc;
Q=25;
fo=4300;                 //in Hz
Rd=3*Q-1;                //R damping
printf("\n Rdamping is %.1f Ohm\n",Rd); // Result
W=2*%pi*fo;
printf("\n The  frequency is = %.0f radians per
    seconds\n",W); // Result
C=1/W;
printf("\n C is %.7f F\n",C); // Result
//practical component value
printf("\n Rdamping and C are %.0f Ohm and %.10f F\n
    ",Rd*5000,C/5000); // Result
//remaining other Resistor are of 5K Ohm
```

Scilab code Exa 11.7 Notch filter

```
// Chapter 11
// Band pass Filter
// Page.No-427
// Example_11_7
// Given
clear;clc;
```

```
Q=30;
fo=60;                  //in Hz
Rd=3*Q-1;               //R damping
printf("\n Rdamping is %.1f Ohm\n",Rd); // Result
W=2*%pi*fo;
printf("\n The  frequency is = %.0f radians per
    seconds\n",W); // Result
C=1/W;
printf("\n C is %.5f F\n",C); // Result
```

Chapter 12

Analog to Digital to Analog Conversion

Scilab code Exa 12.1 determine the resolution

```
// Chapter 12
// Resolution of System
// Page.No-445
// Example12_1
// Given
clear;clc;
V=2;              //in V
Bits=12;
levels=2^Bits;         //12 bit words
step=V/levels;
printf("\n The system can resolve = %.6f V\n",step);
    // Result
Drange=20*log10(levels);
printf("\n The Dynamic Range is = %.0f dB\n",Drange)
    ; // Result

DR=6*Bits;
printf("\n The Dynamic Range is approx (6dB * no.of
    bits),i.e. = %.0f dB\n",DR); // Result
```

Scilab code Exa 12.2 Determine the step size

```
// Chapter 12
// Step size
// Page.No-446
// Example12_2
// Given
clear;clc;
Bits=16;
V=0.775;                   //in V
Vp=1.550;                   //in Vp_p
levels=2^Bits;              //12 bit words
DR=6*Bits;
printf("\n The Dynamic Range is  = %.0f dB\n",DR);
   //
step=Vp/levels;
printf("\n The system can resolve = %.8f V\n",step);
    // Result
```

Scilab code Exa 12.3 sampling rates and no of bits

```
// Chapter 12
// Minimum acceptable frquency range
// Page.No-448
// Example_12_3
// Given
clear;clc;
DR=50;                     //in dB
Bits=DR/6;
printf("\n The Bits required are = %.1f \n",Bits);
   // Result
```

```
//we cannot  have fractional bit so,
printf("\n we cannot  have fractional bit so, Bits
   required are = %.0f \n",Bits+1); // Result
```