Scilab Textbook Companion for Modern Communication Circuits by J. R. Smith[1]

Created by
Pratik Chandrakant Chogale
Bachelor of engineering
Electronics Engineering
Mumbai University
College Teacher
Mr. Atul Atalkar
Cross-Checked by
Mukul Kulkarni

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Book Description

Title: Modern Communication Circuits

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

Exa Example (Solved example)

Eqn Equation (Particular equation of the above book)

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

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

Contents

List of Scilab Codes

List of Figures

Chapter 1

Introduction to Radio Communication System

Scilab code Exa 1.3 IRCS Ex 1 3

```
clc
//Chapter 1:Introduction to Radio Communication
//example 1.3 page no 3
//given
disp('The transfer function has no finite zeros ')
p=poly([1 0.5 1],"s","c")
x=roots(p)
disp('The poles ')
disp(x)
```

Scilab code Exa 1.4 IRCS Ex 1 4

```
clc
//Chapter 1:Introduction to Radio Communication
   Systems
```

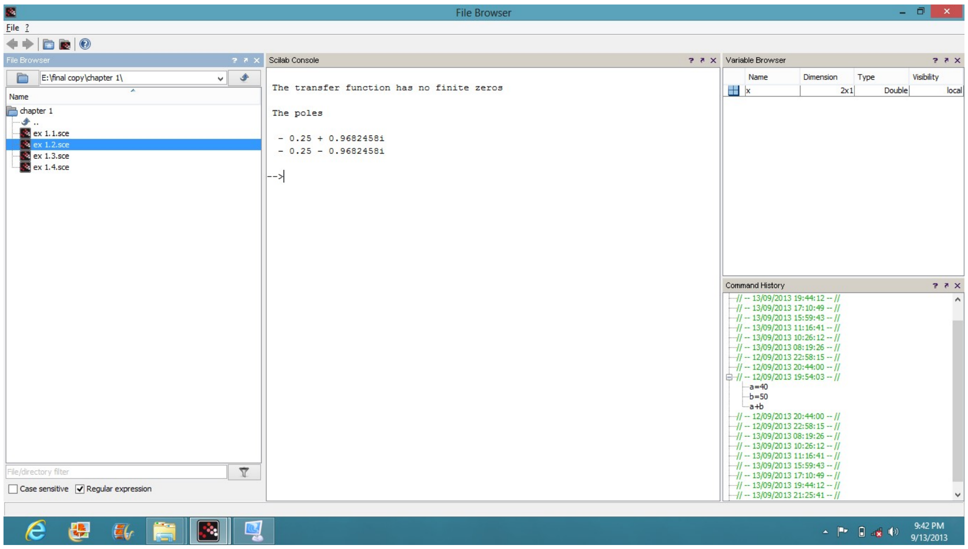

Figure 1.1: IRCS Ex 1 3

```
//example 1.4 page no 8
//given
fIF=455*10^3//intermediate frequency
f0=1.455*10^6//oscillator frequency
fIM=fIF+f0//image frequency
mprintf('the image frequency is %f MHz',fIM*1e-6)
```

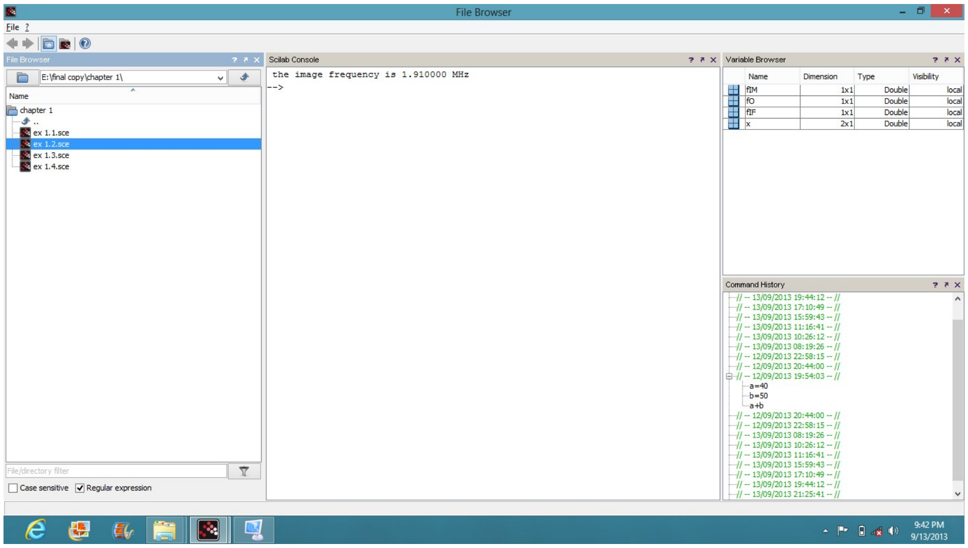

Figure 1.2: IRCS Ex 1 4

Chapter 2

Small Signal Amplifiers

Scilab code Exa 2.1 SSA Ex 2 1

```
clc
//Chapter 2:Small Signal Amplifiers
//example 2.1 page no 17
//given
B=100//current gain
Ic=10^-3//collector bias current
//kT/q=0.026 where as k=Boltzmanns constant T=
    temperature q=charge on an electron
rpi=(0.026*B)/Ic//base emitter resistance
mprintf('the base emitter resistance is %d ohm',rpi)
```

Scilab code Exa 2.2 SSA Ex 2 2

```
clc
//Chapter 2:Small Signal Amplifiers
```

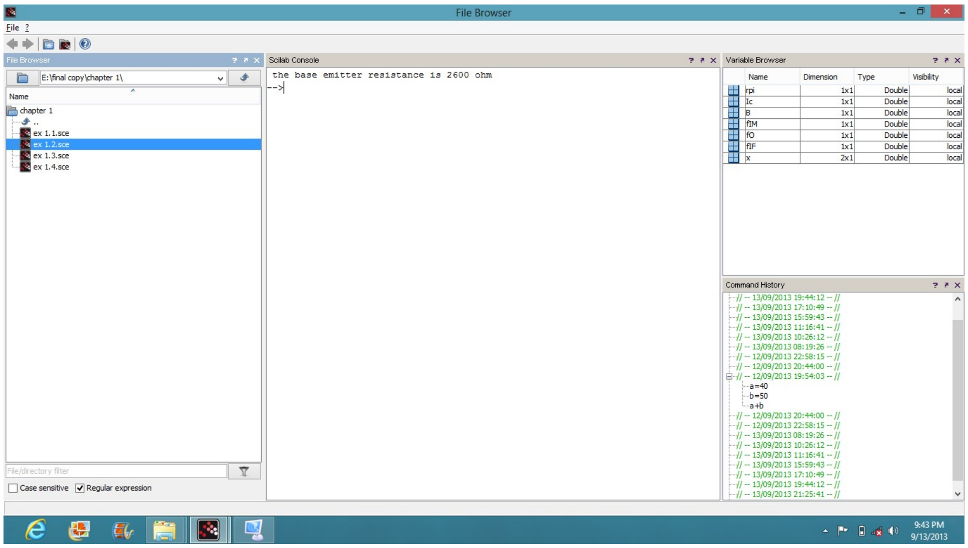

Figure 2.1: SSA Ex 2 1

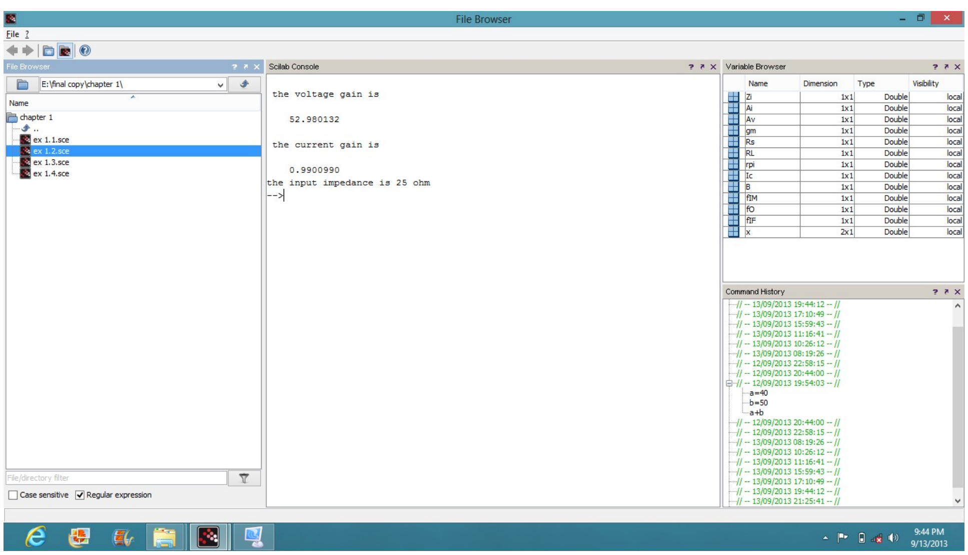

Figure 2.2: SSA Ex 2 2

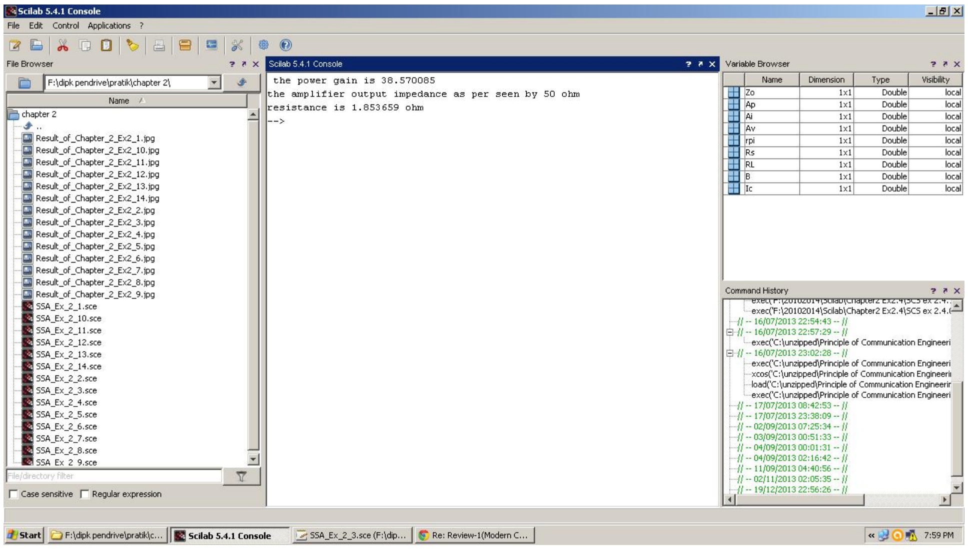

Figure 2.3: SSA Ex 2 3

```
//example 2.2 page no 22
//given
Ic=10^-3//collector bias current
B=100//current gain
RL=4*10^3//load resistance
Rs=50//source resistance
gm=40*Ic//transconductance
rpi=B/gm//base emitter resistance
Av=(B*RL)/(rpi+Rs*(1+B))//voltage gain
disp(Av,'the voltage gain is ')
Ai=B/(1+B)//current gain
disp(Ai,'the current gain is ')
Zi=1/gm//input impedance
mprintf('the input impedance is %d ohm',Zi)
```

Scilab code Exa 2.3 SSA Ex 2 3

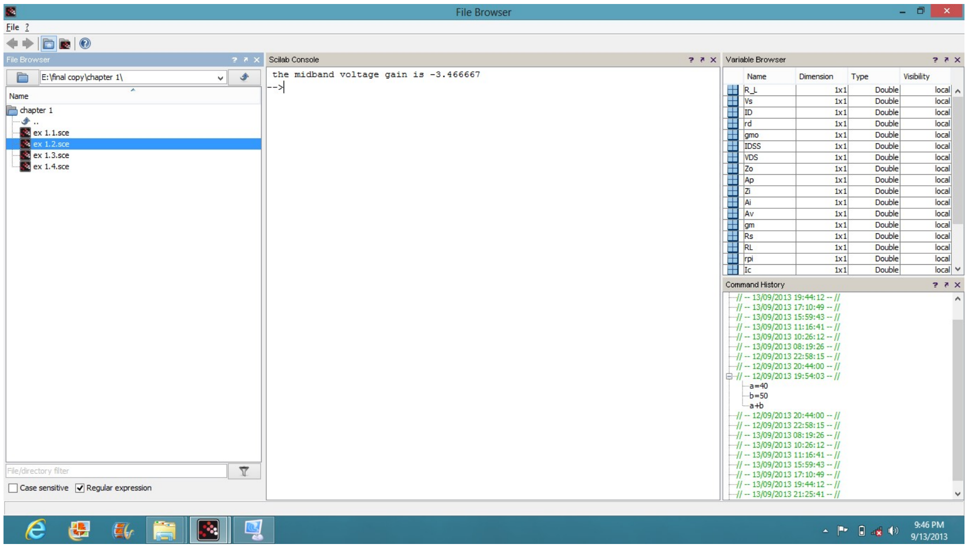

Figure 2.4: SSA Ex 2 4

```
clc
//Chapter 2:Small Signal Amplifiers
//example 2.3 page no 25
//given
Ic=40*10^-3//collector bias current
B=40//current gain
RL=50//load resistance
Rs=50//source resistance
rpi=(0.026*B)/Ic//base emitter resistance
Av=(B*RL)/(rpi+Rs+(1+B)*RL)//voltage gain
Ai=(1+B)//current gain
Ap=Ai*Av//power gain
mprintf('the power gain is %f \n',Ap)
Zo=(rpi+Rs)/(1+B)//output impedance
mprintf('the amplifier output impedance as per seen
    by 50 ohm \nresistance is %f ohm',Zo)
```

Scilab code Exa 2.4 SSA Ex 2 4

```
clc
//Chapter 2:Small Signal Amplifiers
//example 2.4 page no 30
//given
VDS=15
IDSS=8*10^-3
gmo=4*10^-3
rd=13*10^3
ID=2*10^-3//drain current
Vs=0//source is grounded Vgs=Vg-Vs=Vi
RL=2*10^3//load resistance
R_L=(RL*rd)/(RL+rd)//equivalent load resistance
gm=gmo*sqrt(ID/IDSS)//transconductance
Av=-gm*R_L//voltage gain Av=Vo/Vi=-gm*R_L
mprintf('the midband voltage gain is %f ',Av)
```

Scilab code Exa 2.5 SSA Ex 2 5

```
clc
//Chapter 2:Small Signal Amplifiers
//example 2.5 page no 32
//given
gm=60*10^-3//transconductance
Si=50//antenna source impedance
rd=2.5*10^3
Zo=rd/(1+gm*rd)//output impedance without load
RL=200//load resistance
zo1=200*Zo/(200+Zo)//output impedance with load
```

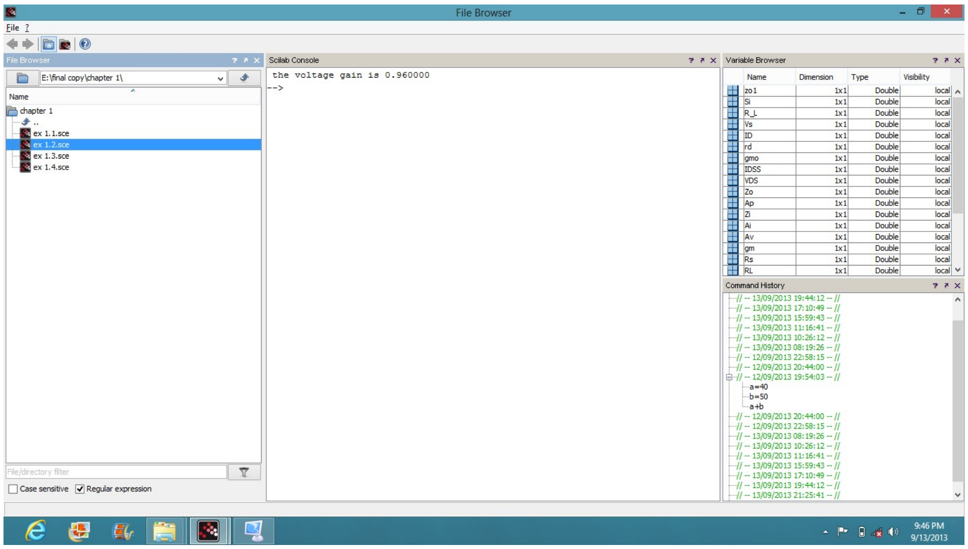

Figure 2.5: SSA Ex 2 5

```
Av=gm*(rd*RL/rd+RL)/(1+gm*(rd*RL/rd+RL))//voltage gain
mprintf('the voltage gain is %f ',Av)
```

Scilab code Exa 2.6 SSA Ex 2 6

```
clc
//Chapter 2:Small Signal Amplifiers
//example 2.6 page no 36
//given
RL=50//load resistance
gm=0.2//tranceconductance
B=100//current gain
rpi=B/gm//transistor input resistance
disp(rpi,'the transistor input resistance is ')
disp('The load resistance seen bythe first stage
```

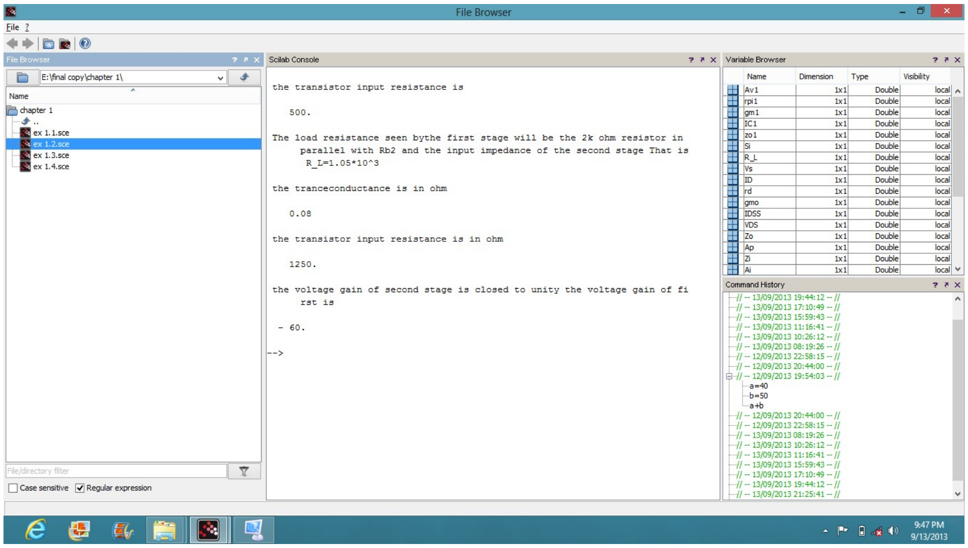

Figure 2.6: SSA Ex 2 6

```
    will be the 2k ohm resistor in parallel with Rb2
    and the input impedance of the second stage That
    is R_L=1.05*10^3')
R_L=1.05*10^3
Rs=500//source resistance
IC1=2*10^-3//collector bias current
gm1=40*IC1//tranceconductance
disp(gm1,'the tranceconductance is in ohm ')
rpi1=B/gm1//transistor input resistance
disp(rpi1,'the transistor input resistance is in ohm
    ')
Av1=-gm1*R_L*(rpi1/(rpi1+Rs))//the voltage gain of
    first
disp(Av1,'the voltage gain of second stage is closed
    to unity the voltage gain of first is ')
```

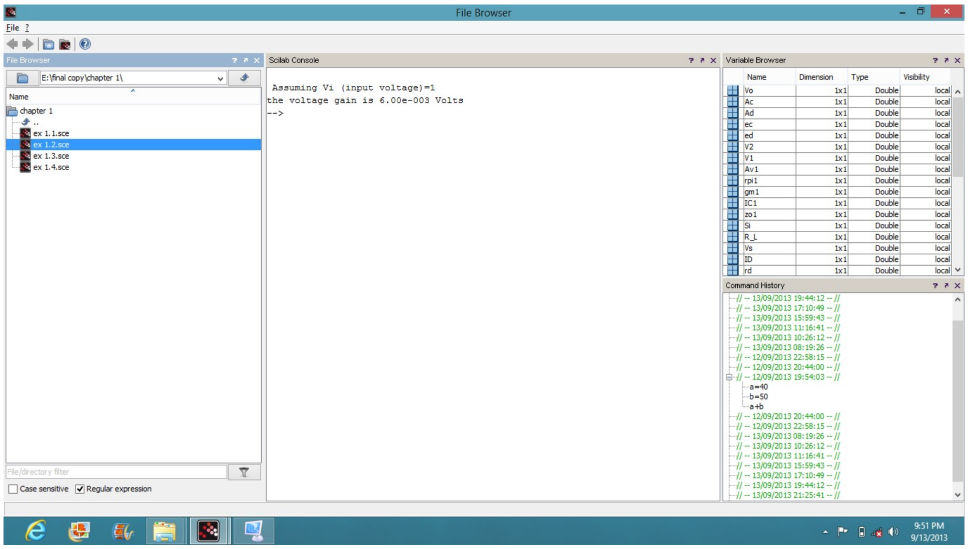

Figure 2.7: SSA Ex 2 8

Scilab code Exa 2.8 SSA Ex 2 8

```
clc
//Chapter 2:Small Signal Amplifiers
//example 2.8 page no 42
//given
disp('Assuming Vi (input voltage)=1')
V1=(5+10^6)/(5+2*10^6)//voltage on the positive terminal
V2=10^6/(5+2*10^6)//the voltage on the inverting terminal
ed=V1-V2//differential voltage
ec=(V1+V2)/2//common-mode voltage
Ad=2*10^3//differentail gain
Ac=2*10^-3//common mode gain (here 20% of differentail gain)
Vo=Ad*ed+Ac*ec//actual amplifier output
mprintf('the voltage gain is %3.2e Volts',Vo)
```

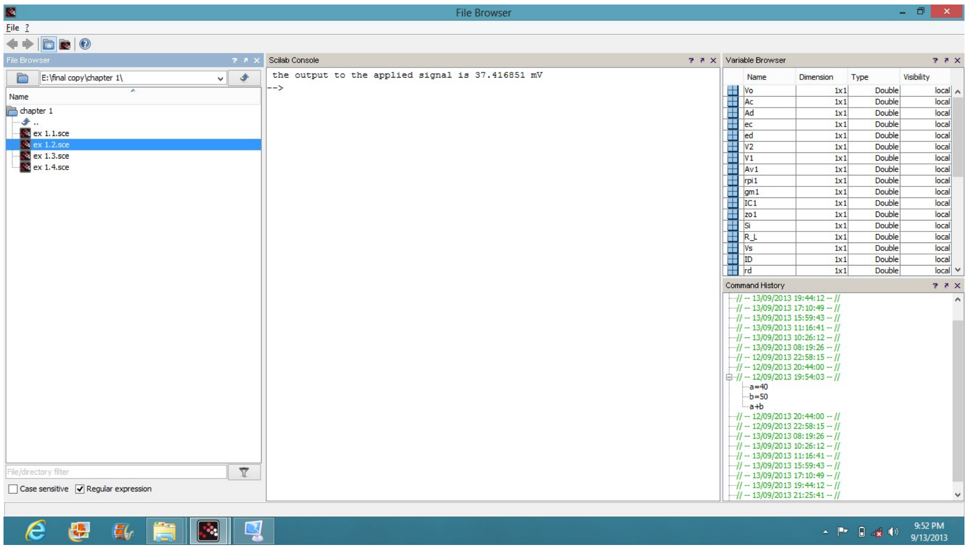

Figure 2.8: SSA Ex 2 9

Scilab code Exa 2.9 SSA Ex 2 9

```
clc
//Chapter 2:Small Signal Amplifiers
//example 2.9 page no 45
//given
ed=5*10^-3//differential voltage
ec=2.5*10^-3//common-mode voltage
gm=1.5*10^-3//tranceconductance
rd=500*10^3
Rs=150*10^3//source resistance
RL=10*10^3//load resistance
Ac=-gm*RL/(1+2*gm*Rs)//common mode gain
Ad=gm*RL/2//differential gain
Vo=ec*Ac+ed*Ad//actual amplifier output
```

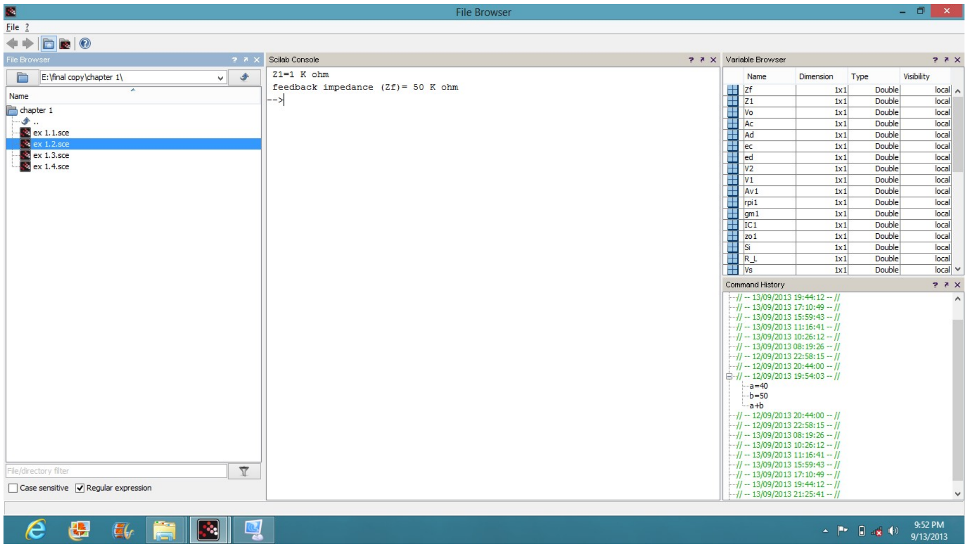

Figure 2.9: SSA Ex 2 10

```
mprintf('the output to the applied signal is %f mV',
    Vo*1e3)
```

Scilab code Exa 2.10 SSA Ex 2 10

```
clc
//Chapter 2:Small Signal Amplifiers
//example 2.10 page no 51
//given
Z1=1*10^3//asumming impedance value for required
    specification
Av=-50//voltage gain
Zf=-Av*Z1//feedback impedance
mprintf('Z1=%d K ohm \n feedback impedance (Zf)= %d
    K ohm',Z1*1e-3,Zf*1e-3)
```

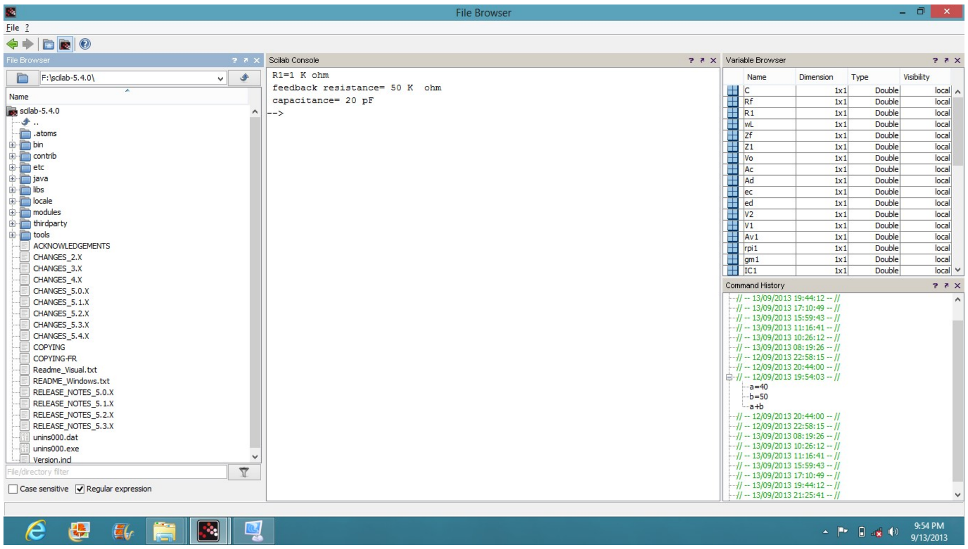

Figure 2.10: SSA Ex 2 11

Scilab code Exa 2.11 SSA Ex 2 11

```
clc
//Chapter 2:Small Signal Amplifiers
//example 2.11 pag no 51
//given
wL=10^6//bandwidth
R1=1*10^3//taking resistance value for required
    specification
Av=-50//voltage gain
Rf=-Av*R1//feedback resistance
C=(wL*Rf)^-1//capacitance
mprintf('R1=%d K ohm \n feedback resistance= %d K
   ohm \n capacitance= %d pF',R1*1e-3,Rf*1e-3,C*1e12
   )
```

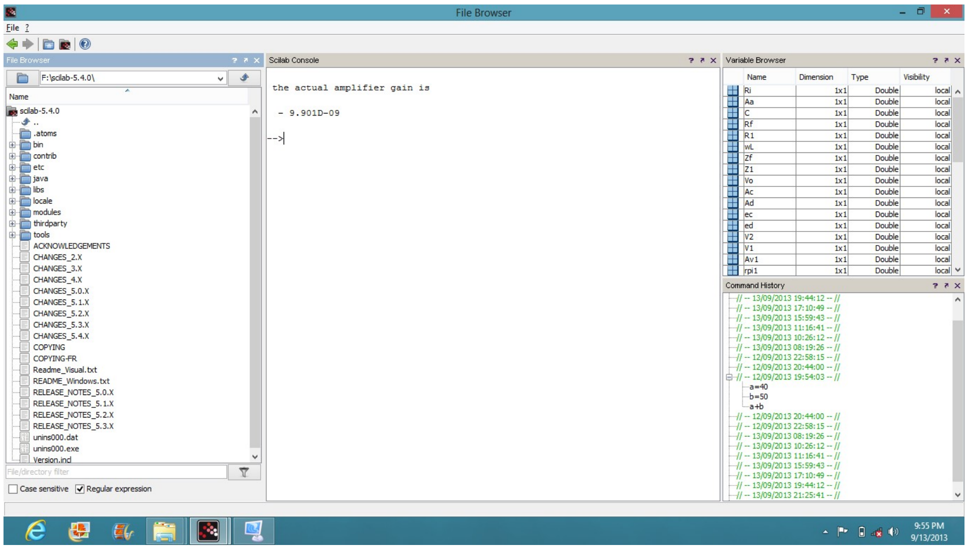

Figure 2.11: SSA Ex 2 12

Scilab code Exa 2.12 SSA Ex 2 12

```
clc
//Chapter 2:Small Signal Amplifiers
//example 2.12 page no 53
//given
Aa=10^4//open loop gain
Rf=10^4//feedback resistance
Ri=100//input resistance
Av=-(Rf/Ri)/(1+(Ri+Rf)*(Aa*Ri))//actual amplifier gain
disp(Av,'the actual amplifier gain is ')
```

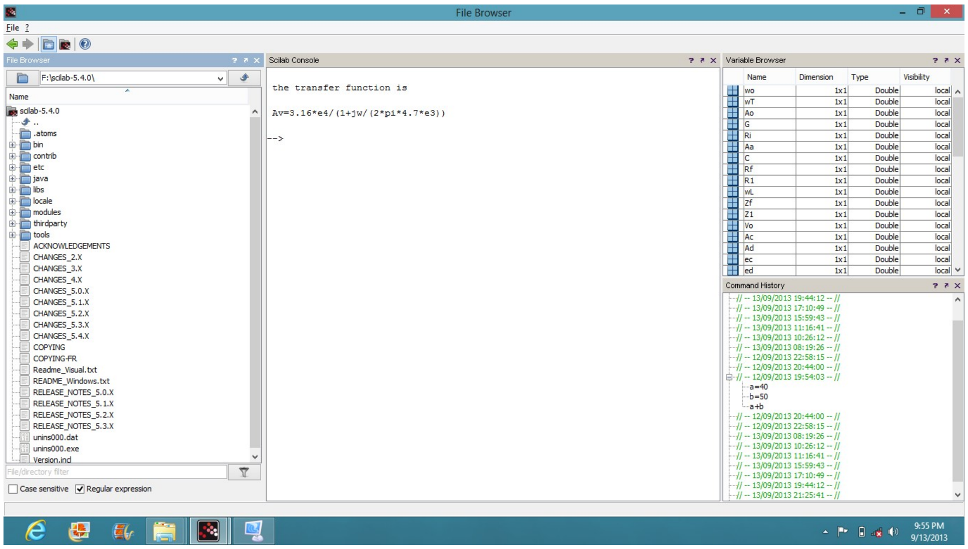

Figure 2.12: SSA Ex 2 13

Scilab code Exa 2.13 SSA Ex 2 13

```
clc
//Chapter 2:Bipolar transistor amplifiers
//example 2.13 page no 53
//given
G=90//low frequency gain in dB
Ao=(G/20)//low frequency open loop gain
wT=150*10^6//gain bandwidth product
wo=wT/Ao//bandwidth
disp('the transfer function is')
disp('Av=3.16*e4/(1+jw/(2*pi*4.7*e3))')
```

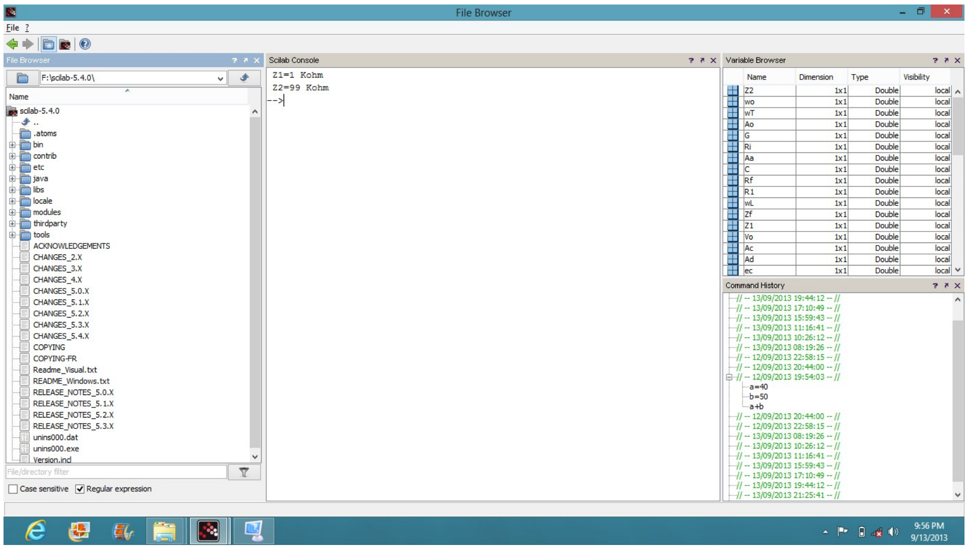

Figure 2.13: SSA Ex 2 14

Scilab code Exa 2.14 SSA Ex 2 14

```
clc
//Chapter 2:Small Signal Amplifiers
//example 2.14 page no 57
//given
Z1=1*10^3//assuming impedance value for required specification
Av=100//voltage gain
Z2=(Av-1)*Z1
mprintf('Z1=%d Kohm \n Z2=%d Kohm',Z1*1e-3,Z2*1e-3)
```

Chapter 3

Network Noise and Intermodulation Distortion

Scilab code Exa 3.3 NNID Ex 3 3

```
clc
//Chapter 3:Network noise and intermodulation distortion
//example 3.3 page no 80
//given
NF1=2//first stage noise figure
NF2=6//second stage noise figure
F1=10^(NF1/10)//first stage noise factor
F2=10^(NF2/10)//second stage noise factor
G1=15.9//gain of first stage equivalent to 12dB
G2=10//gain of second stage equivalent to 10dB
F=F1+(F2-1)/G1//overall noise factor
NF=10*log10(F)//noise figure of the two-stage systemm
printf('the noise figure of the two-stage system is %f dB',round(NF*10)/10)
```

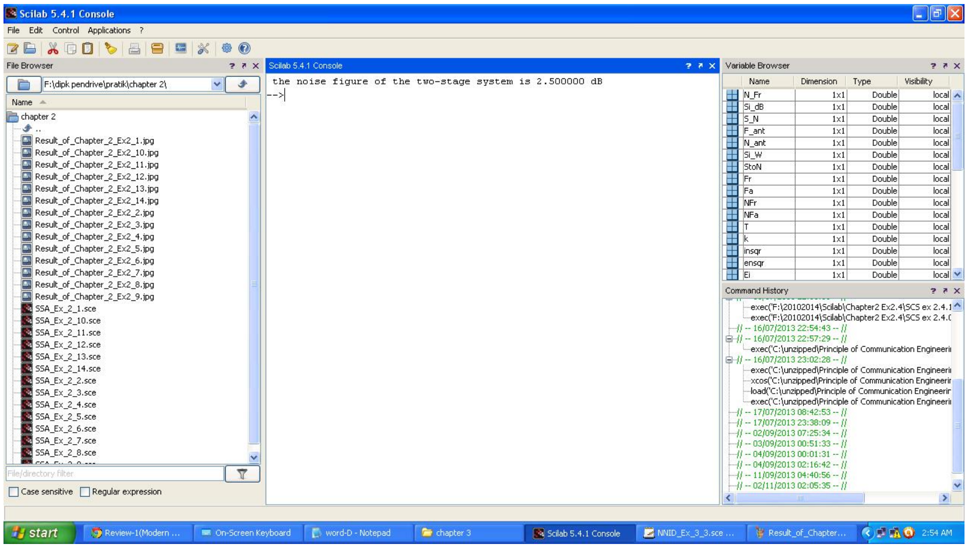

Figure 3.1: NNID Ex 3 3

Scilab code Exa 3.4 NNID Ex 3 4

```
clc
//Chapter 3:Network noise and intermodulation
    distortion
//example 3.4 page no 81
//given
k=1.37*10^-23//boltzmann's onstant
T=290//operating tempreture
B=3*10^3//bandwidth
F=1.779//overall noise factor(from previous ex)
G1=15.9//gain of first stage(from previous ex)
G2=10//gain of second stage(from previous ex)
Ni_Na=F*k*T*B//noise at the input (addition of Ni
    and Na)
No=G1*G2*(Ni_Na)//the output noise
mprintf('the output noise is %3.2e W',No)
```

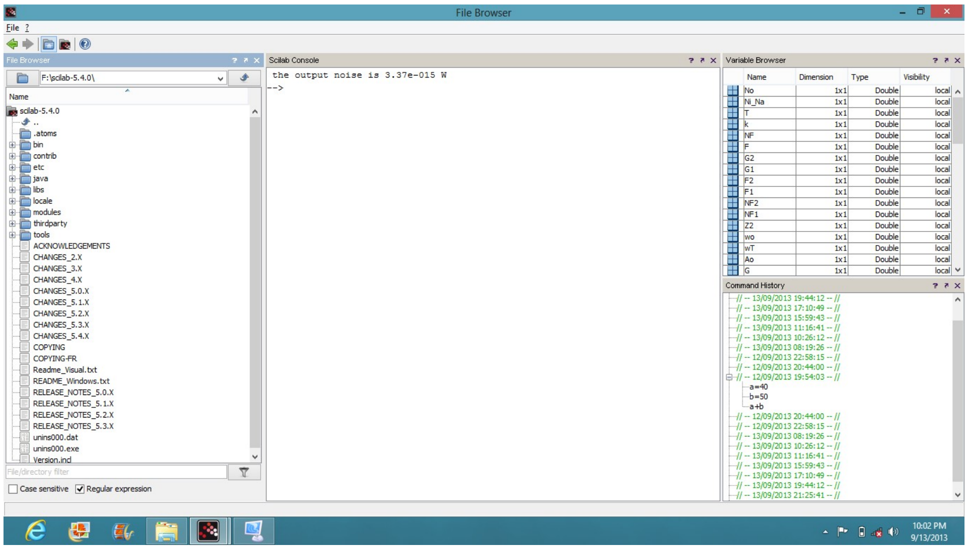

Figure 3.2: NNID Ex 3 4

Scilab code Exa 3.5 NNID Ex 3 5

```
clc
//Chapter 3:Network noise and intermodulation distortion
//example 3.5 page no 82
//given
F=1.6//noise factor
T=290//referance temperture
Tr=(F-1)*T//system noise tempreture
mprintf('the system noise tempreture is %d K',Tr)
```

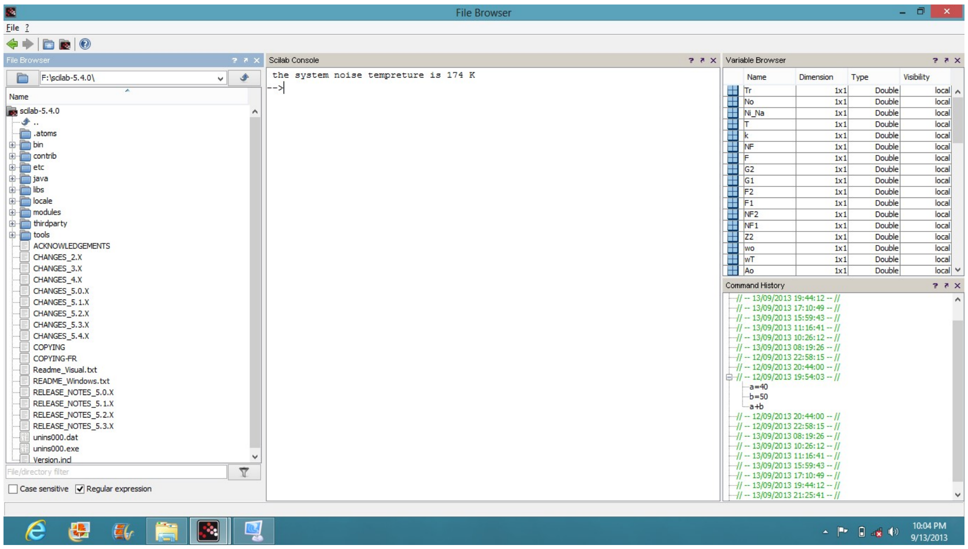

Figure 3.3: NNID Ex 3 5

Scilab code Exa 3.6 NNID Ex 3 6

```
clc
//Chapter 3:Network noise and intermodulation distortion
//example 3.6 page no 82
//given
NF=8//noise figure in dB
B=2.1*10^3//bandwidth
Rs=50//sourse resistance
Si_dB=NF-144+log10(B)//available input power in dBm
Si_W=(10^(Si_dB/10))/10^3//available input power in W
Ei=sqrt(Si_W*4*Rs)//minimum detectable signal
mprintf('the minimum detectable signal is %f uV',round(Ei*1e6*100)/100)
```

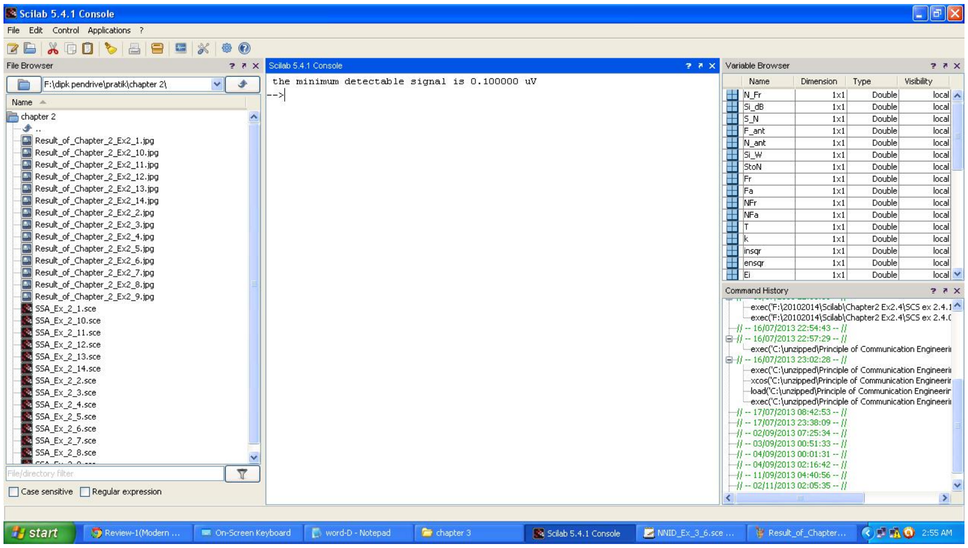

Figure 3.4: NNID Ex 3 6

Scilab code Exa 3.7 NNID Ex 3 7

```
clc
//Chapter 3:Network noise and intermodulation
    distortion
//example 3.7 page no 83
//given
NF=8//noise figure in dB
B=2.1*10^3//bandwidth
Rs=50//sourse resistance
Si_dB=NF-134+log10(B)//available input power in dBm
Si_W=(10^(Si_dB/10))/10^3//available input power in
    Watts
Ei=sqrt(Si_W*4*Rs)//minimum detectable signal
mprintf('the minimum detectable signal is %f uV',
```

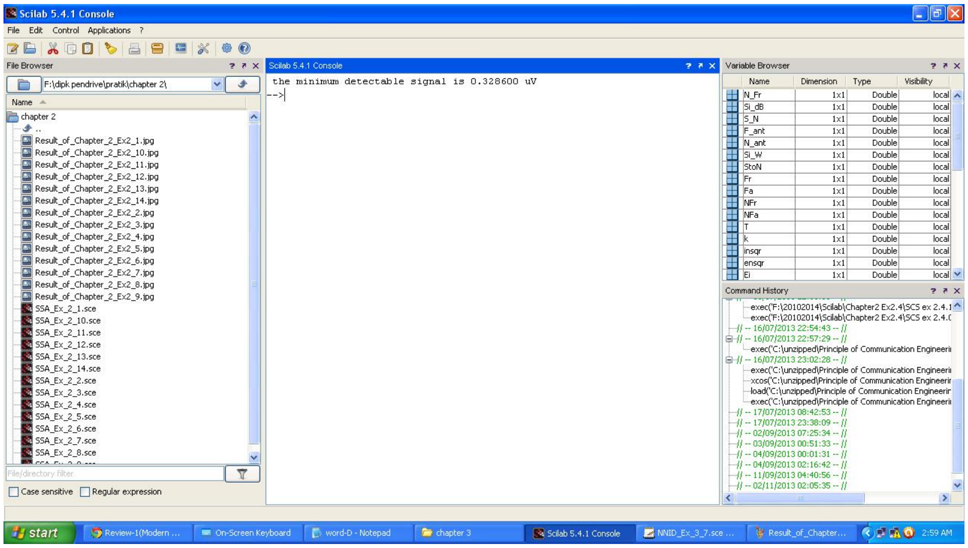

Figure 3.5: NNID Ex 3 7

```
round(Ei*1e7*1000)/10000)
```

Scilab code Exa 3.8 NNID Ex 3 8

```
clc
//Chapter 3:Network noise and intermodulation
    distortion
//example 3.8 page no 83
//given
NF=4//noise figure in dB
B=3*10^3//bandwidth
Rs=50//sourse resistance
k=1.38*10^-23//Boltzmmans constant
T=290//tempreture
//For si of −125dBm the value of Ei is 0.245uV will
    produce a 10dB output to noise ratio. now
```

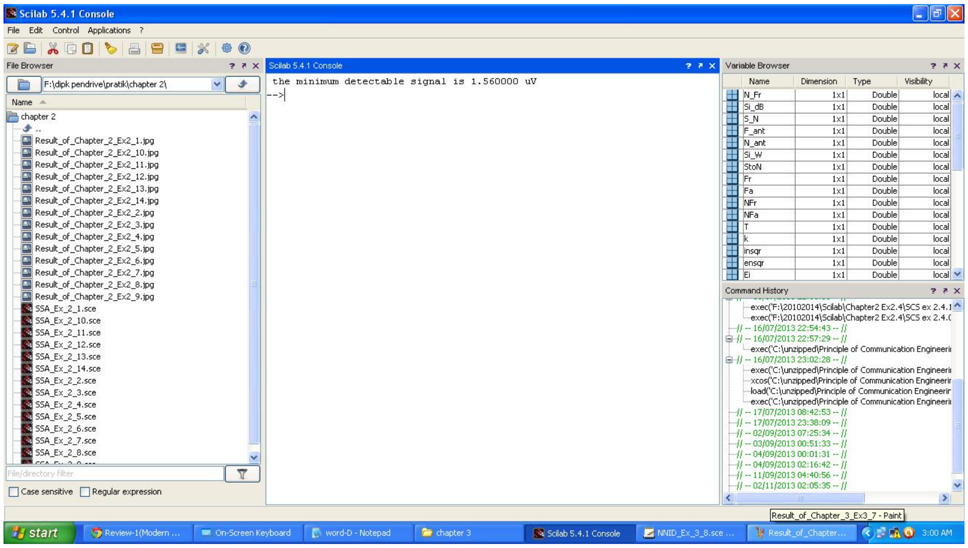

Figure 3.6: NNID Ex 3 8

```
consider the performance of this receiver when it
 is connected to an antenna with a noise figure
of 20dB
N_ant=20//antenna noise figure
N_Fr=4//receiver noise figure
F_ant=10^(N_ant/10)//antenna noise factor
Fr=10^(N_Fr/10)//receiver noise factor
S_N=10//output signal to noise ratio
Si_W=(S_N)*(F_ant+Fr-1)*k*T*B//available input power
 in Watts
Ei=sqrt(Si_W*4*Rs)//minimum detectable signal
mprintf('the minimum detectable signal is %f uV',
 round(Ei*1e6*100)/100)
```

Scilab code Exa 3.9 NNID Ex 3 9

```
clc
//Chapter 3:Network noise and intermodulation
   distortion
//example 3.8 page no 84
//given
NF=4//noise figure in dB
B=3*10^3//bandwidth
Rs=50//sourse resistance
k=1.38*10^-23//Boltzmmans constant
T=290//tempreture
NFa=20//antenna noise figure
NFr=10//receiver noise figure
Fa=10^(NFa/10)//antenna noise factor
Fr=10^(NFr/10)//receiver noise factor
S_N=10//output signal to noise ratio
Si_W=(S_N)*(Fa+Fr-1)*k*T*B//available input power in
    Watts
Ei=sqrt(Si_W*4*Rs)//minimum detectable signal
mprintf('the minimum detectable signal is %f uV',
   round(Ei*1e6*10)/10)
```

Scilab code Exa 3.10 NNID Ex 3 10

```
clc
//Chapter 3:Design of low noise networks
//example 3.10 page no 86
//given
ensqr=8*10^-16//noise voltage
insqr=9*10^-25//rms noise current
Rs=10*10^4//sourse resistance
k=1.37*10^-23//Boltzmmans constant
T=290//tempreture
F=(ensqr+(insqr*Rs^2))/(4*k*T*Rs)//amplifier noise
```

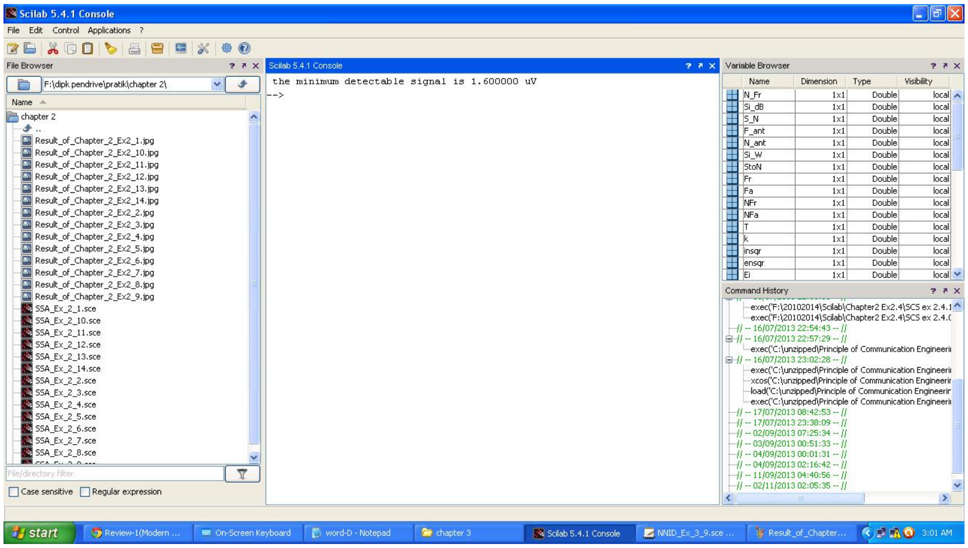

Figure 3.7: NNID Ex 3 9

```
   factor
disp(F,'the amplifier noise factor is ')
```

Scilab code Exa 3.11 NNID Ex 3 11

```
clc
//Chapter 3:Network noise and intermodulation
   distortion
//example 3.11 page no 88
//given
ensqr=8*10^-16//noise voltage
insqr=9*10^-25//rms noise current
Rs=sqrt(ensqr/insqr)//sourse resistance
k=1.38*10^-23//Boltzmmans constant
T=290//tempreture
```

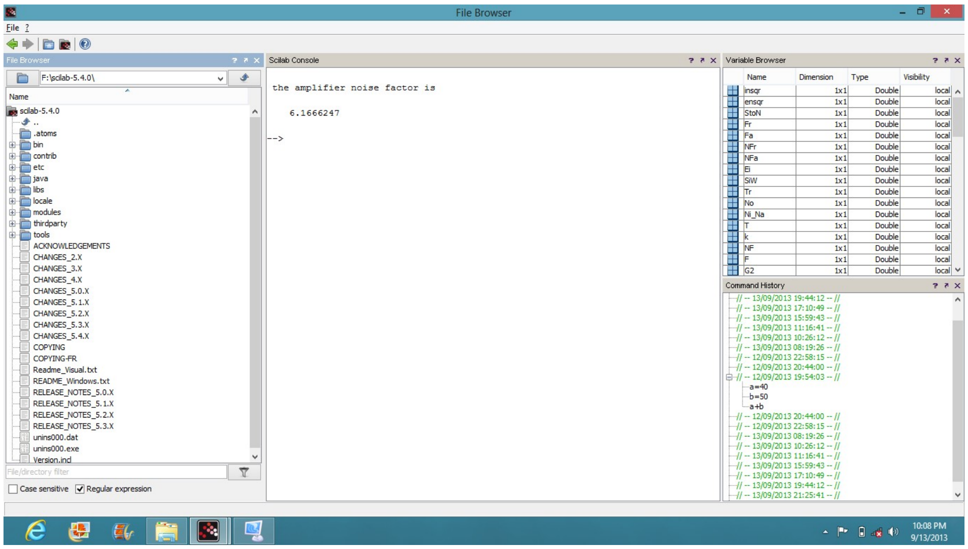

Figure 3.8: NNID Ex 3 10

```
F=(ensqr+insqr*Rs^2+4*k*T*Rs)/(4*k*T*Rs)//amplifier noise factor
NF=10*log10(F)//noise figure
mprintf('the minimum minimum noise figure is %f dB',round(NF*10)/10)
```

Scilab code Exa 3.12 NNID Ex 3 12

```
clc
//Chapter 3:Network noise and intermodulation distortion
//example 3.12 page no 89
//given
ensqr=8*10^-16//noise voltage
insqr=9*10^-25//rms noise current
Rs=9.42*10^3//sourse resistance
```

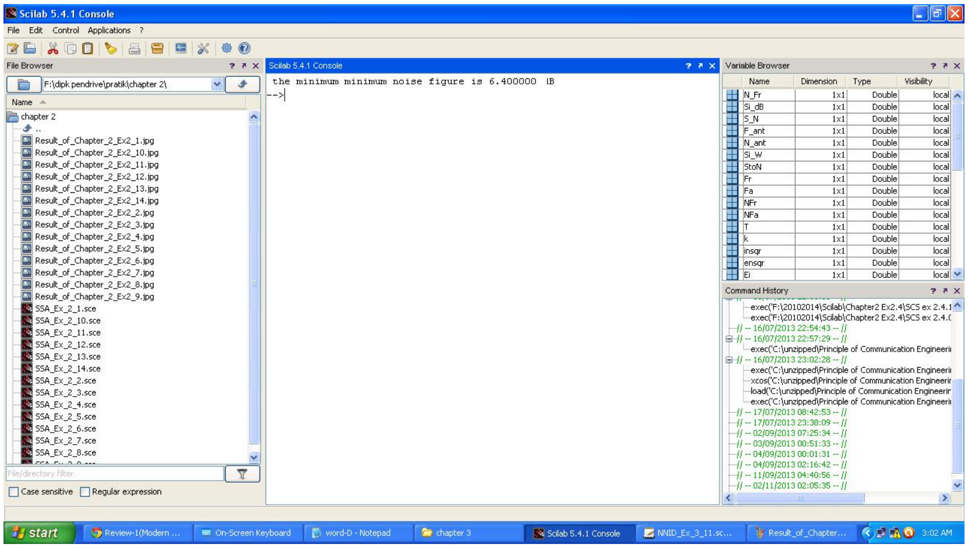

Figure 3.9: NNID Ex 3 11

```
k=1.38*10^-23//Boltzmmans constant
T=290//tempreture
N=ensqr+insqr*Rs^2+4*k*T*Rs//total noise
disp(N,'the total noise is ')
disp('If the sourse resistance is zero,the total
    noise is ')
disp('N=ensqr=8*10^-16')
```

Scilab code Exa 3.13 NNID Ex 3 13

```
clc
//Chapter 3:Network noise and intermodulation
    distortion
//example 3.13 page no 96
//given
PI=20//intercept point in dBm
```

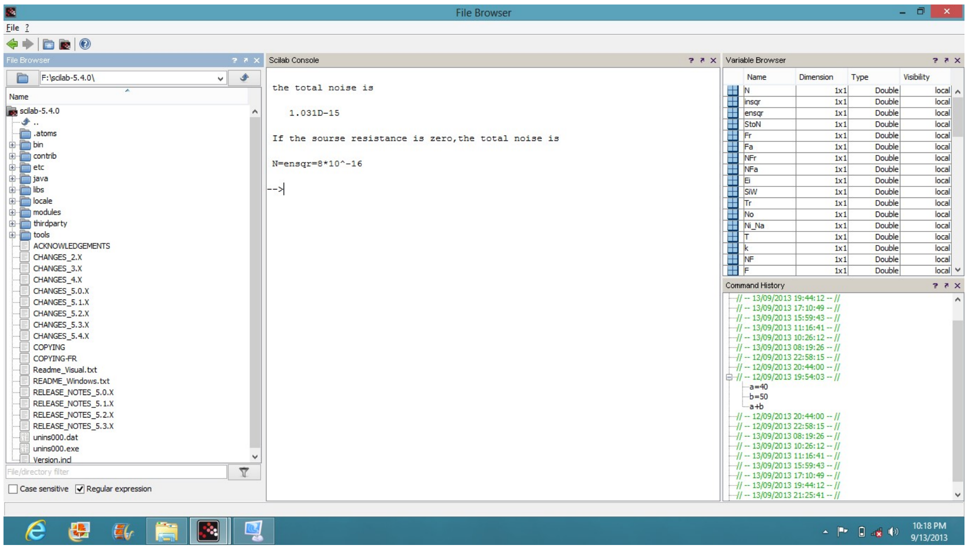

Figure 3.10: NNID Ex 3 12

```
Pi=0//input signal power dBm
PIMR=-2*PI//intermodulation distortion ratio (by the rules of logaritham as values are already given in dBm)
mprintf('the intermodulation distortion ratio  is %d dB',PIMR)
```

Scilab code Exa 3.14 NNID Ex 3 14

```
clc
//Chapter 3:Network noise and intermodulation distortion
//example 3.14 page no 97
//given
PI=20//intercept point in dBm
Nf=-123//noise floor in dBm
```

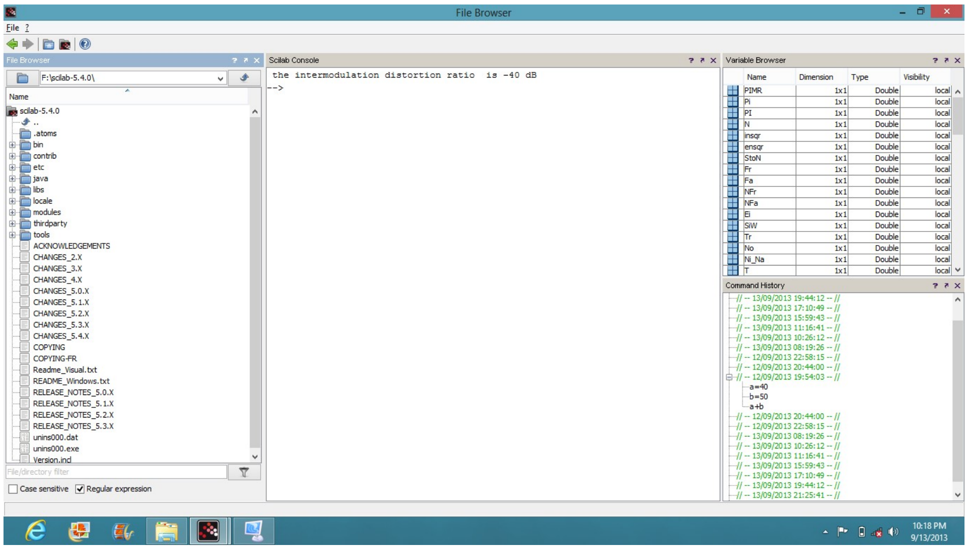

Figure 3.11: NNID Ex 3 13

```
DR=2/3*(PI-Nf)//dynamic range (by the rules of
    logarithms as value are already given in dBm)
mprintf('the dynamic range is %f dB',DR)
```

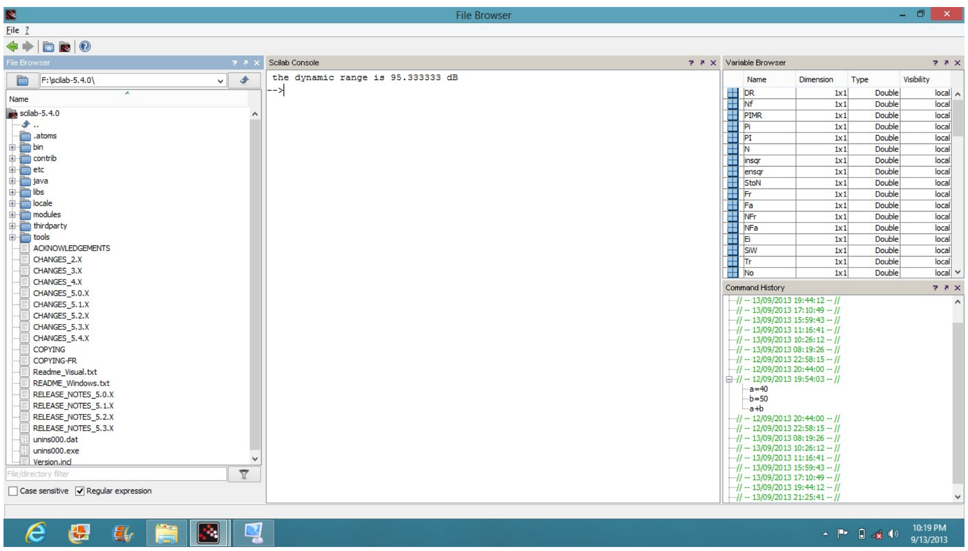

Figure 3.12: NNID Ex 3 14

Chapter 4

Frequency Selective Network and Transformers

Scilab code Exa 4.1 FSNT Ex 4 1

```
clc
//Chapter 4:Frequency selective networks and
   transformers
//example 4.1 page no 108
//given
R=50//load resistance in ohm
B=100//bandwidth in KHz
Cf=5//filter center frequency in MHz
L=R/(2*%pi*10^5)//inductance in micro henry
C=((L)*(2*%pi*Cf*10^6)^2)^-1//capacitance
mprintf('the inductance is %f uH \n the capacitance
   is %f pF ',L*1e6,C*1e12)
```

Scilab code Exa 4.2 FSNT Ex 4 2

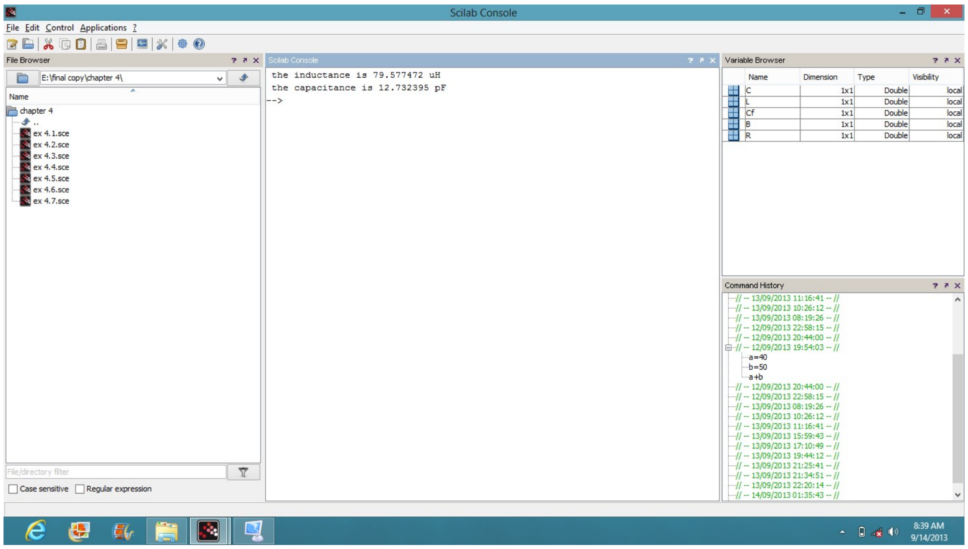

Figure 4.1: FSNT Ex 4 1

```
clc
//Chapter 4:Frequency selective networks and
    transformers
//example 4.2
//given
//Forty decibles corresponds to a voltage ratio of
    100:1 therefore since A(jwo)=1
Ajwo=0.01
n=5//no. of harmonics
Q=n/(Ajwo*(n^2-1))//quality point
mprintf('the minimum circuit Q is =Qmin = %f ',Q)
```

Scilab code Exa 4.3 FSNT Ex 4 3

```
clc
```

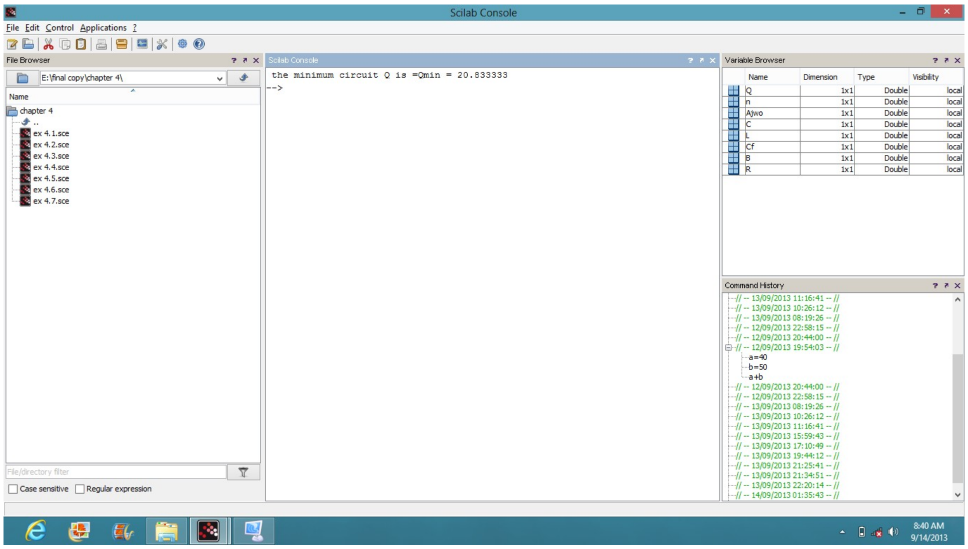

Figure 4.2: FSNT Ex 4 2

```
//Chapter 4:Frequency selective networks and
    transformers
//example 4.3 page no 115
//given
L=10*10^-6//inductance
C=10*10^-12//capacitance
wo=(sqrt(L*C))^-1//resonant frequency(ignoring the
    finite resistance)
Q=100
rs=wo*L/Q//series resistance
Rp=(wo*L)^2/rs//parallel resistance
QL=50*10^3/(wo*L)//loaded Q
mprintf('the loaded Q is %f ',QL)
```

Scilab code Exa 4.4 FSNT Ex 4 4

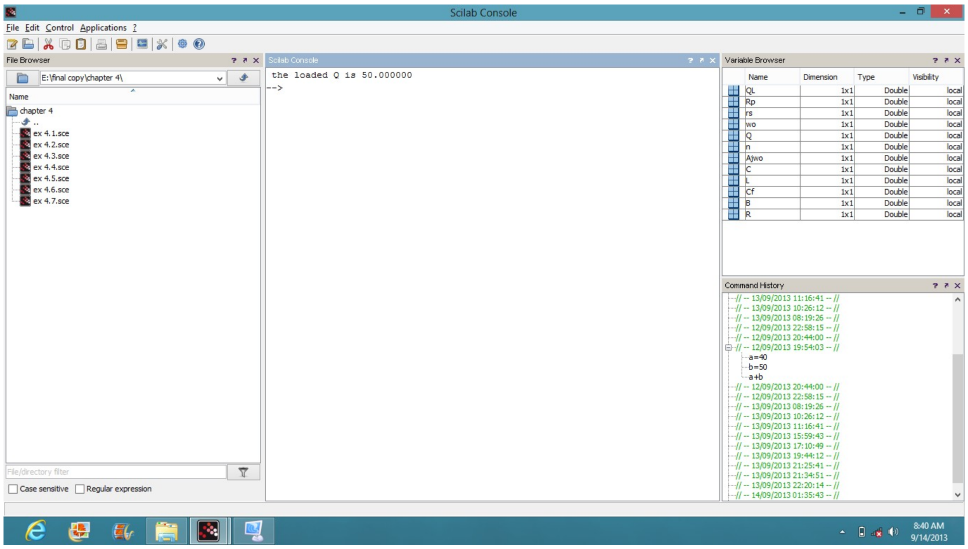

Figure 4.3: FSNT Ex 4 3

```
clc
//Chapter 4:Frequency selective networks and
    transformers
//example 4.4 page no 121
//given
L1=25*10^-6//primary inductance
L2=400*10^-6//secondary inductane
n=(sqrt(L1/L2))//equivalent turns ratio
CT=(8+(2/n^2))*1e-12//total primary capacitance
RL=25*10^3//load resistance reflected to the primary
wo=(sqrt(L1*CT))^-1//resonant frequency
Q=RL/(wo*L1)//quality point
mprintf('the resonant frequency is %3.2e rad/s \n Q
    = %f',wo,Q)
```

Scilab code Exa 4.6 FSNT Ex 4 6

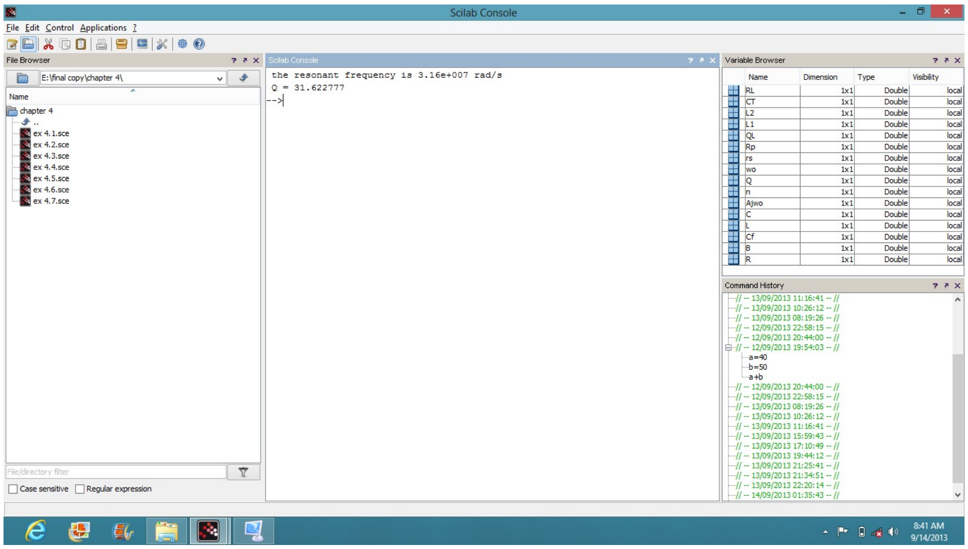

Figure 4.4: FSNT Ex 4 4

```
clc
//Chapter 4:Frequency selective networks and transformers
//example 4.6 paga no 130
//given
Rs=10//source resistance
L=0.2*10^-6//inductor
f=20*10^6//given frequency
XL=(2*%pi*f*L)//inductive reactance
Rp=50//input impedance
Xs=sqrt(Rp*Rs-Rs^2)//series reactance
Xcs=5.1//series capacitive reactance
CS=(2*%pi*f*Xcs)^-1//series capacitance
Xp=(Rs^2+Xs^2)/Xs//equivalent parallel reactance
mprintf('the value of series reactance is j%f ohm \n the value equivalent parallel reactance is j%f ohm ',Xs,Xp)
```

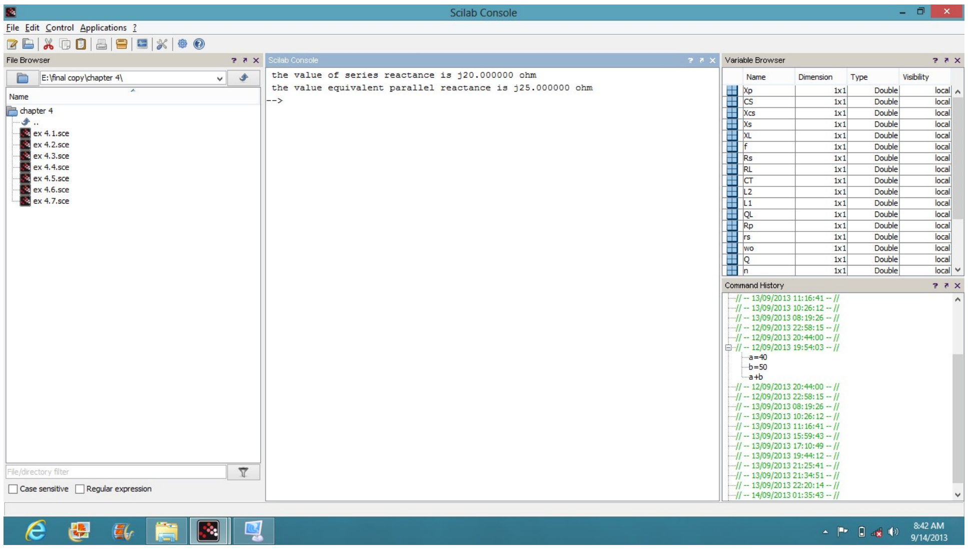

Figure 4.5: FSNT Ex 4 6

Scilab code Exa 4.7 FSNT Ex 4 7

```
clc
//Chapter 4:Frequency selective networks and transformers
//example 4.7 page no 132
//given
Rs=50//series resistance
Rp=100//parallel resistance
Xp=sqrt(Rs*Rp^2/(Rp-Rs))//equivalent parallel reactance
disp(Xp,'the equivalent parallel reactance in ohm is')
```

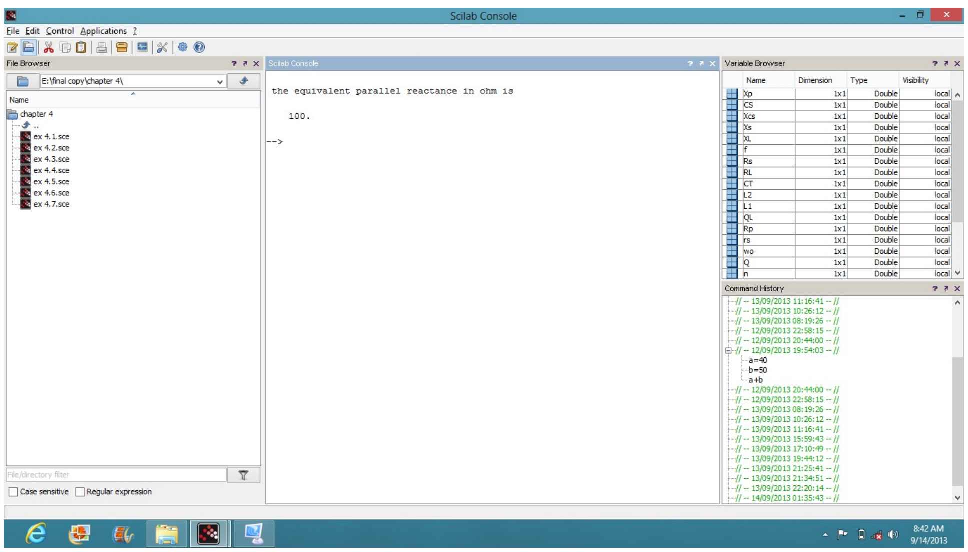

Figure 4.6: FSNT Ex 4 7

Chapter 5

High Frequency Amplifiers and Automatic Gain Control

Scilab code Exa 5.1 HFAAGC Ex 5 1

```
clc
//Chapter 5:High Frequency Amplifiers and Automatic
   Gain Control
//example 5.1 page no 147
//given
B=100
fT=3*10^8//transistor frequency
Cu=4*10^-12//output capacitance common baxe
   configuration
Ic=10*10^-3//collector direct current
rpi=0.026*B/Ic//base emitter resistance
gm=40*Ic//transconductance
wT=0.4/(2*%pi*3*10^8)//gain bandwidth product
Cpi=wT-Cu//base emitter capacitance
mprintf('the base emitter resistance is %d ohm \n
   the transconductance is %f S \n the base emitter
   capacitance is %3.2e pF',rpi,gm,Cpi)
```

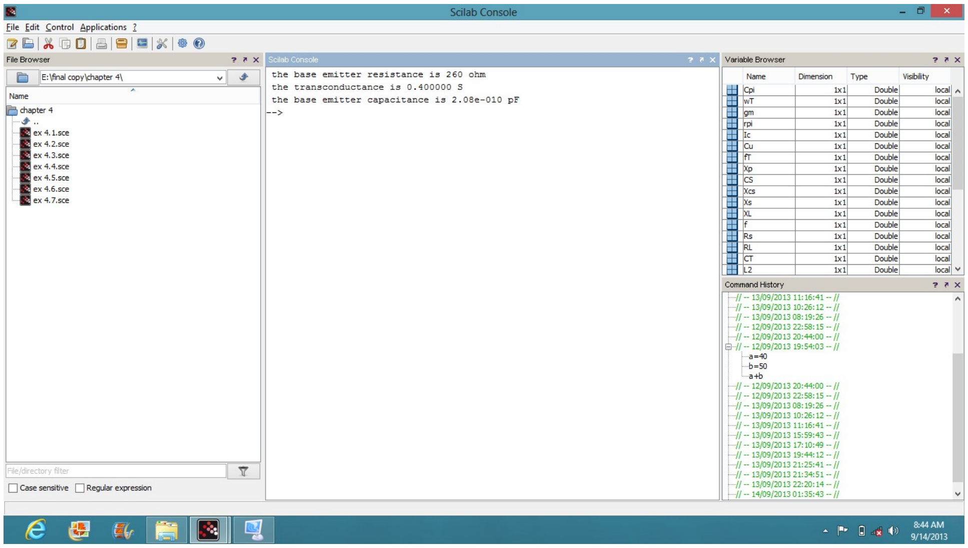

Figure 5.1: HFAAGC Ex 5 1

Scilab code Exa 5.2 HFAAGC Ex 5 2

```
clc
//Chapter 5:High Frequency Amplifiers and Automatic
    Gain Control
//example 5.2 page no 148
//given
wT=3*10^8//gain bandwidth product
w=10*10^6//given frequency
Ai=wT/w//short circuit current gain
mprintf('the short circuit current gain is %d ',Ai)
```

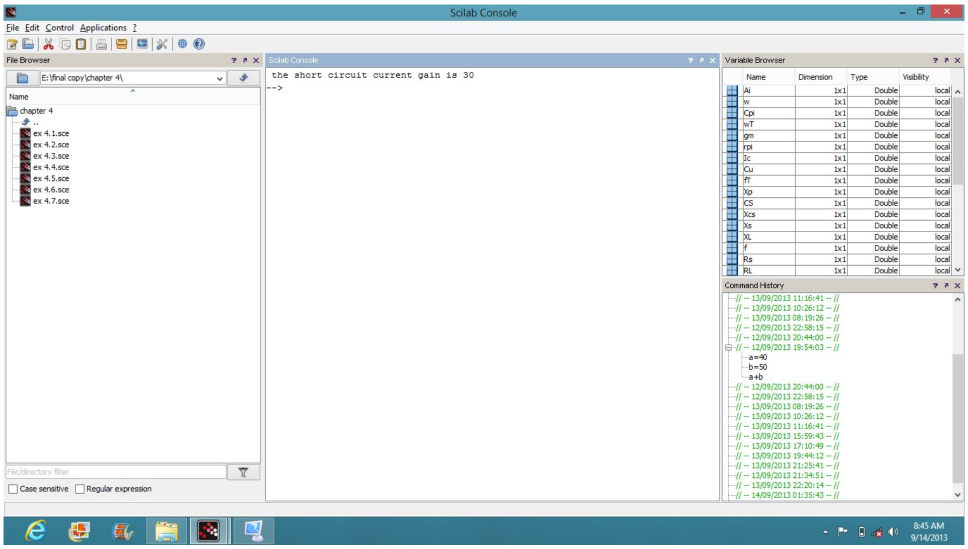

Figure 5.2: HFAAGC Ex 5 2

Scilab code Exa 5.3 HFAAGC Ex 5 3

```
clc
//Chapter 5:High Frequency Amplifiers and Automatic
    Gain Control
//example 5.3 page no 153
//given
gm=2*10^-3//transconductance
Cgs=5*10^-12//equivalent Miller's input capacitance
Cgd=1*10^-12//equivalent Miller's output capacitance
Cds=1*10^-12
rd=13*10^3
R=5*10^3//source resistance
RL=(6*10^3*13*10^3)/(6*10^3+13*10^3)//total load
    resistance
Av=-gm*RL//voltage gain
R_L=RL*rd/(RL+rd)
```

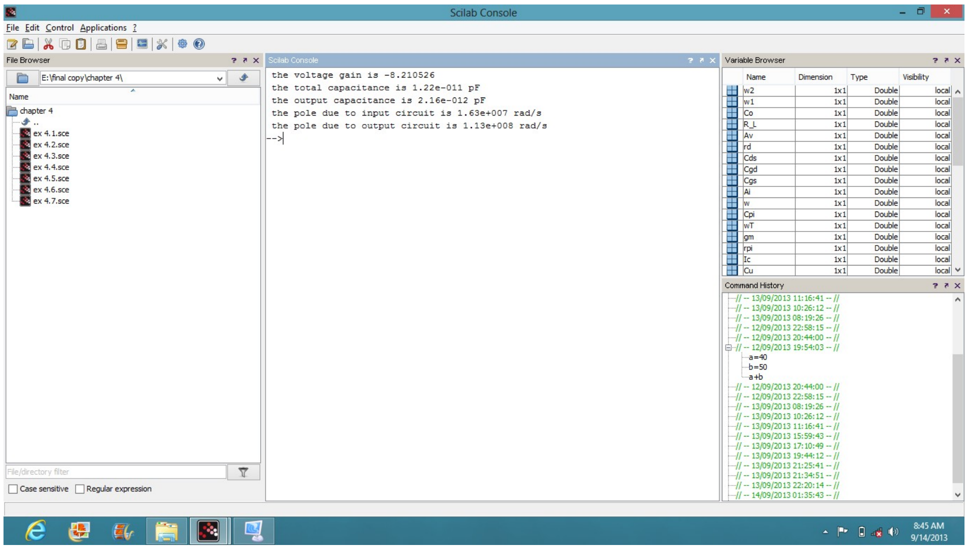

Figure 5.3: HFAAGC Ex 5 3

```
CT=Cgs+Cgd*(1+gm*R_L)//total capacitance
Co=Cds+(Cgd*(1+gm*R_L)/(gm*R_L))//output capacitance
w1=(R*CT)^-1//pole due to input circuit
w2=(RL*Co)^-1//pole due to output circuit
mprintf('the voltage gain is %f \n the total capacitance is %3.2e pF \n the output capacitance is %3.2e pF \n the pole due to input circuit is %3.2e rad/s \n the pole due to output circuit is %3.2e rad/s ',Av,CT,Co,w1,w2)
```

Scilab code Exa 5.4 HFAAGC Ex 5 4

```
clc
//Chapter 5:High Frequency Amplifiers and Automatic Gain Control
//example 5.4 page no 155
```

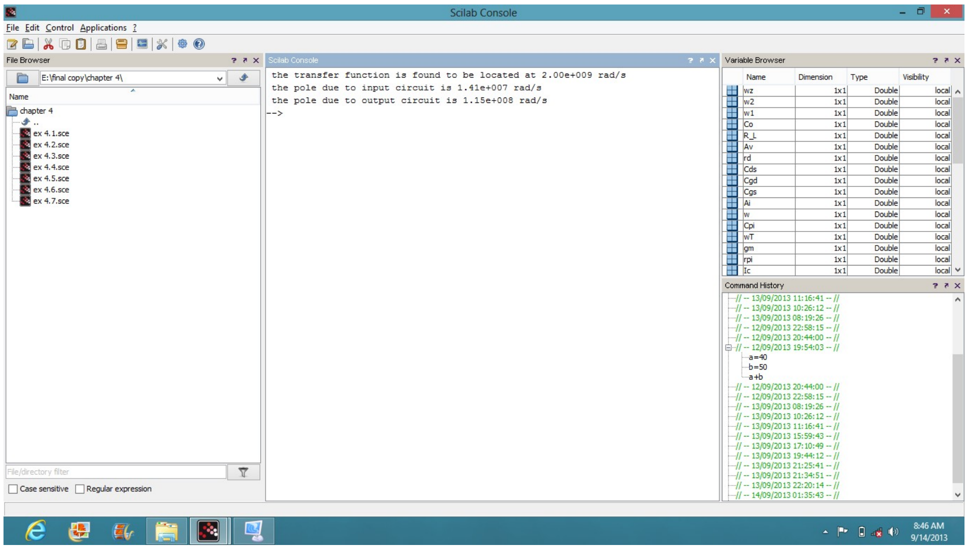

Figure 5.4: HFAAGC Ex 5 4

```
//given
gm=2*10^-3//transconductance
Cgs=5*10^-12//equivalent Miller's input capacitance
Cgd=10^-12//equivalent Miller's output capacitance
Cds=10^-12
R=5*10^3
R_L=4.1*10^3
wz=2*10^9
CT=Cgs+Cgd*(1+gm*R_L)//total capacitance
Co=Cds+(Cgd*(1+gm*R_L)/(gm*R_L))//output capacitance
w1=(R*CT)^-1//pole due to input circuit
w2=(R_L*Co)^-1//pole due to output circuit
mprintf('the transfer function is found to be located at %3.2e rad/s \n the pole due to input circuit is %3.2e rad/s \n the pole due to output circuit is %3.2e rad/s ',wz,w1,w2)
```

Scilab code Exa 5.5 HFAAGC Ex 5 5

```
clc
//Chapter 5:High Frequency Amplifiers and Automatic
    Gain Control
//example 5.5 page no 157
//given
gm=0.4//transconductance
rpi=260
Re=237//emitter resistance
RL=600//load resistance
Rs=500//source resistance
Vi=1//input voltage(asumme Vi=1)
R=rpi*Rs/(rpi+Rs)
Vo=-gm*RL*Re/(Re+Rs)//output voltage
Cgs=960*10^-12//equivalent Miller's input
    capacitance
Ci=206*10^-12//input capacitance
CT=Cgs+Ci//total capacitance
Co=4*10^-12//output capacitance
w1=(R*CT)^-1//pole due to input circuit
w2=(RL*Co)^-1//pole due to output circuit
disp('The high-frequency performance is determined
    by the input circuit The upper -3dB frequency of
    this amplifier is equal to w1')
mprintf('the upper 3dB frequency is %3.2e rad/s ',w1
    )
```

Scilab code Exa 5.6 HFAAGC Ex 5 6

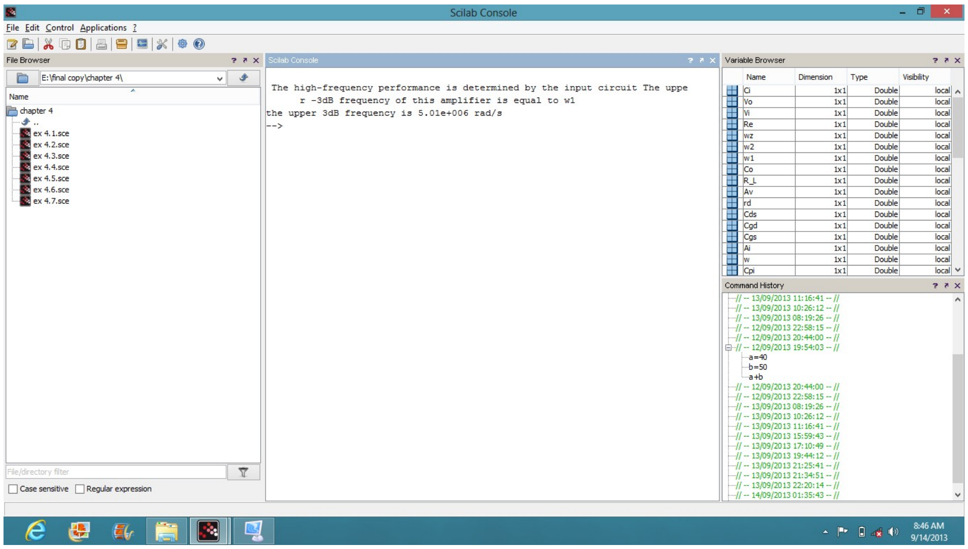

Figure 5.5: HFAAGC Ex 5 5

```
clc
//Chapter 5:High Frequency Amplifiers and Automatic
    Gain Control
//example 5.5 page no 159
//given
s=poly(0,"s")
Vo=-(0.4-s*4*10^-12)*(966*10^3)
Vth=s^2*(79.6*10^-18)+s*(190.2*10^-9)+1
disp(Vo/Vth,'the transfer function is ')
wz=10^11//transfer function zero
w1=-5.5*10^6//pole due to input circuit
w2=-2.41*10^9//pole due to output circuit
mprintf('the transfer function zero is found to be
    located at %3.2e rad/s \n the pole due to input
    circuit is %3.2e rad/s \n the pole due to output
    circuit is %3.2e rad/s ',wz,w1,w2)
```

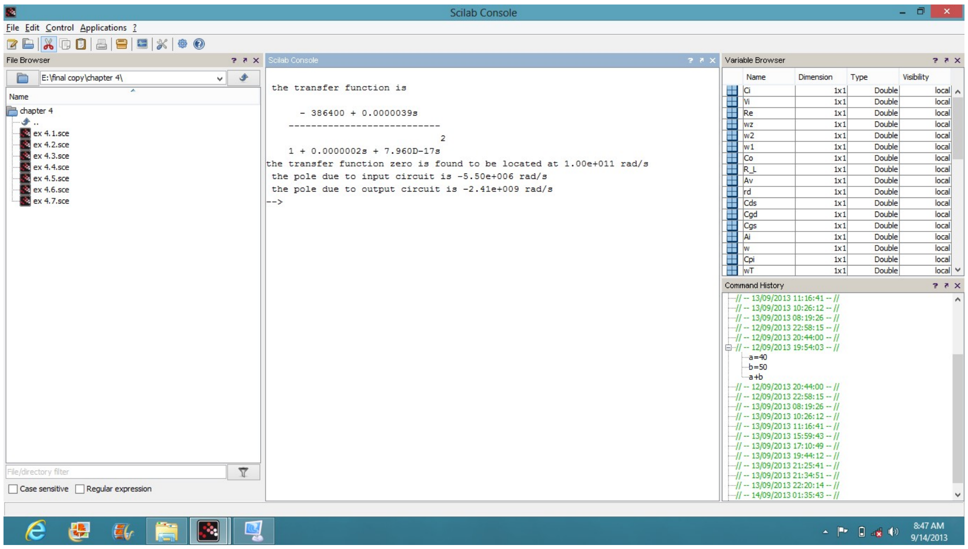

Figure 5.6: HFAAGC Ex 5 6

Scilab code Exa 5.7 HFAAGC Ex 5 7

```
clc
//Chapter 5:High Frequency Amplifiers and Automatic
    Gain Control
//example 5.7 page no 162
//given
gm=0.4//transconductance
RL=600//load resistance
Rs=500//source resistance
Avec=gm*RL//midband emitter to collector voltage
    gain
CM=(1-Avec)*10^-12//miller capacitance
C_M=CM/Avec//collector to ground miller capacitance
Ri=gm^-1
Av=Avec*(Ri/Rs)//midfrequency voltage gain
Co=(4+1)*10^-12//output capacitance
```

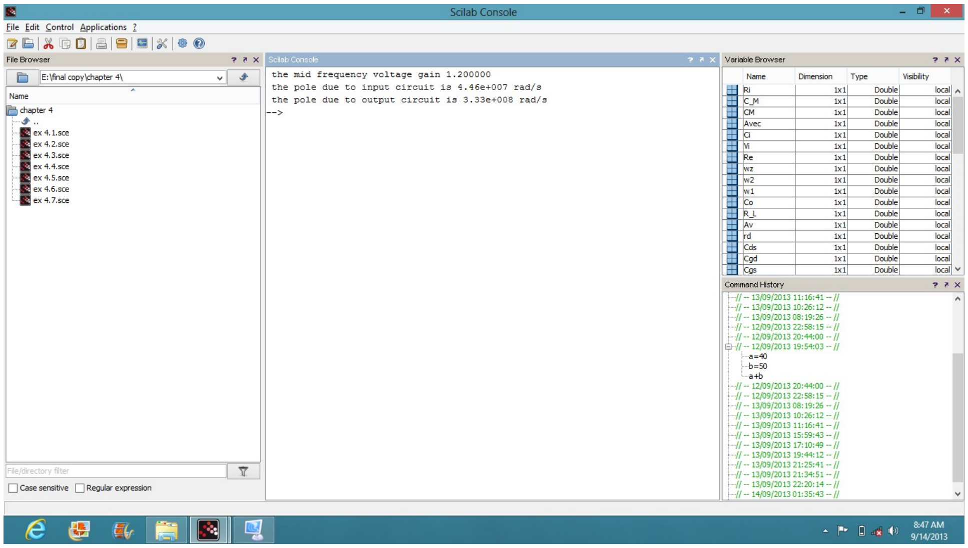

Figure 5.7: HFAAGC Ex 5 7

```
CT=(206+CM)*10^-12//toatl capacitance
R=(500^-1+300^-1+260^-1)^-1
w1=(R*CT)^-1//pole due to input circuit)
w2=(RL*Co)^-1//pole due to output circuit
mprintf('the mid frequency voltage gain %f \n the
    pole due to input circuit is %3.2e rad/s \n the
    pole due to output circuit is %3.2e rad/s ',Av,w1
    ,w2)
```

Scilab code Exa 5.8 HFAAGC Ex 5 8

```
clc
//Chapter 5:High Frequency Amplifiers and Automatic
    Gain Control
//example 5.8 page no 166
//given
```

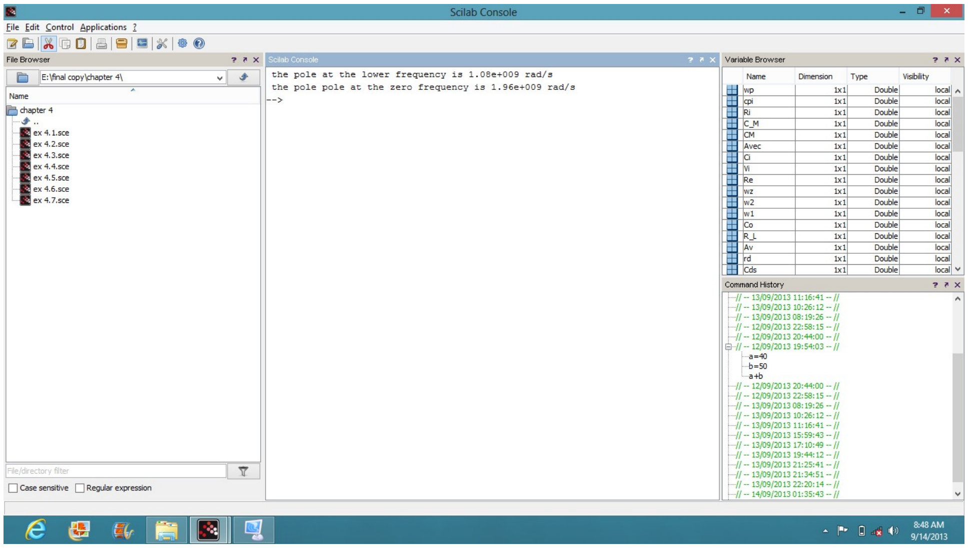

Figure 5.8: HFAAGC Ex 5 8

```
Rs=500//source resistance
rpi=260
gm=0.4//transconductance
RL=600//load resistance
cpi=206*10^-12
wp=(Rs+rpi+(1+gm*rpi)*RL)/(rpi*cpi*(Rs+RL))//pole at
    the lower frequency
wz=(1+gm*rpi)/(rpi*cpi)//pole at the zero frequency
mprintf('the pole at the lower frequency is %3.2e
   rad/s \n the pole pole at the zero frequency is
   %3.2e rad/s ',wp,wz)
```

Scilab code Exa 5.10 HFAAGC Ex 5 10

```
clc
```

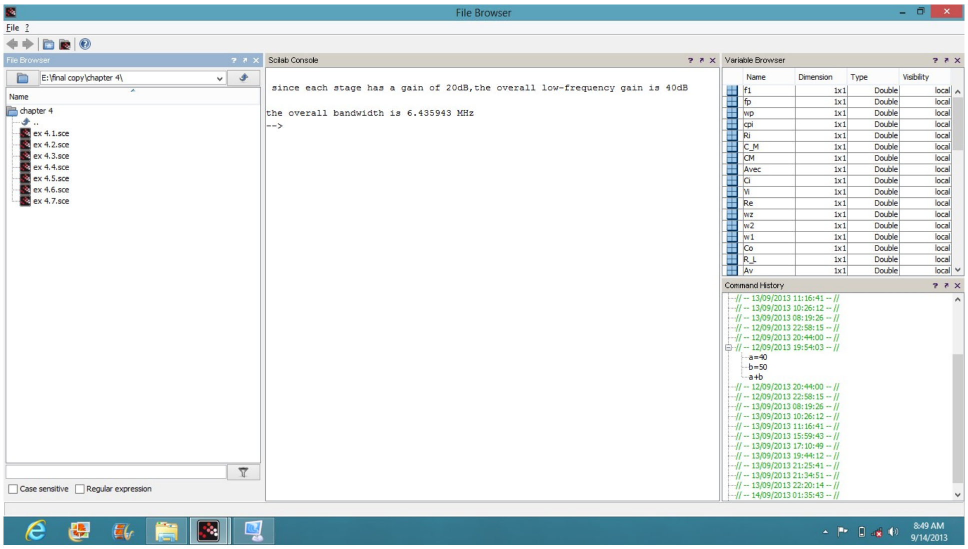

Figure 5.9: HFAAGC Ex 5 10

```
//Chapter 5:High Frequency Amplifiers and Automatic
    Gain Control
//example 5.10 page no 178
//given
fp=10*10^6//upper corner frequency
n=2//no. of stages
f1=fp*sqrt(2^(1/n)-1)//overall bandwidth
disp('since each stage has a gain of 20dB,the
    overall low-frequency gain is 40dB ')
mprintf('the overall bandwidth is %f MHz',f1*1e-6)
```

Scilab code Exa 5.11 HFAAGC Ex 5 11

```
clc
//Chapter 5:High Frequency Amplifiers and Automatic
    Gain Control
```

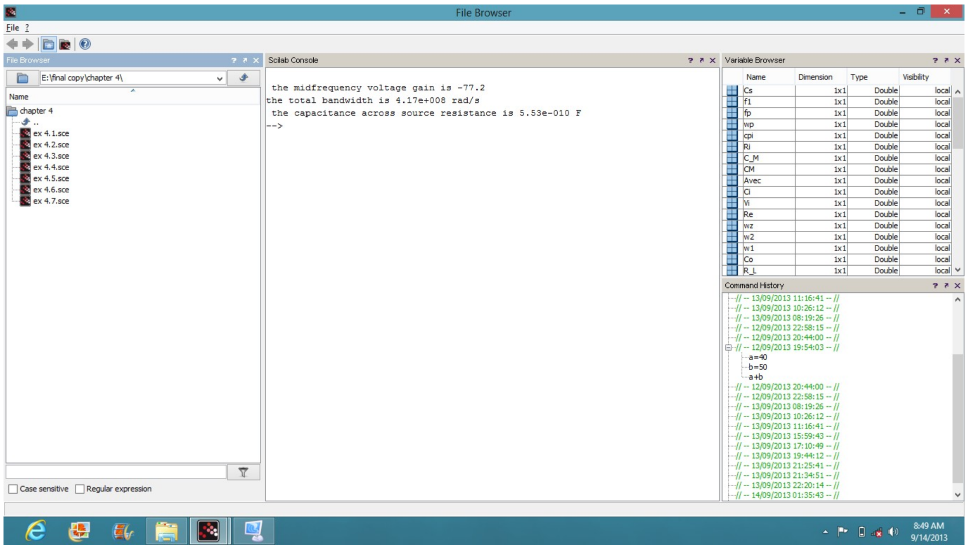

Figure 5.10: HFAAGC Ex 5 11

```
//example 5.11 page no 181
//given
rpi=237
CM=1166*10^-12//miller capacitance
Co=4*10^-12//equivalent miller capacitance reflected at output side
Rs=500//source resistance
RL=600//load resistance
Cs=rpi*CM/Rs//capacitance across source resistance
B=(RL*Co)^-1//total bandwidth
disp('the midfrequency voltage gain is -77.2')
mprintf('the total bandwidth is %3.2e rad/s \n the capacitance across source resistance is %3.2e F',B,Cs)
```

Scilab code Exa 5.12 HFAAGC Ex 5 12

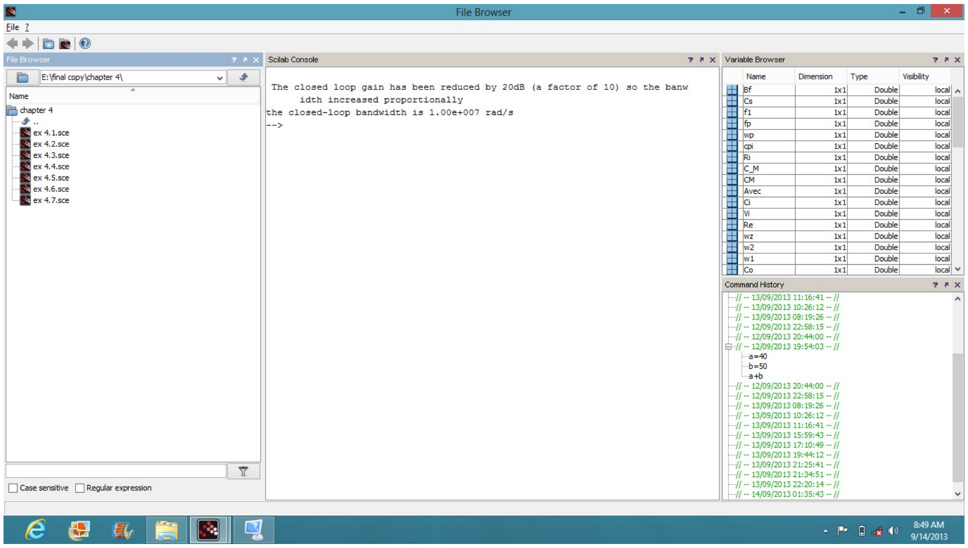

Figure 5.11: HFAAGC Ex 5 12

```
clc
//Chapter 5:High Frequency Amplifiers and Automatic
    Gain Control
//example 5.12
//given
B=10^7//amplifier bandwidth
Bf=10*B//closed loop bandwidth
disp('The closed loop gain has been reduced by 20dB
    (a factor of 10) so the banwidth increased
    proportionally')
mprintf('the closed-loop bandwidth is %3.2e rad/s',B
    )
```

Scilab code Exa 5.13 HFAAGC Ex 5 13

```
clc
```

```
//Chapter 5:High Frequency amplifiers and automatic
    gain control
//Example 5.13 page no 184
//Example on emitter feedback
disp('The parallel combination of the two base
    biasing resistors is 2.66k ohm resistor. The
    parallel combination of this resistor and the 260
    ohm emitter resistance is 237ohm  i.e.rpi=237ohm'
    )
gm=0.4//transconductance
rpi=237//base emitter resistance
RL=600//load resistance (values of resistance are
    taken from the figure)
Rs=500//source resistance
Av=gm*RL*rpi/(rpi+Rs)//Voltage gain
B=0.84*10^6//Bandwidth (The value of Bandwidth is
    taken from the Graph firure 5.51)
GB=Av*B//Gain bandwidth product
mprintf('The gain bandwidth product is %3.2e Hz ',GB
    )
```

Scilab code Exa 5.14 HFAAGC Ex 5 14

```
clc
//Chapter 5:High Frequency amplifiers and automatic
    gain control
//Example 5.14 page no 189
//Example on voltage to current feedback
gm=0.4//transconductance
RL=600//load resistance
Rs=500//source resistance (refer figure 5.54)
disp('Av=-gm*RL/(1+gf*RL+gm*RL*(Rs/RF))')//Voltage
    gain
```

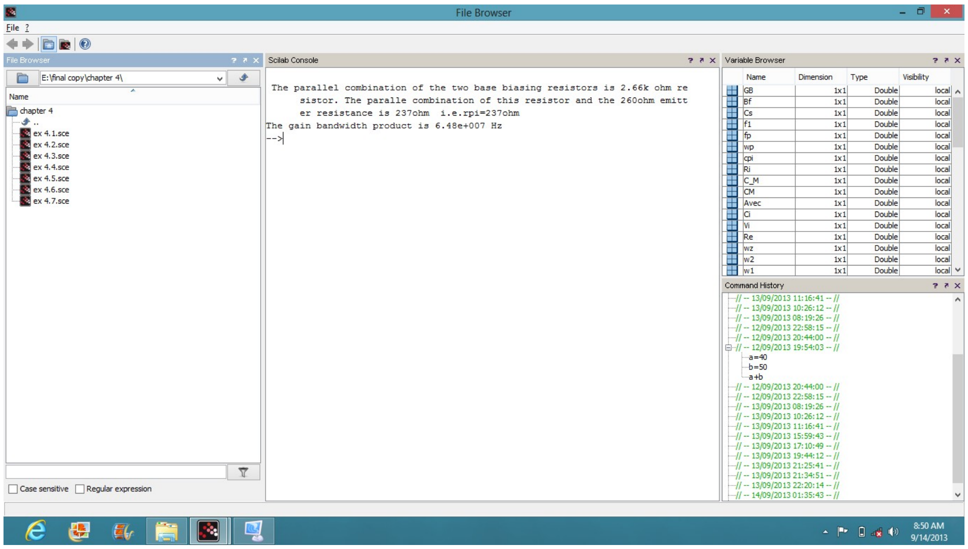

Figure 5.12: HFAAGC Ex 5 13

```
disp('GB=Av*B')
disp('The gain bandwidth product varies from a low
    of 59.5*10^6 Hz for a gain of unity 265.1*10^6 Hz
     for a closed loop gain of 17.9 ')//(refer figure
     5.55)
```

Scilab code Exa 5.15 HFAAGC Ex 5 15

```
clc
//Chapter 5:High Frequency amplifiers and automatic
    gain control
//Example 5.15 page no 193
disp('Gain bandwidth product of a common base
    amplifier with lossless feedback ')
//All the Bandwidth values are taken by graph
m1=0//i.e. for no turns ratio
```

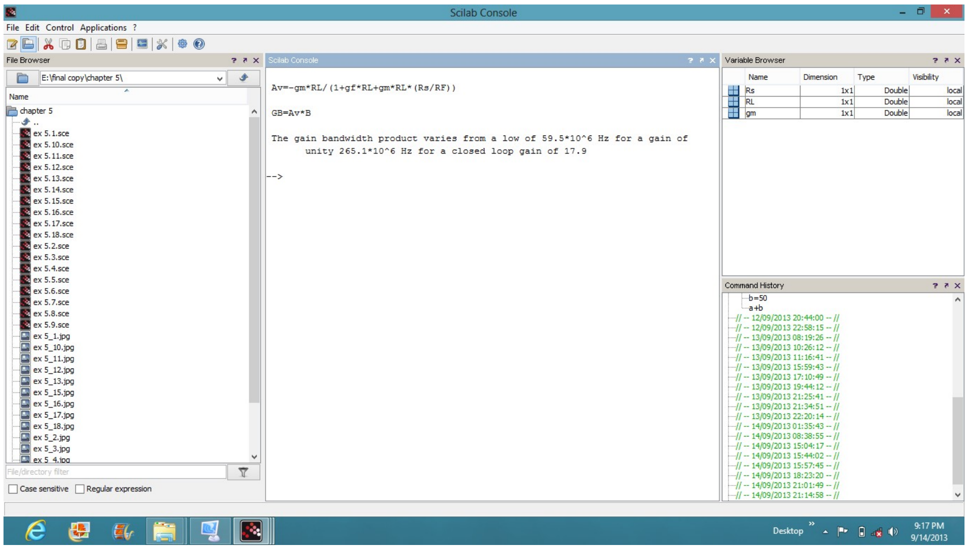

Figure 5.13: HFAAGC Ex 5 14

```
Av1=1//for no turns ratio voltage gain is approx
    unity
B1=79.4*10^6//bandwidth
GB1=Av1*B1//Gain bandwidth product
m2=4//i.e. for turns ratio is 4
Av2=m2/2//voltage gain
B2=11.22*10^6//bandwidth
GB2=Av2*B2//Gain bandwidth product
m3=6//i.e. for turns ratio is 6
Av3=m3/2//voltage gain
B3=4.67*10^6//bandwidth
GB3=Av3*B3//Gain bandwidth product
m4=10//i.e. for turns ratio is 10
Av4=m4/2//voltage gain
B4=1.6*10^6//bandwidth
GB4=Av4*B4//Gain bandwidth product
m5=20//i.e. for turns ratio is 20
Av5=m5/2//voltage gain
B5=4.22*10^5//bandwidth
GB5=Av5*B5//Gain bandwidth product
```

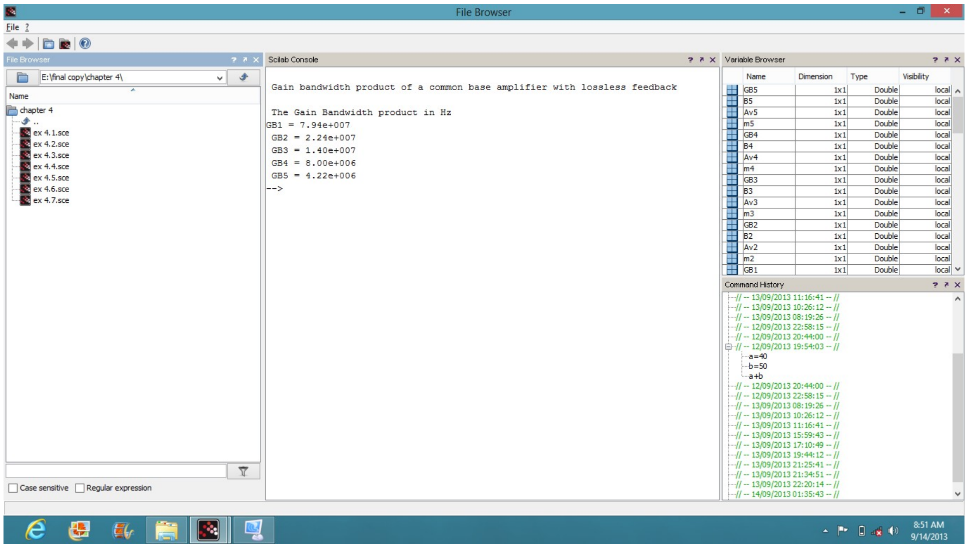

Figure 5.14: HFAAGC Ex 5 15

```
disp('The Gain Bandwidth product in Hz')
mprintf('GB1 = %3.2e \n GB2 = %3.2e \n GB3 = %3.2e \
    n GB4 = %3.2e \n GB5 = %3.2e ',GB1,GB2,GB3,GB4,
    GB5)
```

Scilab code Exa 5.18 HFAAGC Ex 5 18

```
clc
//Chapter 5:High Frequency Amplifiers and Automatic
    Gain Control
//example 5.18
//given
Vr=1//reference voltage
Vc=0.5
Vo=Vr-Vc//output voltage
Vi=Vo/Vc^2//input voltage
```

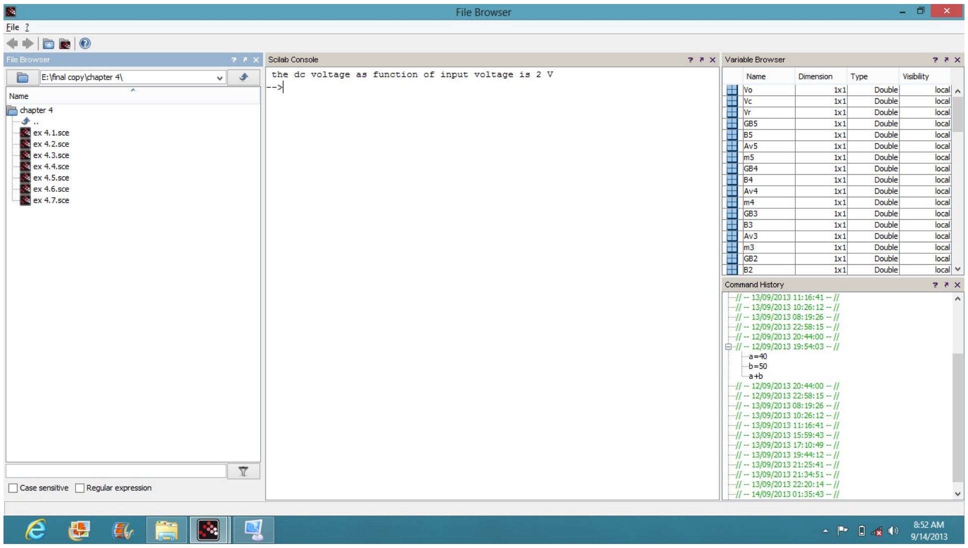

Figure 5.15: HFAAGC Ex 5 18

```
mprintf('the dc voltage as function of input voltage
    is %d V',Vi)
```

Chapter 6

Hybrid and Transmission Line Transforms

Scilab code Exa 6.2 HTLT Ex 6 2

```
clc
//Chapter 6:Three winding transformer
//example 6.2 page no 221
//given
k=1
R=50//resistor
R1=R*k
R2=R
R3=100
R4=R1/(1+k)
N=sqrt(R1/(2*R3))//turns ratio
mprintf('the turns ratio %f \n R4=%d ',N,R4)
disp('the output voltage Eo= -I3.RL = E1/2')
```

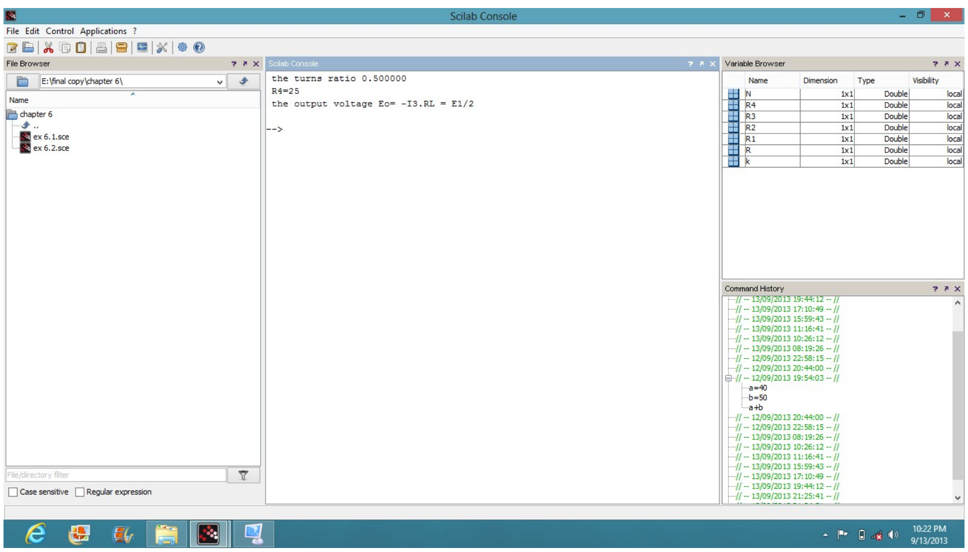

Figure 6.1: HTLT Ex 6 2

Chapter 7

Oscillators

Scilab code Exa 7.1 Oscillators Ex 7 1

```
clc
//Chapter 7:Conditions for Oscillation
//example 7.1 page no 247
//given
B=100//current gain
f=20*10^6//oscillator frequency
VT=26*10^-3
Ic=1*10^-3//dc bias current
ri=VT/Ic//common base inout resistance
gm=ri^-1//transconductance
GH=3//In oscillator design the loop gain is usually
    selected to be about 3,which allow for some error
     in the approximation so that (C1+C2)/C1=3
C2=(2*%pi*f*8)^-1//second capacitor
C1=C2/2//first capacitor
Req=ri*((C1+C2)/C1)^2//equivalent resistor
L=(((2*%pi*f)^2)*((C1*C2)/(C1+C2)))^-1//inductor
mprintf('the value of second capacitor is %f pF \n
    the value of first capacitor is %f pF \n the
    value of equivalent resistor is %d ohm \n the
    value of indicator is %f uH',C2*1e12,C1*1e12,Req,
```

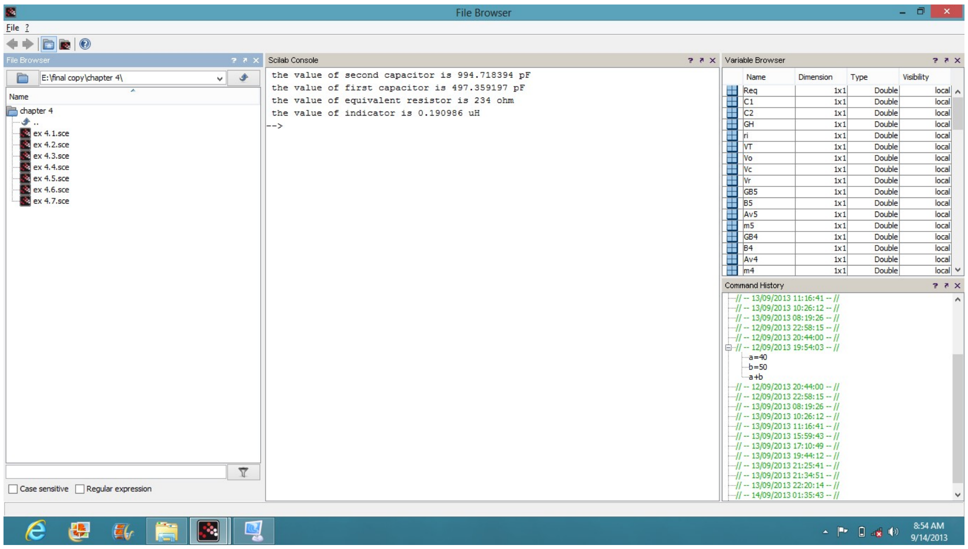

Figure 7.1: Oscillators Ex 7 1

```
L*1e6)
```

Scilab code Exa 7.2 Oscillators Ex 7 2

```
clc
//Chapter 7:Conditions for Oscillation
//example 7.2 page no 251
//given
B=100
f=5*10^6//oscillator frequency
L=10*10^-6//inductor
X=(L*(2*%pi*f)^2)^-1//Taking X=C1'*C2/(C1'+C2)
r=3.14//series resistance of inductor
C1=200*10^-12//first capacitor(asumming values of
    capacitors)
C2=200*10^-12//second capacitor
```

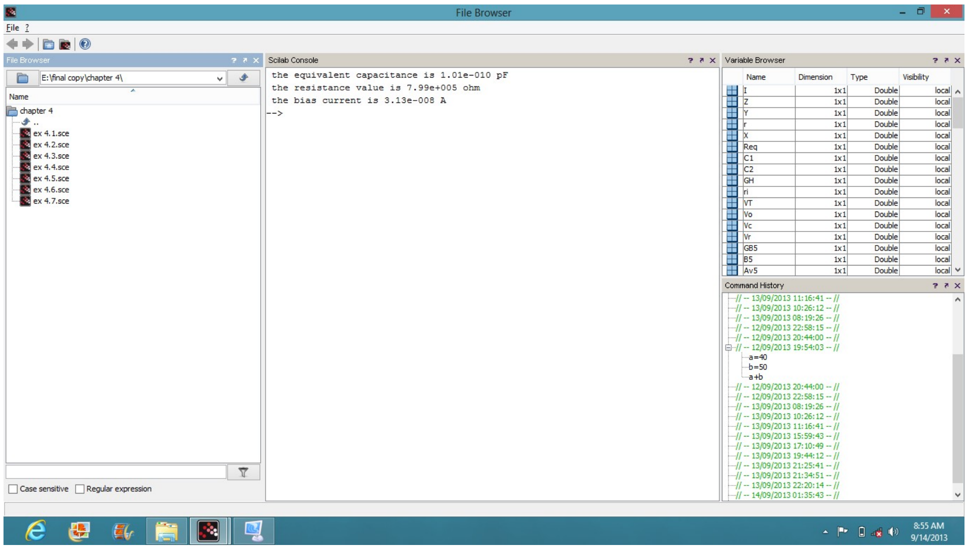

Figure 7.2: Oscillators Ex 7 2

```
Y=(1+B)/(((2*%pi*f)^2)*C1*C2)
Z=L/C1
rpi=(Y-Z)*r^-1//resistance
gm=rpi^-1//transconductance
I=gm/40//bias current
mprintf('the equivalent capacitance is %3.2e pF \n
    the resistance value is %3.2e ohm \n the bias
    current is %3.2e A',X,rpi,I)
```

Scilab code Exa 7.3 Oscillators Ex 7 3

```
clc
//Chapter 7:Conditions for Oscillation
//example 7.3
//given
rpi=1000
```

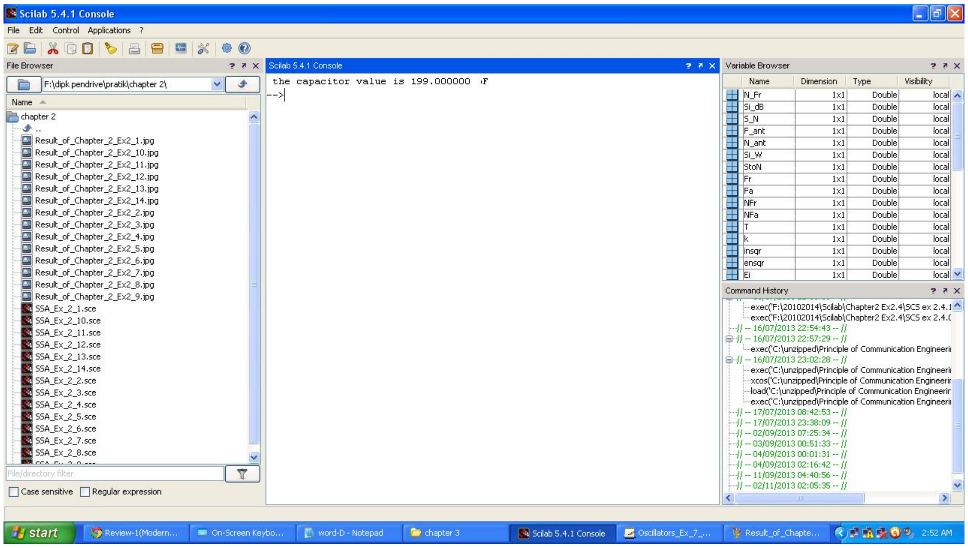

Figure 7.3: Oscillators Ex 7 3

```
C1=200*10^-12
r=3.14//series resistance
C_1=C1/(1+(r/rpi))//capacitance

mprintf('the capacitor value is %f pF',round(C_1*1
    e12))
```

Scilab code Exa 7.4 Oscillators Ex 7 4

```
clc
//Chapter 7:Conditions for Oscillation
//example 7.4 page no 255
//given
gm=6*10^-3
r=4
f=10^6
```

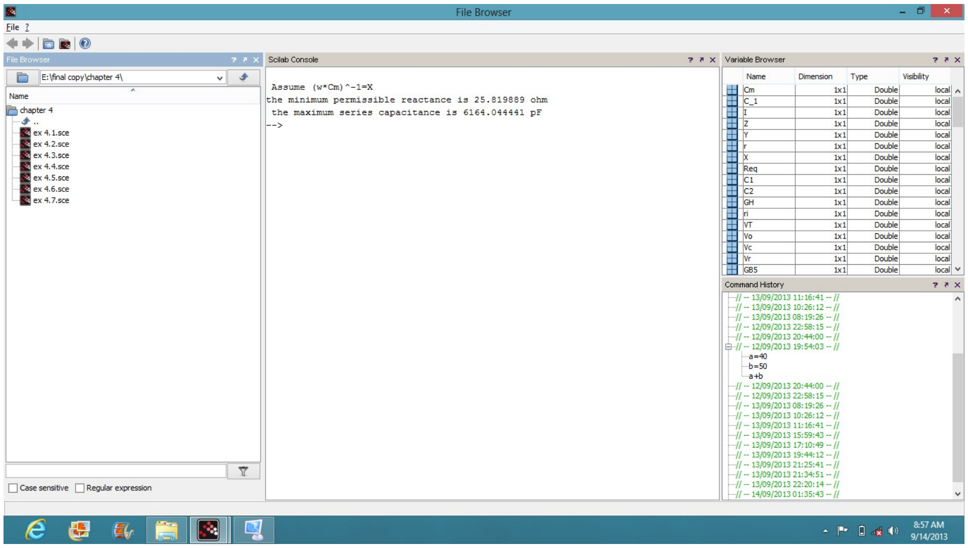

Figure 7.4: Oscillators Ex 7 4

```
disp('Assume (w*Cm)^-1=X')
X=sqrt(r/gm)//minimum permissible reactance
Cm=(2*%pi*f*X)^-1//maximum series capacitance
mprintf('the minimum permissible reactance is %f ohm
    \n the maximum series capacitance is %f pF',X,Cm
   *1e12)
```

Scilab code Exa 7.5 Oscillators Ex 7 5

```
clc
//Chapter 7:Conditions for Oscillation
//example 7.5 page no 265
//given
Co=3.2//shunt capacitance
C1=0.008
k=Co/C1//ratio
```

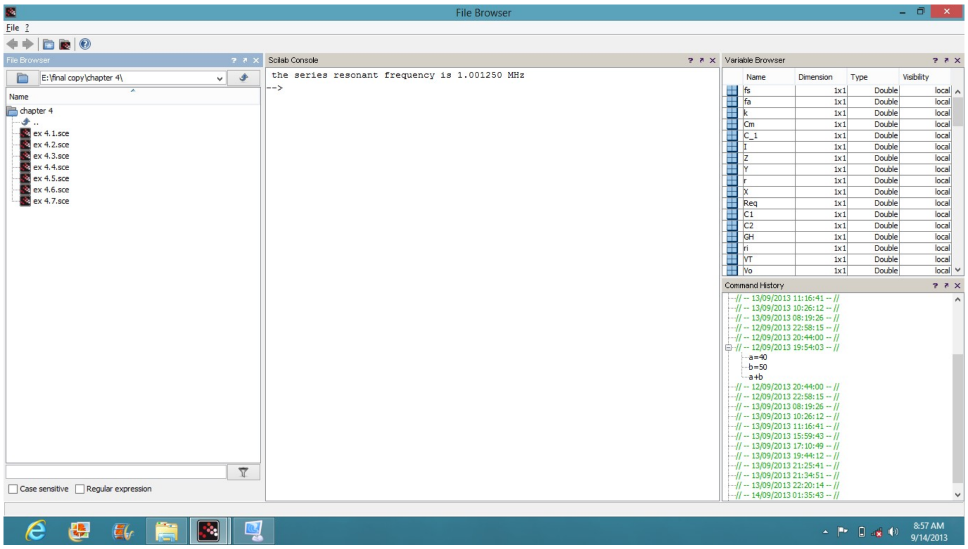

Figure 7.5: Oscillators Ex 7 5

```
fa=10^6//crystai 's antiresonant frequency
fs=1+(2*k)^-1//series resonant frequency
mprintf('the series resonant frequency is %f MHz',fs
    )
```

Scilab code Exa 7.6 Oscillators Ex 7 6

```
clc
//Chapter 7:Conditions for Oscillation
//example 7.6 page no 265
//given
f=5.7*10^6//given frequency
Xs=4654//shunt reactance for shunt capacitacne of 6
    pF
r=25//series resistance
```

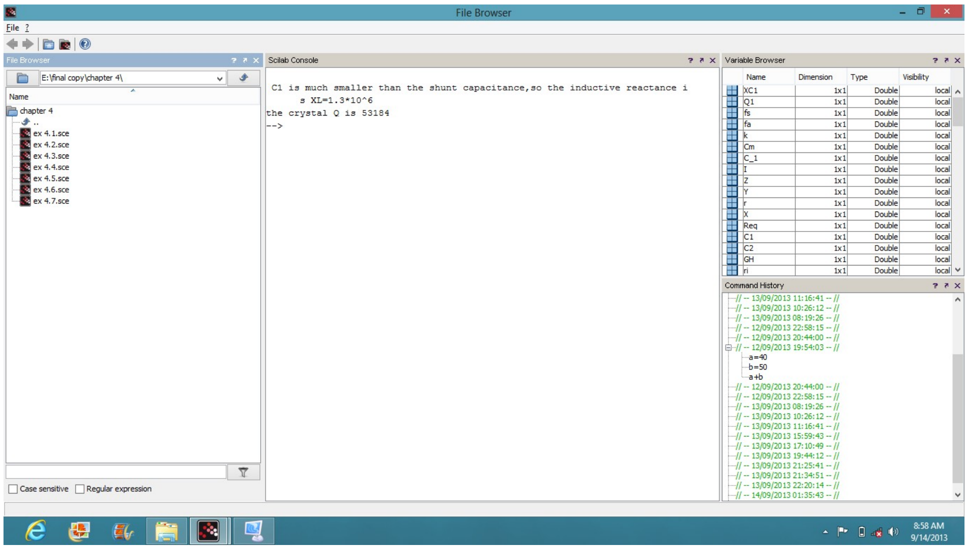

Figure 7.6: Oscillators Ex 7 6

```
Q1=Xs/r//equivalent to crystal Q for easily
    expressing
C1=21*10^-15
XC1=(C1*2*%pi*f)^-1//capacitive reactance
disp('C1 is much smaller than the shunt capacitance,
    so the inductive reactance is XL=1.3*10^6')
Q=XC1/r//crystal Q
mprintf('the crystal Q is %d ',Q)
```

Scilab code Exa 7.7 Oscillators Ex 7 7

```
clc
//chapter 7:Crystal Oscillator Characteristics
//Example 7.7 page no 266
//given
f=20*10^6//given frequency
```

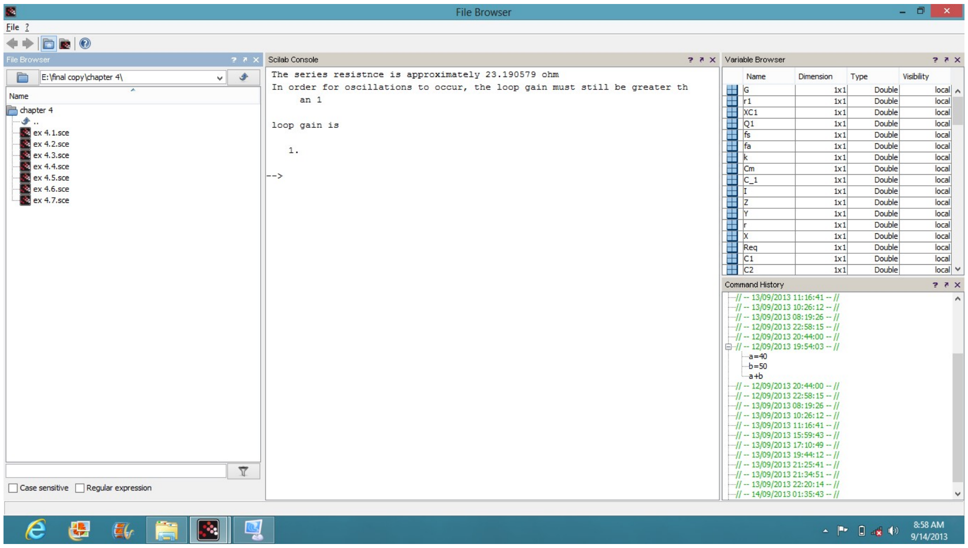

Figure 7.7: Oscillators Ex 7 7

```
//If the crystal load capacitnace is specified to be
    32pF, then the series combination of C1 and C2
   must be 32pF. this could be satisfied by using 64
   pF capacitors for both C1 and C2.
gm=1.5*10^-3//transconductance
C1=64*10^-12
C2=64*10^-12
r1=gm/((2*%pi*f)^2*C1*C2)//series resistance of the
    crystal
mprintf('The series resistnce is approximately %f
   ohm ',r1)
disp('In order for oscillations to occur, the loop
    gain must still be greater than 1')
G=gm*((2*%pi*f*C1)^-1)^2/r1//loop gain
disp(G,'loop gain is ')
```

Scilab code Exa 7.8 Oscillators Ex 7 8

```
clc
//Chapter 7:Conditions for Oscillation
//example 7.8 page no 270
//given
fa=5.7*10^6//parallel antiresonant frequency
C1=21*10^-15
Co=37.1*10^-12//here 32pF is parallel with 5.1pF so
    they get added
CL=22*10^-12
f_a=fa*((1+C1/(2*(Co+CL)))/(1+C1/(2*Co)))//new
    parallel antiresonant frequency
r1=25
Rp=r1*(1+((r1*2*%pi*f_a*(Co+CL))^-1)^2)//equivalent
    parallel resistance
mprintf('the new parallel antiresonant frequency is
    %f MHz \n the equivalent parallel resistance is
    %f Kohm',f_a*1e-6,Rp*1e-3)
```

Scilab code Exa 7.9 Oscillators Ex 7 9

```
clc
//Chapter 7:Conditions for Oscillation
//example 7.9 page no 284
//given
rd=50*10^3
gm=5*10^-3//transconductance
f=16*10^6//frequency of oscillation
Rs=15
XC1=1*10^3//capacitive reactance of first capacitor
XC2=Rs/(gm*XC1)//capacitive reactance of second
    capacitor
```

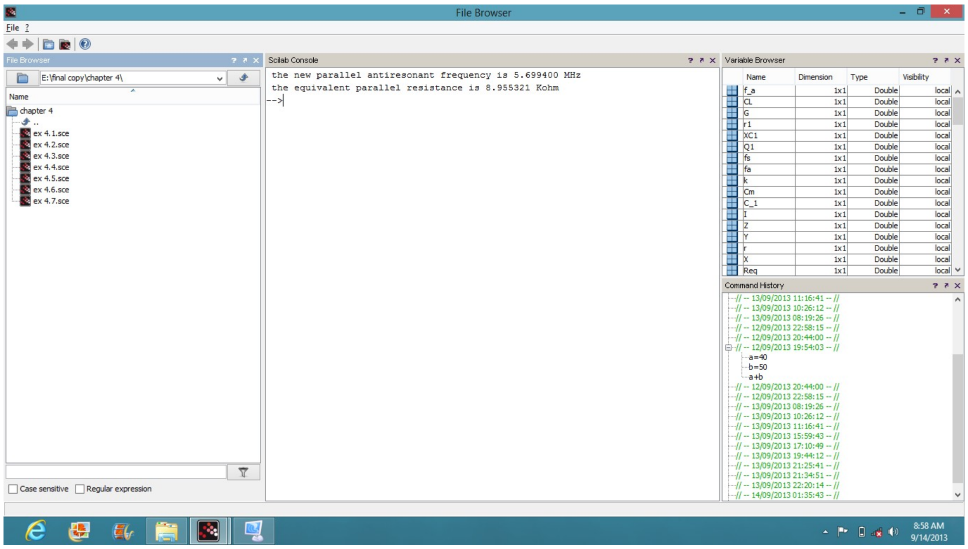

Figure 7.8: Oscillators Ex 7 8

```
C1=(2*%pi*f*XC1)^-1//value of first capacitor
C2=(2*%pi*f*XC2)^-1//value of second capacitor
mprintf('the value of first capacitor is %3.2e pF\n the value of second capacitor is %3.2e pF\n ',C1,C2)
disp('This value of C1 may be so small that the transistor output capacitance has a effect. therefore it is desirable to incease C1.If C1 is increased by a factor of 10,so that XC1=100,then C2 must also be increased ')
XC_2=Rs/(gm*100)//new value of reactance
XL=100+XC_2//inductive reactance
L=XL/(2*%pi*f)//value of inductor
mprintf('the value of inductor is %3.2e H',L)
```

Scilab code Exa 7.11 Oscillators Ex 7 11

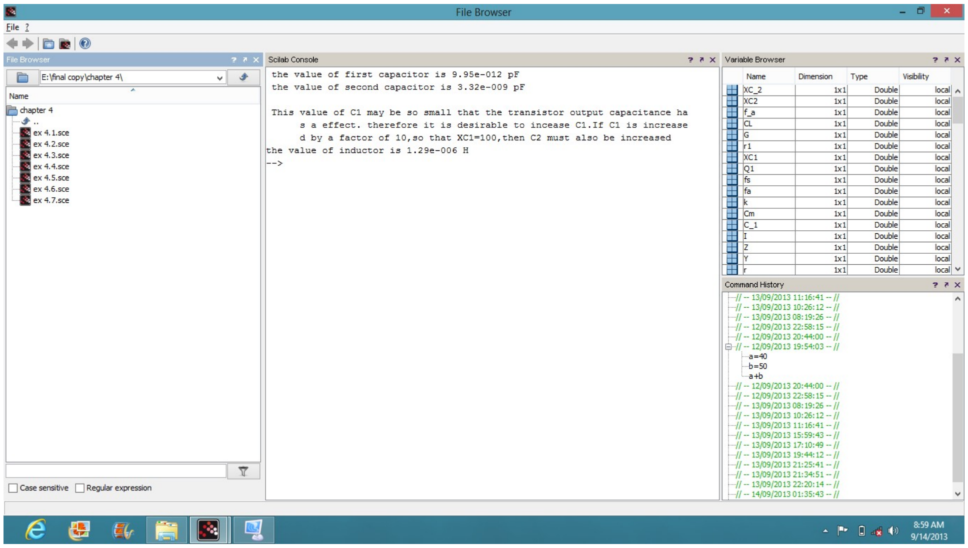

Figure 7.9: Oscillators Ex 7 9

```
clc
//Chapter 7:Oscillators
//Example 7.11 page no 292
disp('In order to convert the input waveform from
    87.5MHz to 10.7MHz the local oscillator would
    need to be 76.8MHz(low side injection) or 98.2MHz
     (high side injection).To convert the input
    waveform from 108.0MHz the local oscilltor would
    need to be 97.3MHz (low side injection) or 118.7
    MHz (high side injection) ')
L=0.05*10^-6//choosing value of indicator
f1=76.8*10^6//starting frequency
f2=97.3*10^6//ending frequency
C1=((1/(2*%pi*f1))^2)/L//Capacitor value for
    starting frequency
C2=((1/(2*%pi*f2))^2)/L//Capacitor value for ending
    frequency
mprintf('The value of C is varies batween %3.2e F to
     %3.2e F ',C1,C2)
```

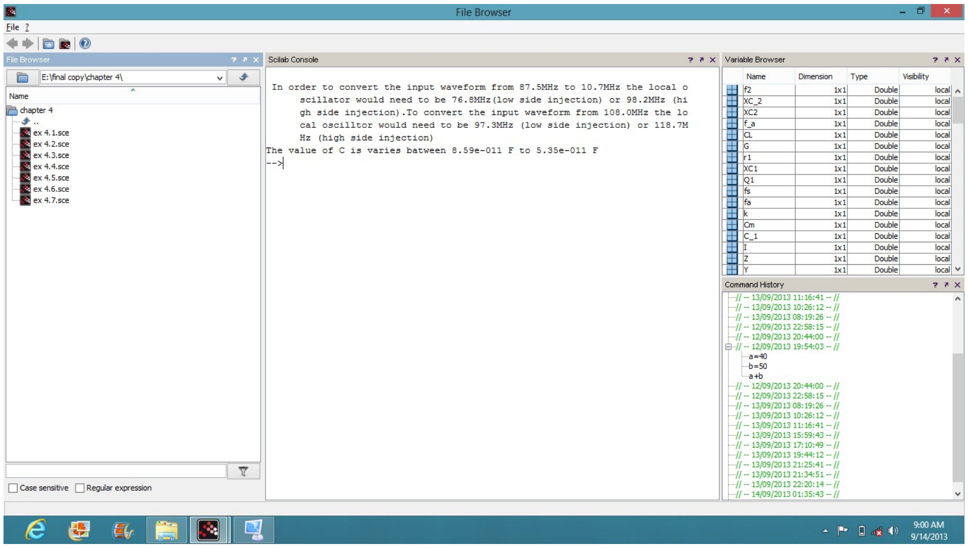

Figure 7.10: Oscillators Ex 7 11

Chapter 8

Phase Locked Loops

Scilab code Exa 8.1 PLL Ex 8 1

```
clc
//Chapter 8:Linear model of phase locked loop
//example 8.1 page no 314
//given
fo=1*10^6//output frequency
fr=25*10^3//reference frequency
N=fo/fr
Kd=2//phase detector gain factor
Ko=100//VCO gain factor
thetao=(2*100*2*%pi)//output phase
s=poly(0,"s")
thetar=s+(2*100*2*%pi)/N//input phase
Tf=thetao/thetar
disp(Tf,'the closed loop transfer function is ')
Kv=Kd*Ko/N//bandwidth
mprintf('the synthesizer bandwidth will be %d Hz',Kv
   )
```

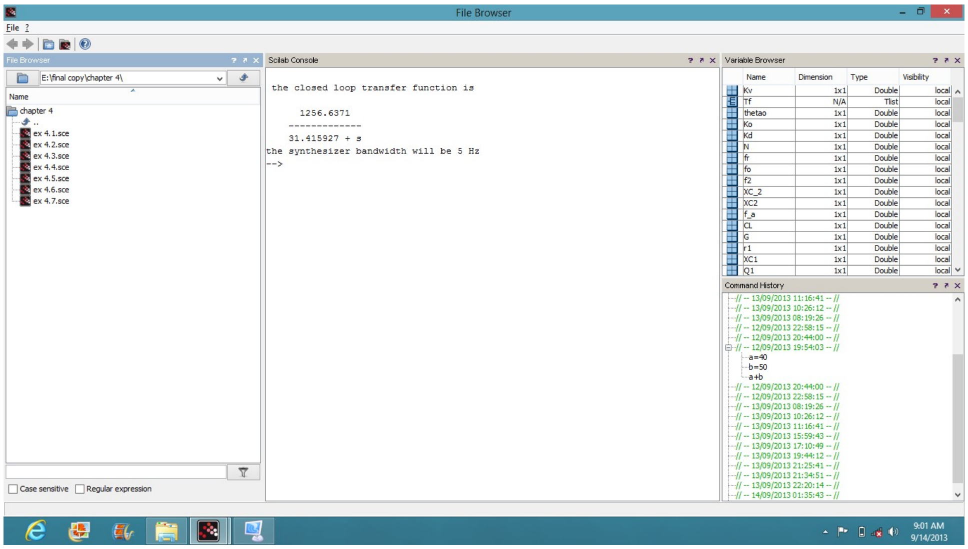

Figure 8.1: PLL Ex 8 1

Scilab code Exa 8.2 PLL Ex 8 2

```
clc
//Chapter 8:Linear model of phase locked loop
//example 8.2 page no 316
//given
zeta=0.707//damping ratio for butterworth filter
Kv=10*%pi//bandwidth
wL=Kv*(2*zeta)^2//low pass filter bandwidth
wn=sqrt(Kv*wL)//bandwidth of closed loop system
tr=2.2/wn//rise time
mprintf('low pass filter bandwidth is %f rad/s \n
    bandwidth of closed loop system is %f rad/s \n
    the system rise time is %3.2e s',wL,wn,tr)
```

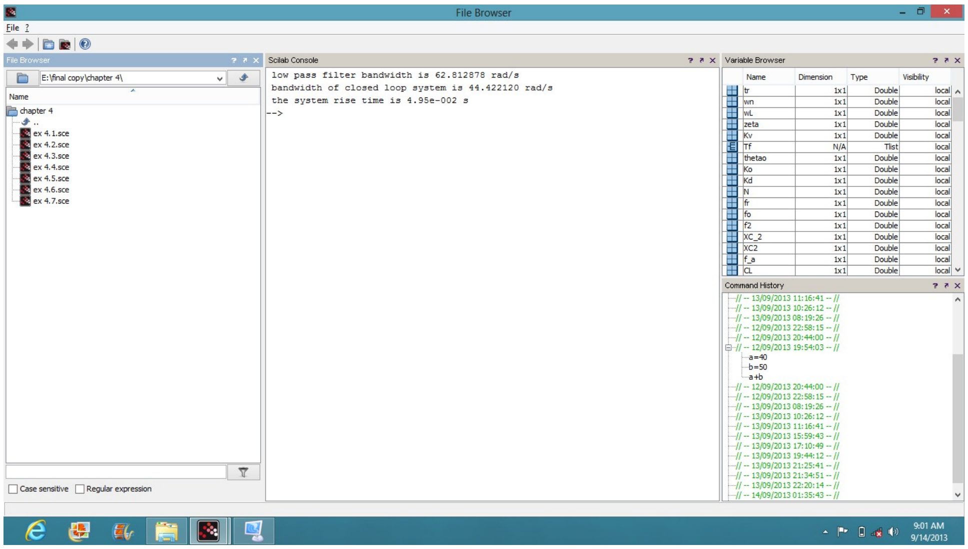

Figure 8.2: PLL Ex 8 2

Scilab code Exa 8.4 PLL Ex 8 4

```
clc
//Chapter 8:Linear model of phase locked loop
//example 8.6 page no 349
//given
//The VCO is designed to oscillate at 100kHz
R1=10.8*10^3
R2=10.8*10^3
C=1*10^-9
N=2//order of filter
fmin=(R2*(C+32*10^-12))^-1//minimum frequency
fmax=fmin+(R1*(C+32*10^-12))^-1//maximum frequency
VDD=9//regulated power supply
Kvco=(2*%pi*(fmax-fmin))/(VDD-2)
Kv=Kvco*(VDD/%pi)/N
zeta=0.707//damping ratio for butterworth filter
```

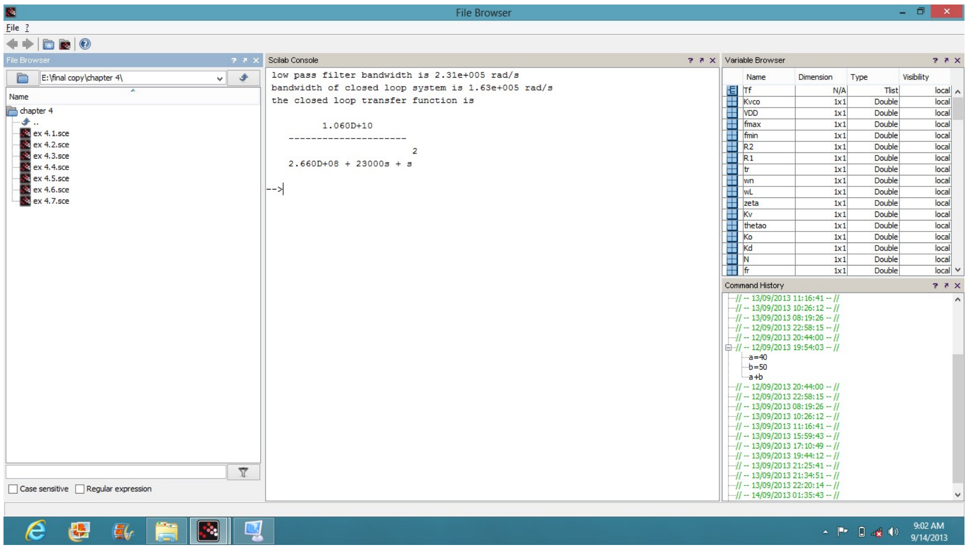

Figure 8.3: PLL Ex 8 4

```
wL=Kv*(2*zeta)^2//low pass filter bandwidth
wn=sqrt(Kv*wL)//bandwidth of closed loop system
mprintf('low pass filter bandwidth is %3.2e rad/s \n bandwidth of closed loop system is %3.2e rad/s',wL,wn)
thetao=(10.6*10^9)//output phase
s=poly(0,"s")
thetar=s^2+s*2.3*10^4+2.66*10^8//input phase
Tf=thetao/thetar
disp(Tf,'the closed loop transfer function is ')
```

Chapter 9

Phase Locked Loop Analysis

Scilab code Exa 9.1 PLLA Ex 9 1

```
clc
//chapter 9: Stability Analysis
//Example 9.1 page no 357
//given
Kv=50//DC gain
wL=100//corner frequency
disp('The system crossover frequecny is
    approximately 50 rad/s')
PhaseMargin=90-(atan(50/wL)*180/%pi)//phase margin
    of system
disp('At this frequency the phase shift of the open
    loop transfer function is −112.5')
disp(PhaseMargin,'The phase margin is ')
```

Scilab code Exa 9.2 PLLA Ex 9 2

```
clc
```

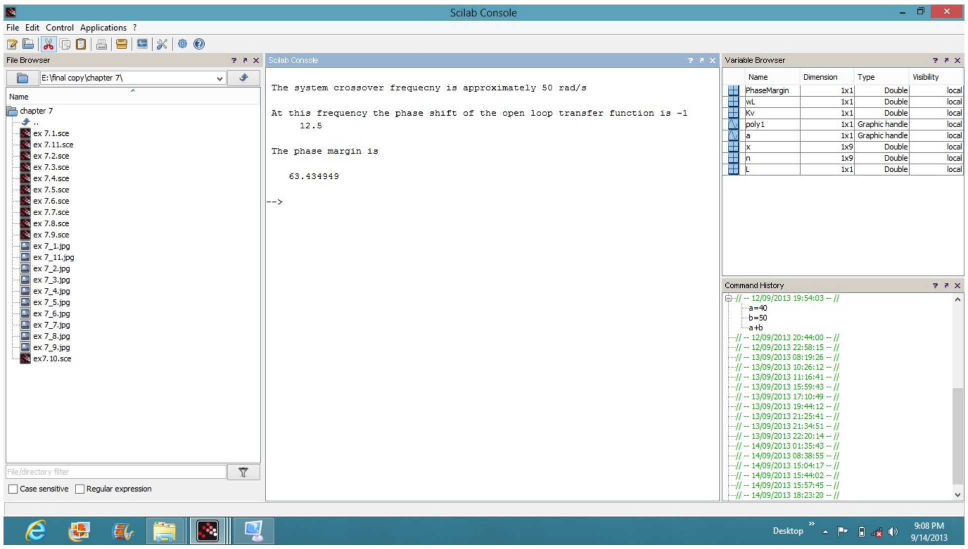

Figure 9.1: PLLA Ex 9 1

```
//chapter 9: Stability Analysis
//Example 9.2 page no 357
//given
Kv=50//DC gain
wL=10//corner frequency
disp('The system crossover frequecny is
    approximately 22 rad/s')
PhaseMargin=90-(atan(22/wL)*180/%pi)//phase margin
    of system
disp(PhaseMargin,'The phase margin is ')
```

Scilab code Exa 9.3 PLLA Ex 9 3

```
clc
close
//chapter 9: Stability Analysis
```

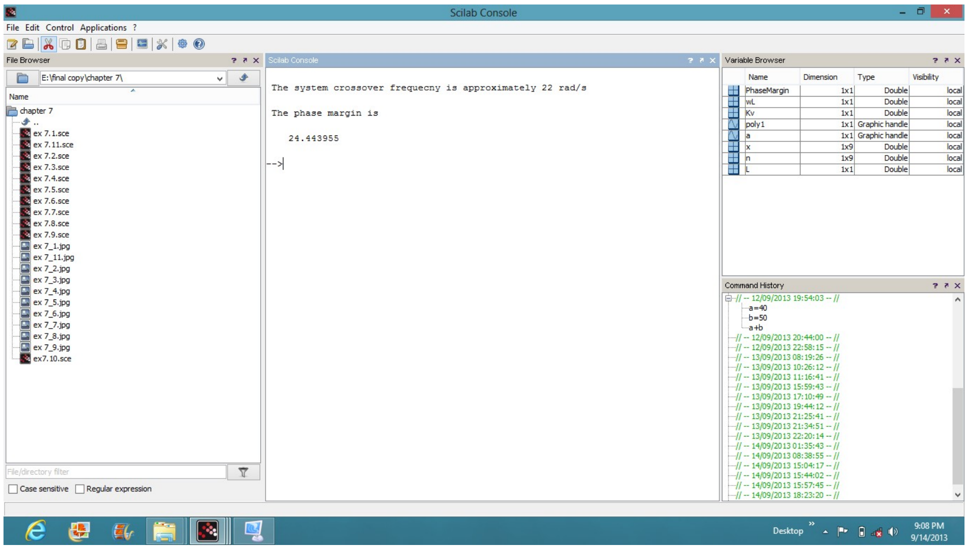

Figure 9.2: PLLA Ex 9 2

```
//Example 9.3 page no 361
//given
clear
wL=258
s=poly(0,'s')
h=syslin('c',(100/(s*(s/wL+1)^2 )))
clf();bode(h,1,1000);
disp('The open loop gain and the phase plots are
    given .It is seen that the crossover frequency is
     15Hz,and the phase margin is 50degree')
disp('We know that the overshoot can be increased by
     decreasing the phase margin.In fact,in this case
     selecting wL=233 rad/s corresponding to phase
    margin of 43.5degree gives an overshoot of 20
    persent')
```

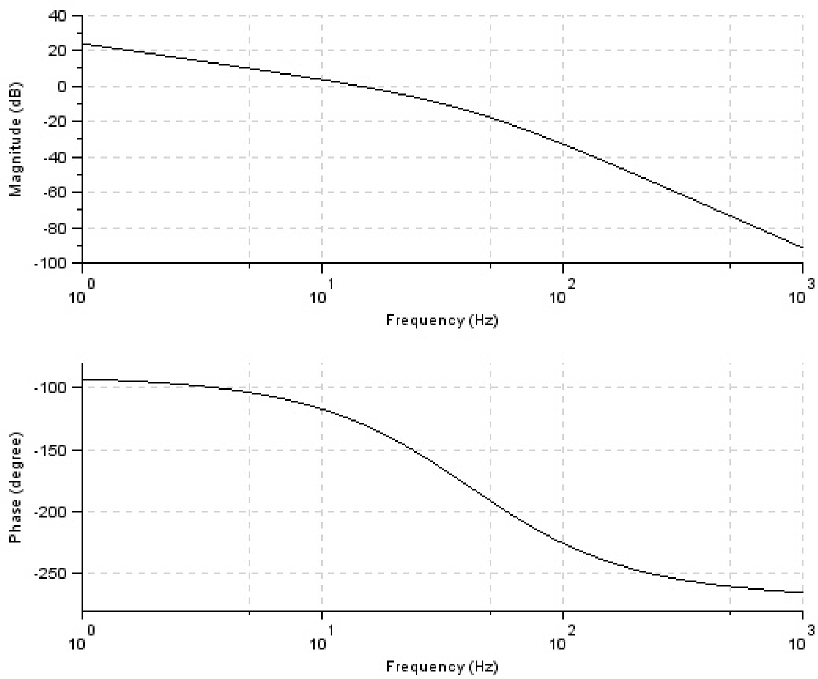

Figure 9.3: PLLA Ex 9 3

Scilab code Exa 9.4 PLLA Ex 9 4

```
clc
close
//chapter 9: Stability Analysis
//Example 9.4 page no 363
//given
clear
N=2
Kv=0.83*10^3//DC gain
B=1250//closed loop bandwidth
wn=1.27*10^3
wL=wn^2/Kv//corner frequency
s=poly(0,'s')
h=syslin('c',(1/((s^2/wn^2)+0.9*s/wn+1)))
clf();bode(h,1,1000);
```

Scilab code Exa 9.5 PLLA Ex 9 5

```
clc
close
//chapter 9: Stability Analysis
//Example 9.5 page no 368
//given
clear
Ka=(2.2e3)^2
wz=(2*%pi)/(2.2/sqrt((2.2e3)^2))
s=poly(0,'s')
h=syslin('c',(1000*(s/(wz+1))/(s^2/Ka +(s/wz) +1)))
clf();bode(h,1,1000);
```

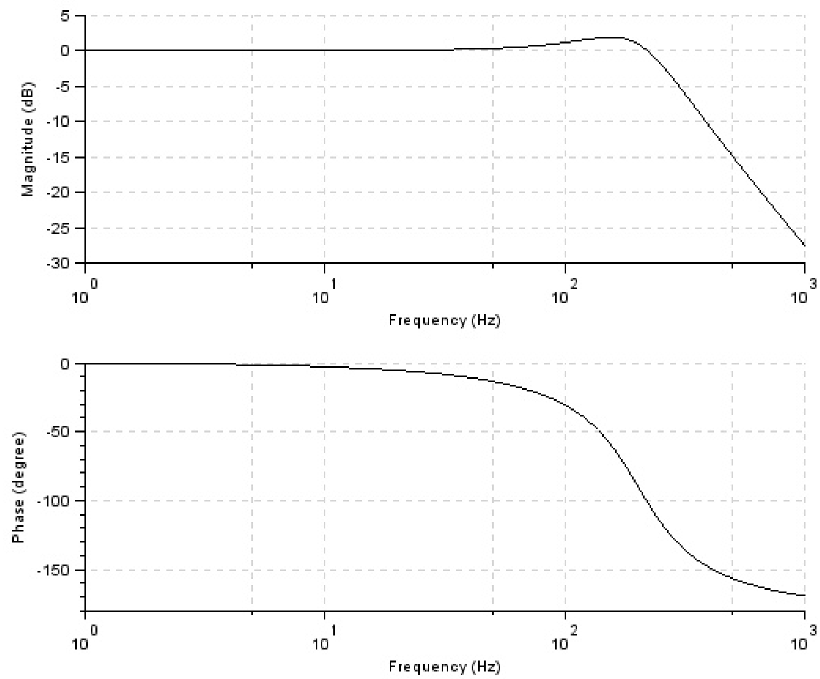

Figure 9.4: PLLA Ex 9 4

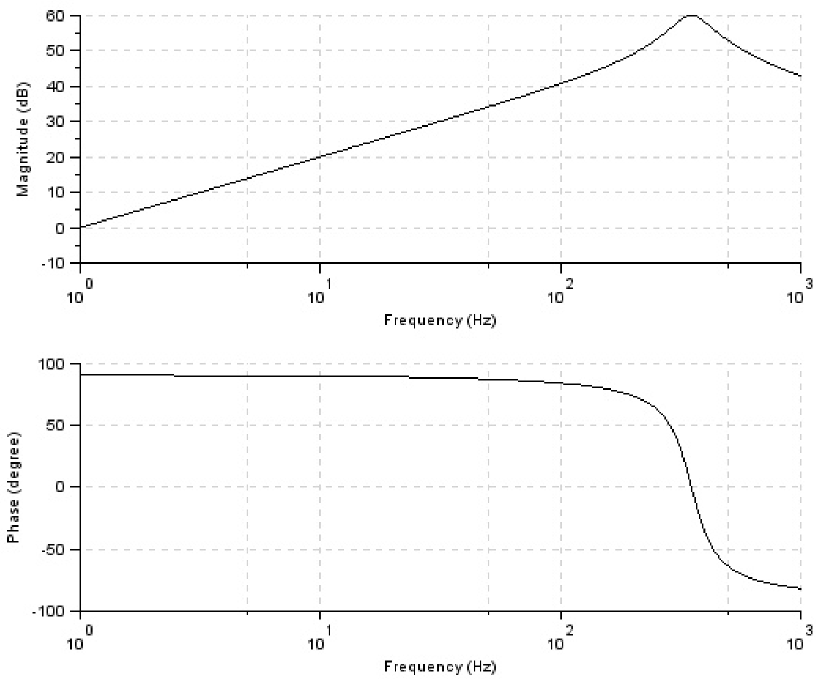

Figure 9.5: PLLA Ex 9 5

Scilab code Exa 9.6 PLLA Ex 9 6

```
clc
//Chapter 9:Stability Analysis
//example 8.6 page no 373
//given
zeta=0.8//damping ratio
B=10^3//closed loop bandwidth
X=sqrt(1+2*zeta^2+sqrt(2+4*zeta^2+4*zeta^4))
Ka=(B/X)^2//loop gain
wn=sqrt(Ka)//
wz=wn/(2*zeta)//the system zero
mprintf('the closed loop gain is %3.2e (rad/s)^2 \n
    wn = %f rad/s \n the system has zero at %d rad/s'
    ,Ka,wn,wz)
```

Scilab code Exa 9.7 PLLA Ex 9 7

```
clc
//Chapter 9:Phase locked loop Analysis
//Example 9.7 page no 376
a=28//taking alpha as a
Ka=0.21*10^6
GF=20*log10(a)^1/2
disp(GF,'The value of gain is ')
disp('so we must determine where the uncompensated
    frequency response is -14.5dB ')
Wc=a^(1/4)*Ka^(1/2)
disp('The 28:1 lead ratio will increase the
    crossover frequency by a factor 2.3  The factor
```

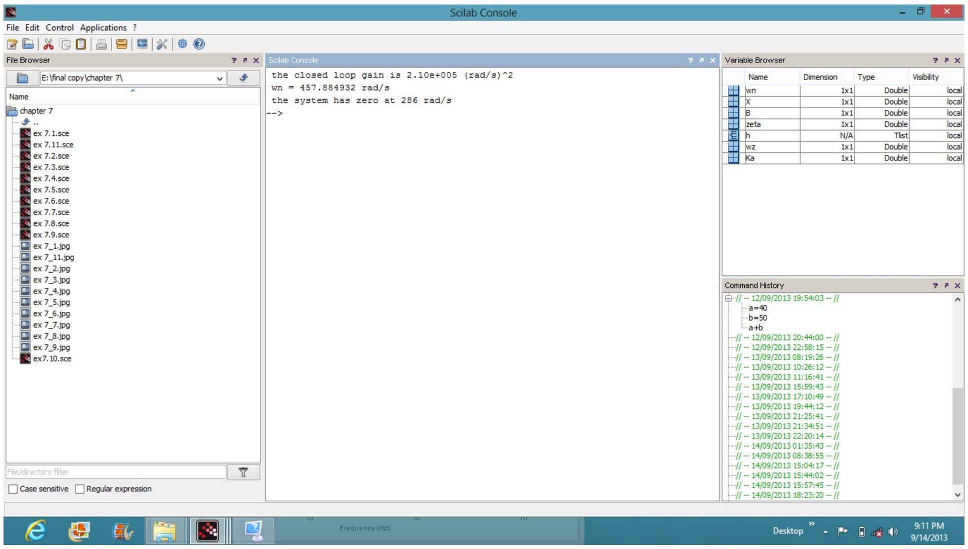

Figure 9.6: PLLA Ex 9 6

```
    zero is placed at ')
Wz=Wc/sqrt(a)//systems zero
Wp=a*Wz//systems pole
mprintf('The crossover frequency is %3.2e rad/s \n
    The zero is placed at %d rad/s \n The pole is
    placed at %d rad/s ',Wc,Wz,Wp)
```

Scilab code Exa 9.9 PLLA Ex 9 9

```
clc
//Chapter 9:Phase locked loop Analysis
//Example 9.9 page no 380
disp('since the phase margin without time delay is
    50 degree, a 10 degree phase lag can be
    introduced by the time delay at the crossover
    frequecy.That is ,')
```

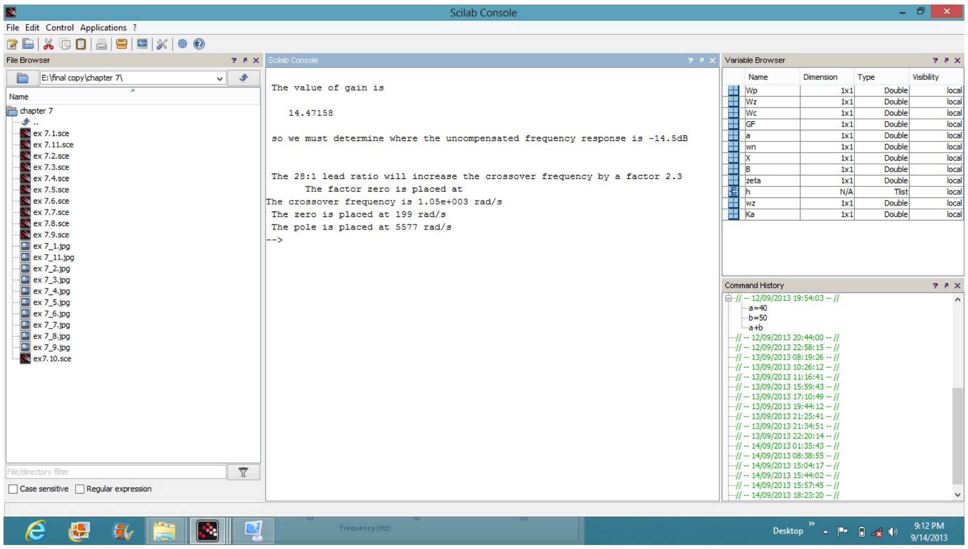

Figure 9.7: PLLA Ex 9 7

```
Wc=1000//crossover frequency
thetaT=-0.174
T=thetaT/Wc//time delay
mprintf('The time delay is %3.2e ',T)
```

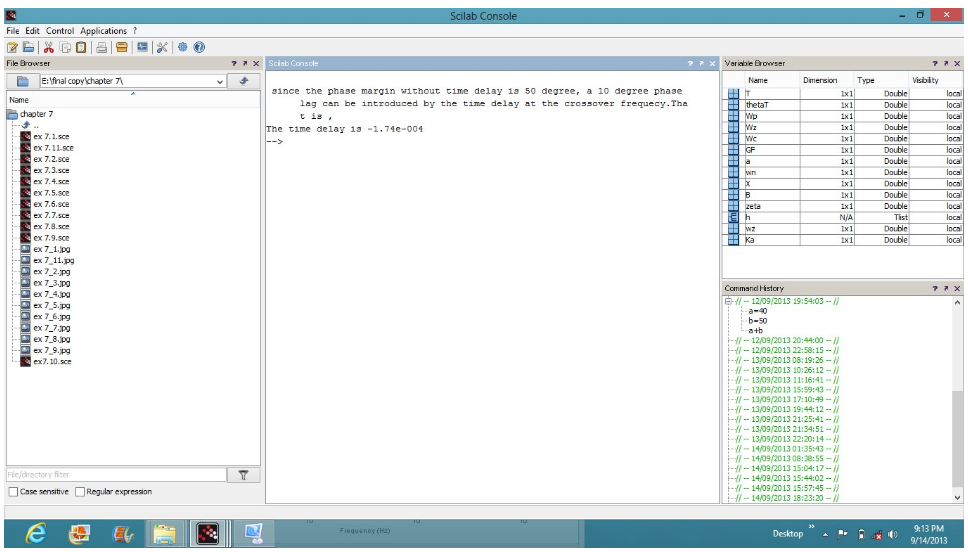

Figure 9.8: PLLA Ex 9 9

Chapter 10

Frequency Synthesizers

Scilab code Exa 10.3 FS Ex 10 3

```
clc
//Chapter 10:Frequency Synthesizers
//Example 10.3 page no 416
fr=1*10^6//reference frequency
f=100*10^6//given frequency
fi=1*10^6//increment in frequency
Dmin=fr*f/fi
mprintf('The value of Dmin is %d Hz',Dmin)
```

Scilab code Exa 10.4 FS Ex 10 4

```
clc
//Chapter 10:Frequency Synthesizers
//Example 10.4 page no 417
fo=185.6*10^6//required output frequency
fr=31.25*10^3//reference frequency
P=64
```

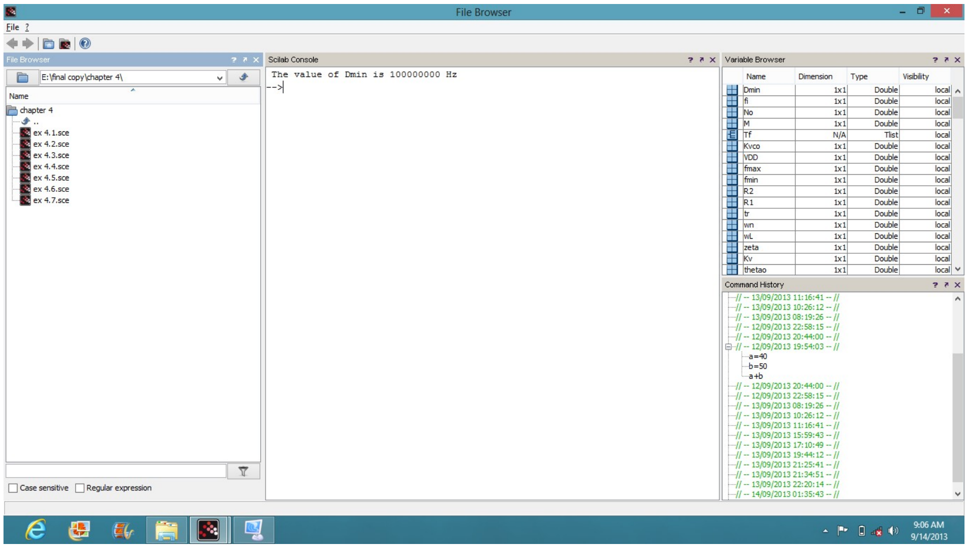

Figure 10.1: FS Ex 10 3

```
disp('To begin with the hopping bin channel spacing
    requirement of at least 20KHz,a 2MHz crystal is
    connected to the MC14512-2 with the reference
    address inputs(pins 4,5,6) connected such that
    the crystal is divided by 64(RA2=0,RA1=0,RA0=1)
    This gives a reference frequency of 31.25KHz; and
     the maximum number of hops is 5.2MHz/31.25KHz
    =166.4hops FOr 185.6MHZ the values of N and A are
     found as follows:')
N=(fo/fr)/P//finding N for A=0
disp('For this value of N,find A by ')
A=(fo/fr)-92*P
mprintf('N = %d \n A = %d ',N,A)
```

Scilab code Exa 10.5 FS Ex 10 5

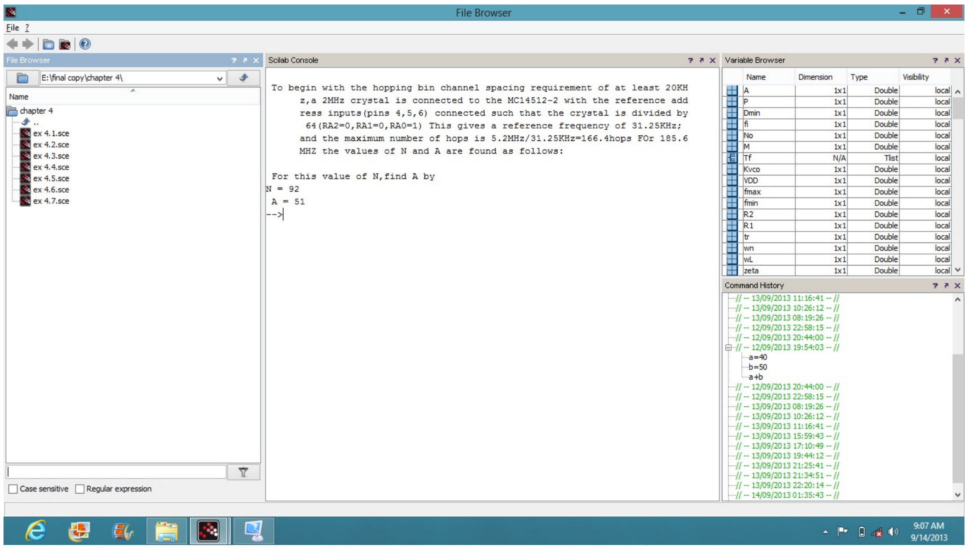

Figure 10.2: FS Ex 10 4

```
clc
//Chapter 10:Frequency Synthesizers
//Example 10.5 page no 426
fr=100*10^3//reference frequency
f=10*10^6//given frequency
fi=1*10^3//increment in frequency
fo=fr*f/fi//required VCO operating frequency
mprintf('The value of VCO operating frequency is %3
    .2e Hz',fo)
```

Scilab code Exa 10.7 FS Ex 10 7

```
clc
//Chapter 10:Frequency Synthesizers
//Example 10.7 page no 429
N=4
```

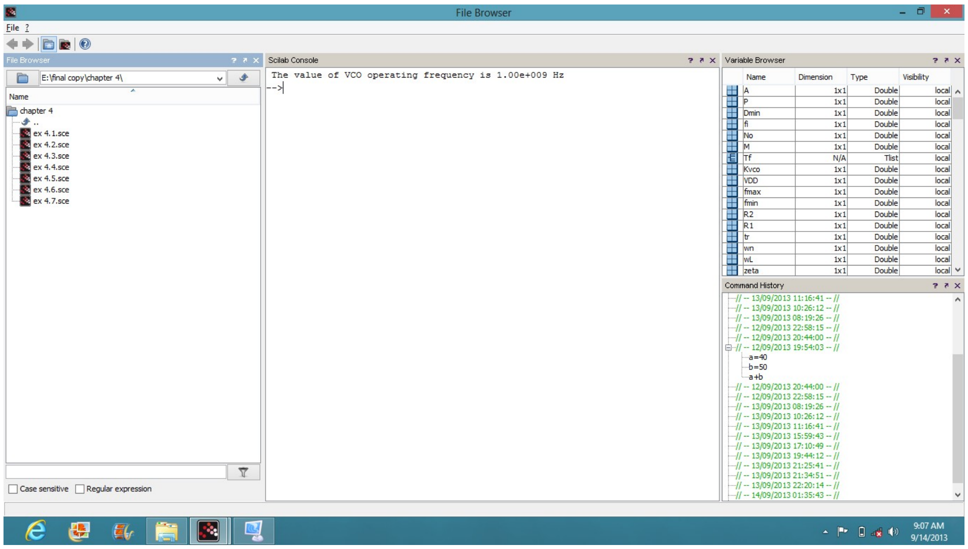

Figure 10.3: FS Ex 10 5

```
M=1.8//count
fr=100*10^3//reference frequency
fo=fr*(N+M^-1)//output frequency
mprintf('The value of output frequency is %3.2e Hz',
    fo)
```

Scilab code Exa 10.8 FS Ex 10 8

```
clc
//Chapter 10:Frequency Synthesizers
//Example 10.8 page no 429
N=100
M=10//count
fr=10*10^3//reference frequency
fo=fr*(N+M^-1)//output frequency
mprintf('The value of output frequency is %f Hz',fo)
```

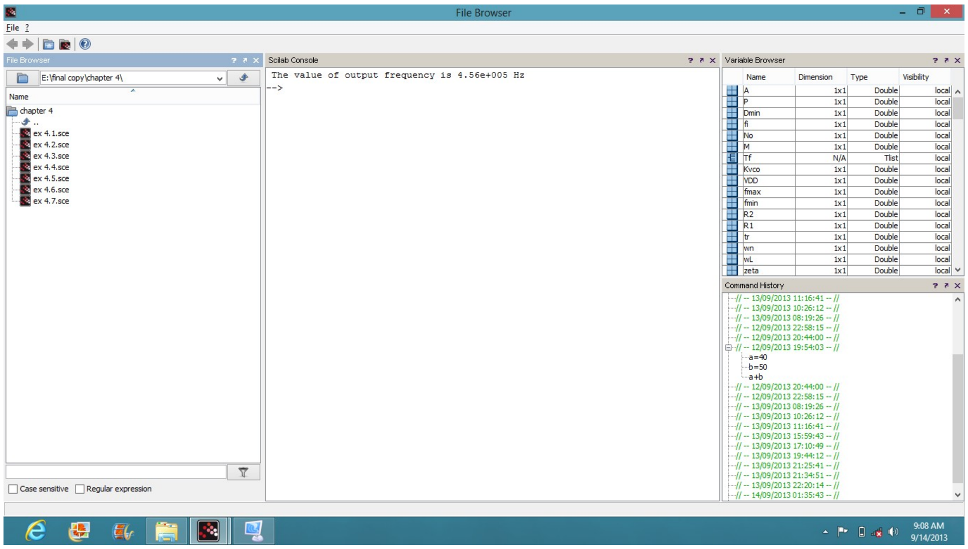

Figure 10.4: FS Ex 10 7

Scilab code Exa 10.11 FS Ex 10 11

```
clc
//Chapter 10:Frequency Synthesizers
//Example 10.11 page no 446
disp('A signal sideband power is −140dB/Hz ')
N=5*10^6//frequency of reference oscillator
M=5*10^3//count
No=-140+10*log10((N/M)^2)//the output noise power due to the reference oscillator
mprintf('The single sideband noise power at a frequency offset of 0.5KHz is %d dB/Hz ',No)
```

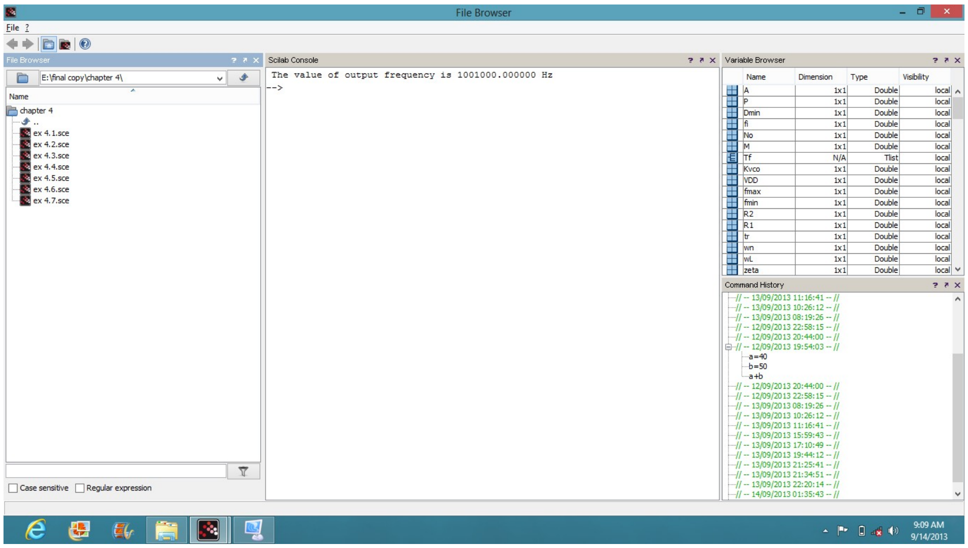

Figure 10.5: FS Ex 10 8

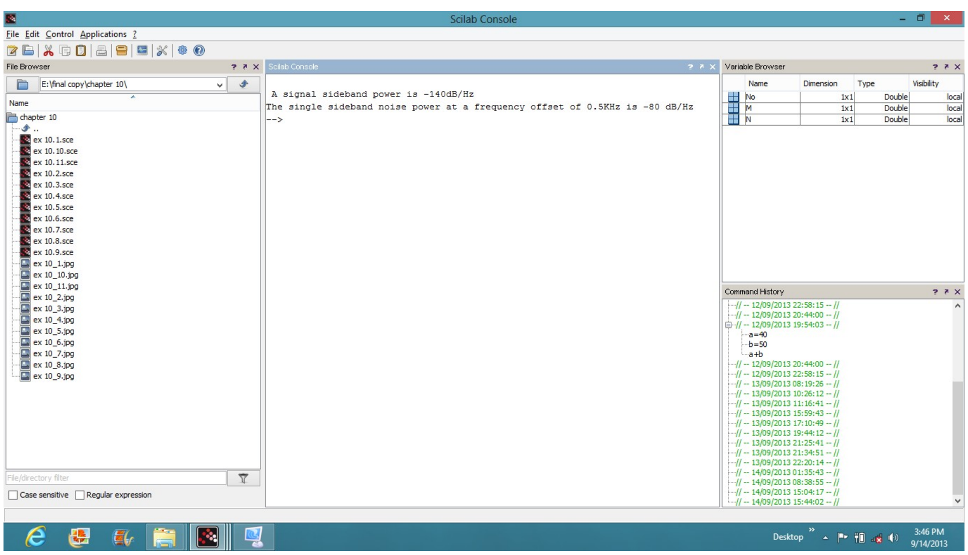

Figure 10.6: FS Ex 10 11

Chapter 11

Power Amplifiers

Scilab code Exa 11.1 PA Ex 11 1

```
clc
//Chapter 11:Power amplifiers
//example 11.1 page no 456
//given
Po=5//max power in watts
Rl=50//load resistance in ohm
Vp=sqrt(2*5*50)//peak voltage across Rl
Vcc=24//supply voltage
Ip=Vp/Rl//peak current corresponding to Vp
Iq=Vcc/50//Q point current value
Pcc=Vcc*Iq//power supplied
Eff=(Po/Pcc)*100//efficiency
mprintf('peak voltage across Rl is %f V \n the peak
   current is %f A \n the power supplied is %f W \n
   the efficiency is %f ',Vp,Ip,Pcc,Eff)
disp('the transistor that is selected must be able
   to dissipate 11.52W in case the input power drops
    to zero and the transistor Vce breakdown voltage
    must be at least 48V(2*Vcc)')
```

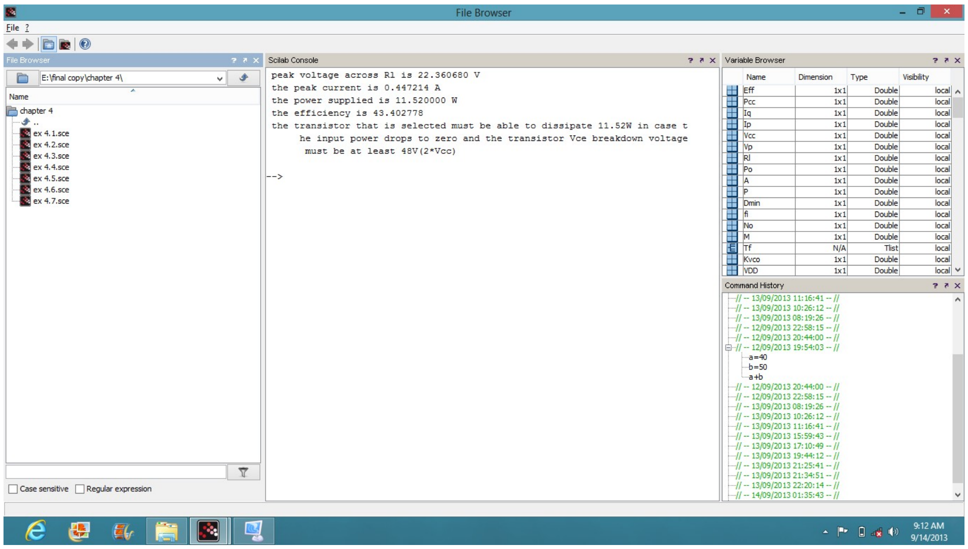

Figure 11.1: PA Ex 11 1

Scilab code Exa 11.2 PA Ex 11 2

```
clc
//Chapter 11:Power amplifiers
//example 11.2 page no 466
//given
Po=5//max power in watts
Rl=50//load resistance in ohm
//asumme'1:1 truns ratio transformer coupled push
    pull amplifier each supllying 2.5 watt'
disp('since a push pull amplifier is used, each
    class B amplifier will supply 2.5W')
Pomax=2.5
Vcc=sqrt(4*Rl*Po)//supply voltage
Ptmax=Pomax*(4/%pi^2)//maximum power handling
```

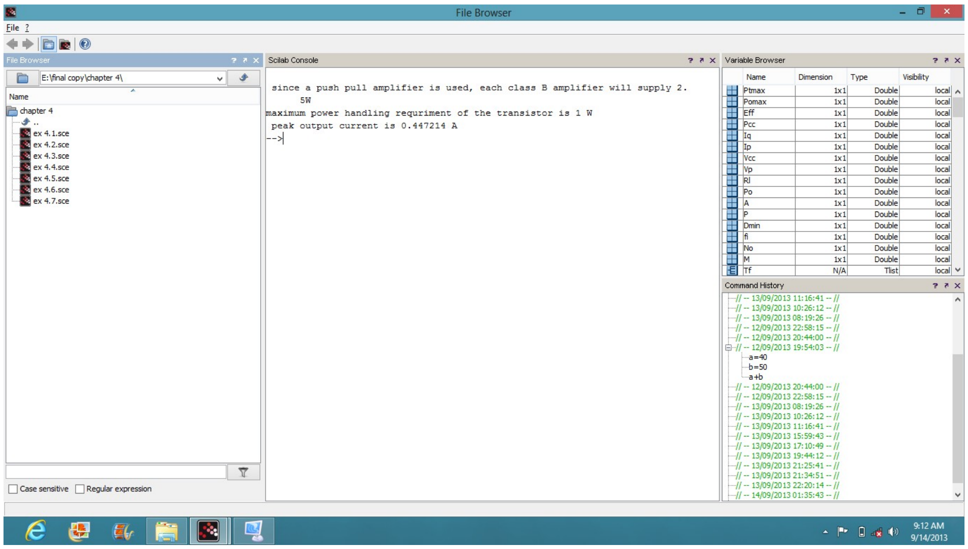

Figure 11.2: PA Ex 11 2

```
    requriment of the transistor
I=sqrt((4*Pomax)/Rl)//peak output current
mprintf('maximum power handling requriment of the
    transistor is %d W \n peak output current is %f A
    ',Ptmax,I)
```

Scilab code Exa 11.3 PA Ex 11 3

```
clc
//Chapter 11:Power amplifiers
//example 11.2 page no 474
//given
Po=5//max power in watts
Rl=50//load resistance in ohm
f=1e6//operating frequency in hertz
Vcc=sqrt(2*Rl*Po)
```

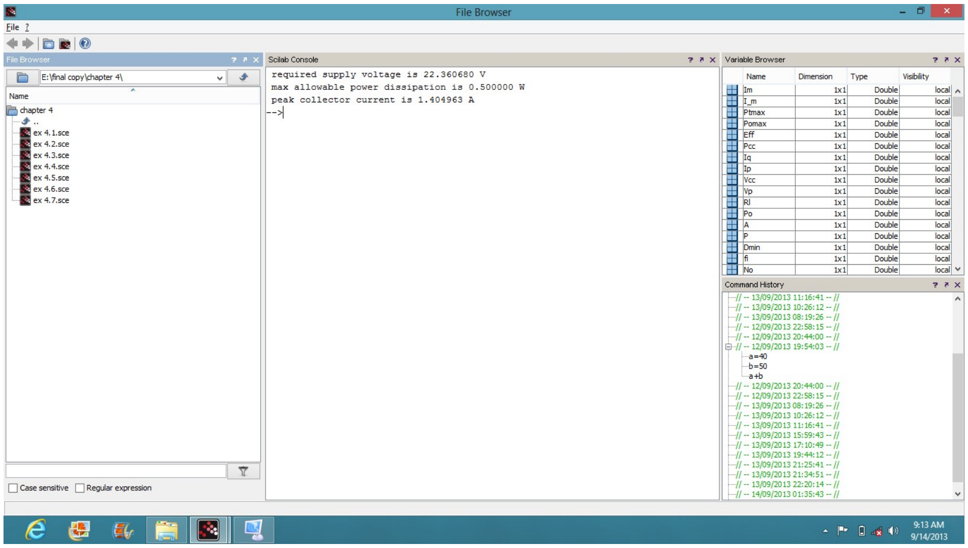

Figure 11.3: PA Ex 11 3

```
Ptmax=0.1*Po//allowable power dissipation
I_m=0.5
Im=(2*%pi*Vcc*I_m)/Rl//peak collector current
mprintf('required supply voltage is %f V \n max allowable power dissipation is %f W \n peak collector current is %f A',Vcc,Ptmax,Im)
```

Scilab code Exa 11.4 PA Ex 11 4

```
clc
//Chapter 11:Power amplifiers
//example 11.4 page no 475
//given
Pt=4//max power dissipation in watt
Idmax=1.5//max drain current in amp
Vcc=48//supply voltage
```

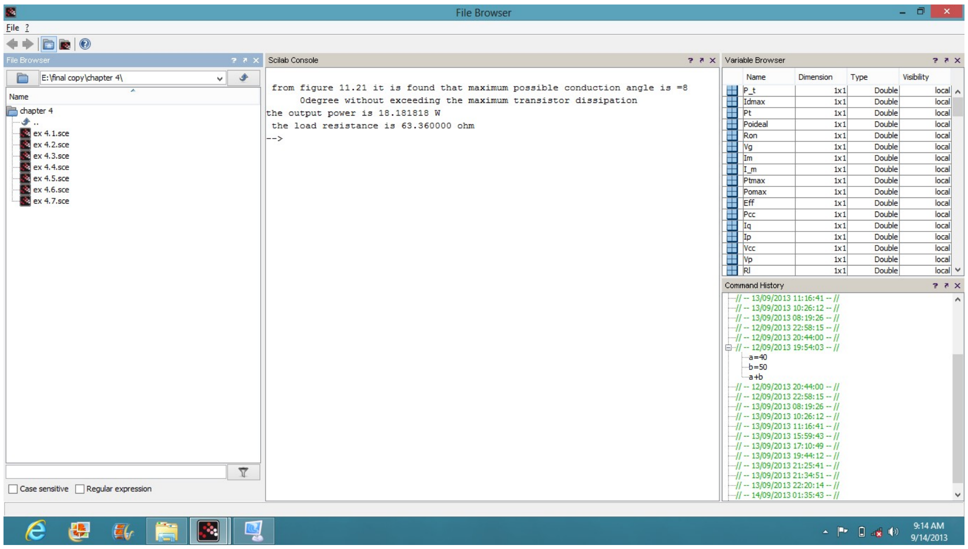

Figure 11.4: PA Ex 11 4

```
P_t=(4*%pi*Pt)/(Vcc*Idmax)//the normalised max
    transistor dissipation
disp('from figure 11.21 it is found that maximum
    possible conduction angle is =80degree without
    exceeding the maximum transistor dissipation')
Po=Pt/0.22//output power
Rl=Vcc^2/(2*Po)//load resistance
mprintf('the output power is %f W \n the load
    resistance is %f ohm ',Po,Rl)
```

Scilab code Exa 11.5 PA Ex 11 5

```
clc
//Chapter 11:Power amplifiers
//example 11.5 page no 477
//given
```

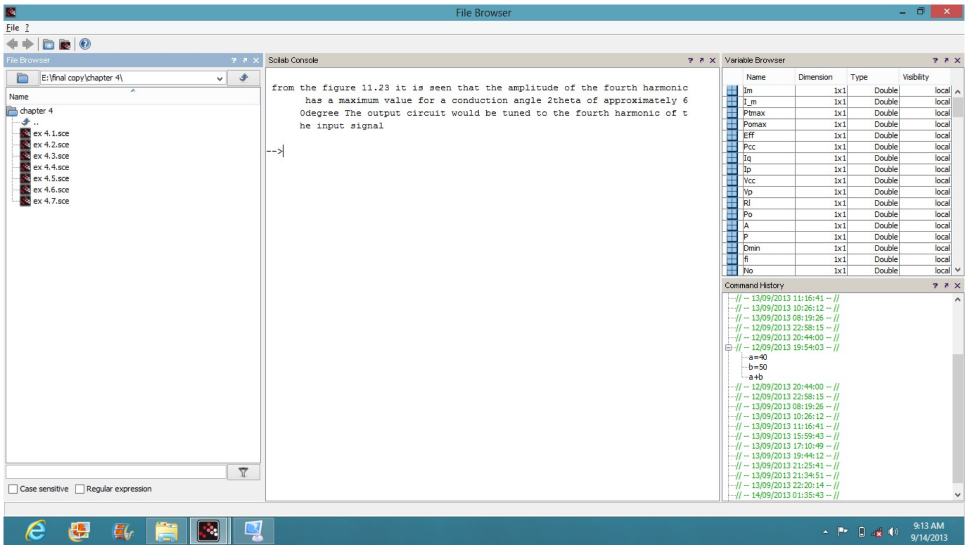

Figure 11.5: PA Ex 11 5

```
disp('from the figure 11.23 it is seen that the
    amplitude of the fourth harmonic has a maximum
    value for a conduction angle 2theta of
    approximately 60degree The output circuit would
    be tuned to the fourth harmonic of the input
    signal')
```

Scilab code Exa 11.6 PA Ex 11 6

```
clc
//Chapter 11:Power amplifiers
//example 11.6 page no 479
//given
Po=20//power delivered in watt
Rl=50//load resistance
Vcc=sqrt(%pi^2*Rl*Po/8)//suppy volatage
```

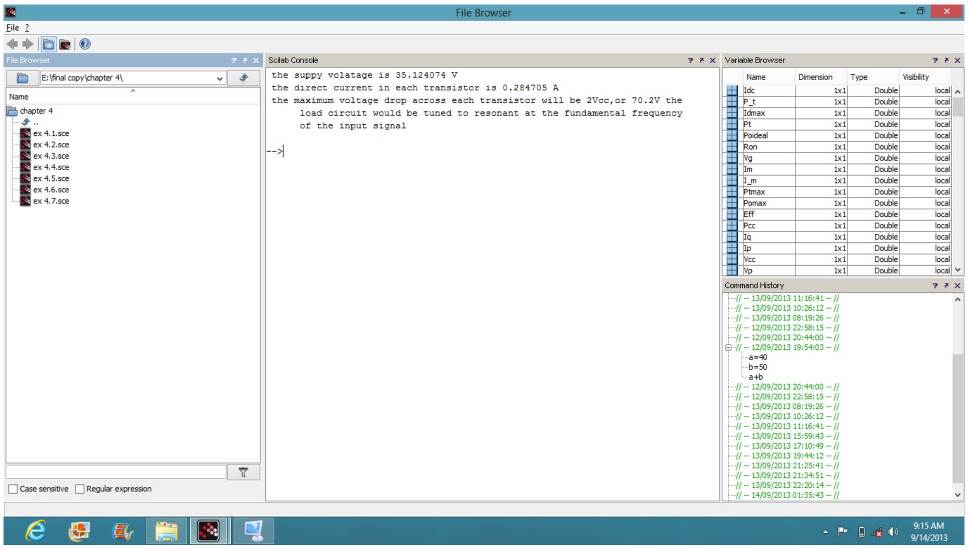

Figure 11.6: PA Ex 11 6

```
Idc=4*Vcc/(Rl*%pi^2)//direct current in each
    transistor
mprintf('the suppy volatage is %f V \n the direct
    current in each transistor is %f A',Vcc,Idc)
disp('the maximum voltage drop across each
    transistor will be 2Vcc,or 70.2V the load circuit
     would be tuned to resonant at the fundamental
    frequency of the input signal')
```

Scilab code Exa 11.7 PA Ex 11 7

```
clc
//Chapter 11:Power amplifiers
//example 11.7 page no 480
//given
Vg=8//get signal level for VMOS 2N6659
```

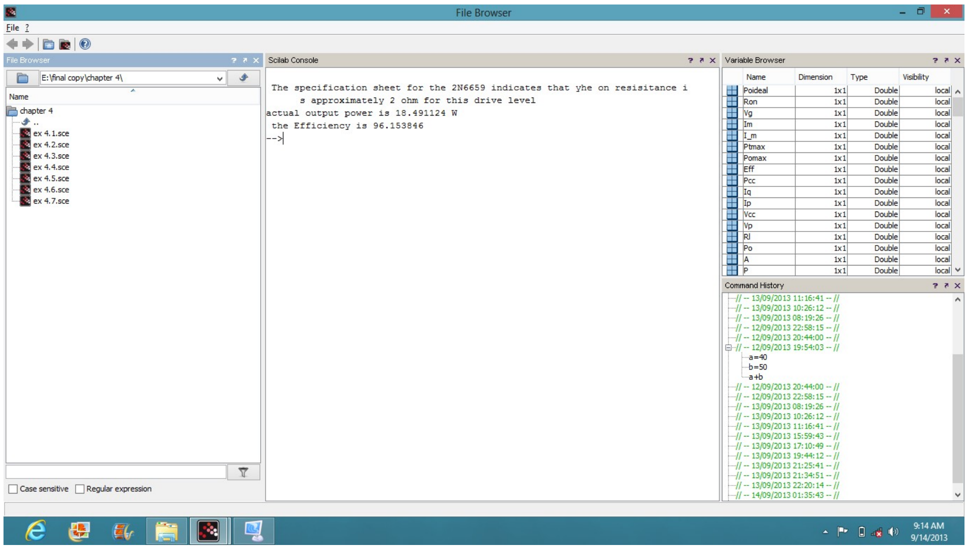

Figure 11.7: PA Ex 11 7

```
Rl=50//load resistance in ohms(it should have been
    given in the problem but its missing)
disp('The specification sheet for the 2N6659
    indicates that yhe on resisitance is
    approximately 2 ohm for this drive level')
Ron=2
Poideal=20
Po=Poideal*((Rl/(Rl+Ron))^2)//actual output power
Eff=Rl*100/(Rl+Ron)//Efficiency
mprintf('actual output power is %f W \n the
    Efficiency is %f ',Po,Eff)
```

Chapter 12

Modulators and Demodulators

Scilab code Exa 12.2 MD Ex 12 2

```
clc
//Chapter 12:Frequency mixers
//example 12.2 page no 504
//given
gm=14*10^-3//tranconductance
IDSS=40*10^-3
RL=50//load resistance
Vgs=0
Vp=2*IDSS/gm//pinch off voltage
gc=IDSS/(2*Vp)//conversion tranconductance
Av=gc*RL//voltage gain
mprintf('the conversion voltage gain is %f ',Av)
```

Scilab code Exa 12.4 MD Ex 12 4

```
clc
//Chapter 12:Frequency mixers
```

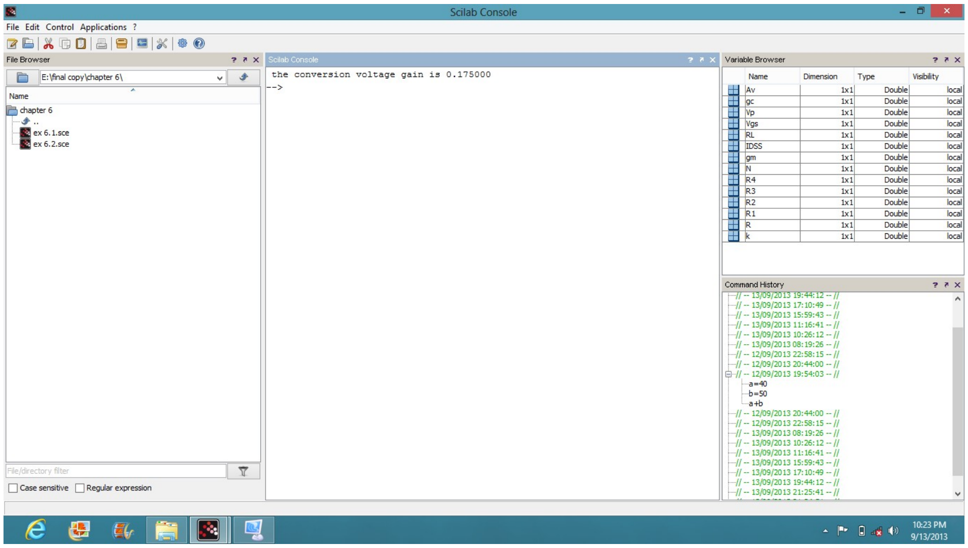

Figure 12.1: MD Ex 12 2

```
//example 12.4
//given
f=1*10^3//maximum frequency of unknown signal
df=1//maximum error in signal
fs=f^2/df//sampling frequency
disp(fs,'the required sampling frequency is')
```

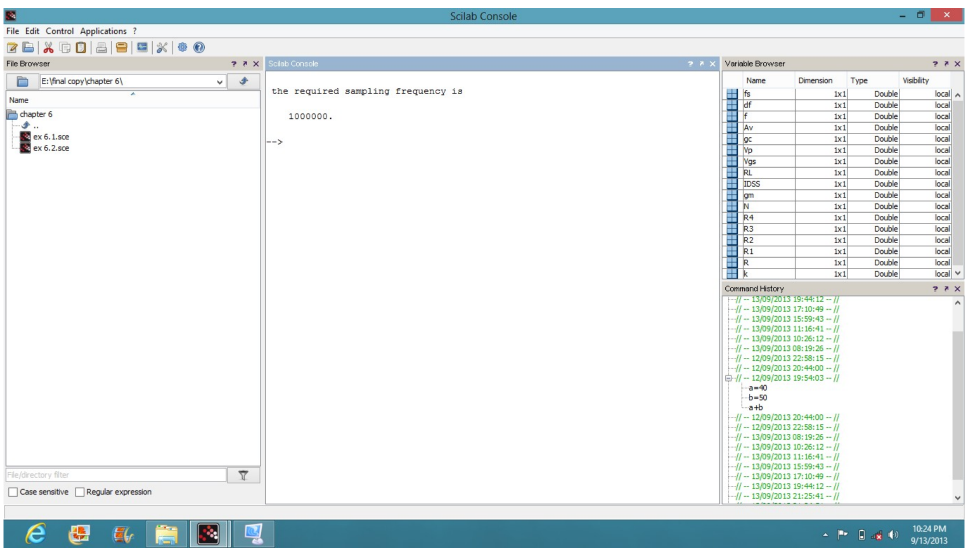

Figure 12.2: MD Ex 12 4