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

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Book Description

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

Exa Example (Solved example)

Eqn Equation (Particular equation of the above book)

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

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

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Chapter 1

Introduction to Radio Communication System

Scilab code Exa 1.3 IRCS Ex 1 3

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

Scilab code Exa 1.4 IRCS Ex 1 4

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

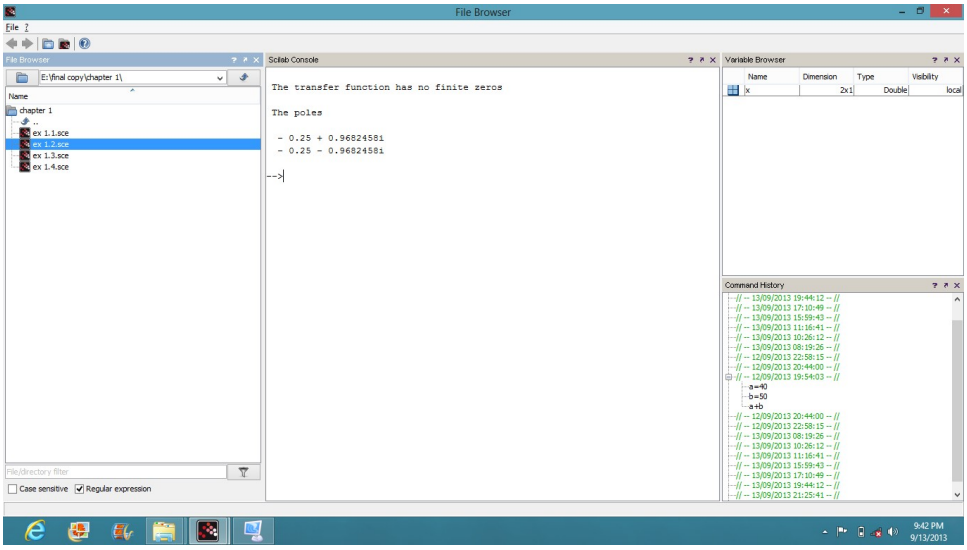

Figure 1.1: IRCS Ex 1 3

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

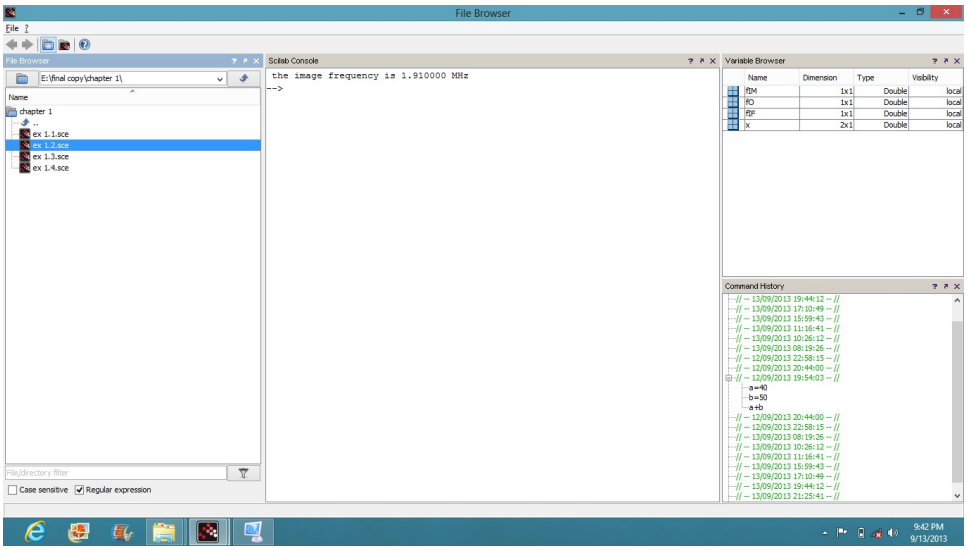

Figure 1.2: IRCS Ex 1 4

Chapter 2

Small Signal Amplifiers

Scilab code Exa 2.1 SSA Ex 2 1

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

Scilab code Exa 2.2 SSA Ex 2 2

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

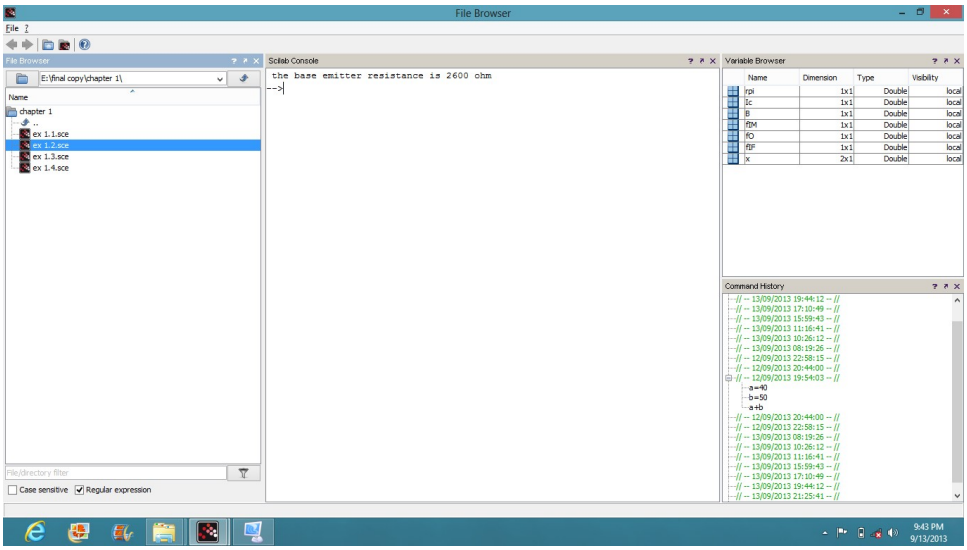

Figure 2.1: SSA Ex 2 1

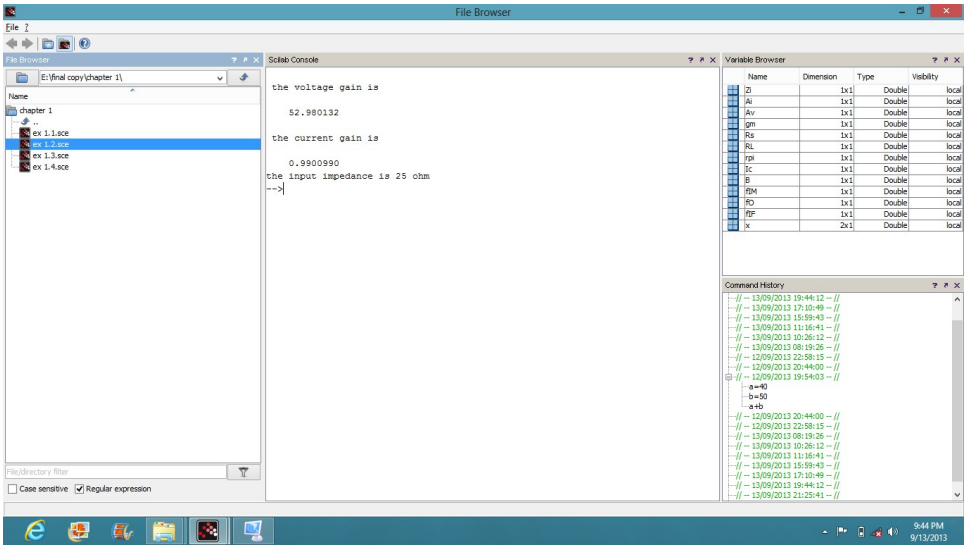

Figure 2.2: SSA Ex 2 2

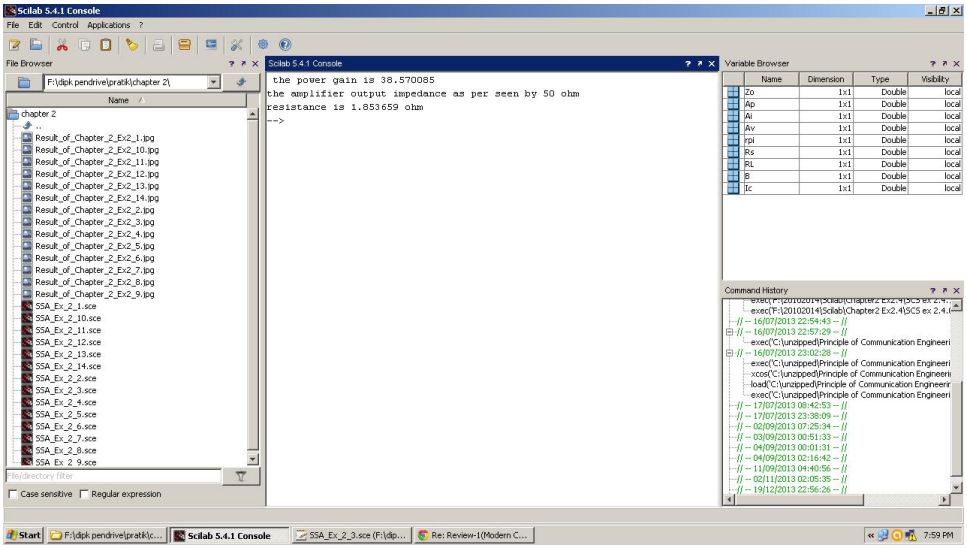

Figure 2.3: SSA Ex 2 3

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

Scilab code Exa 2.3 SSA Ex 2 3

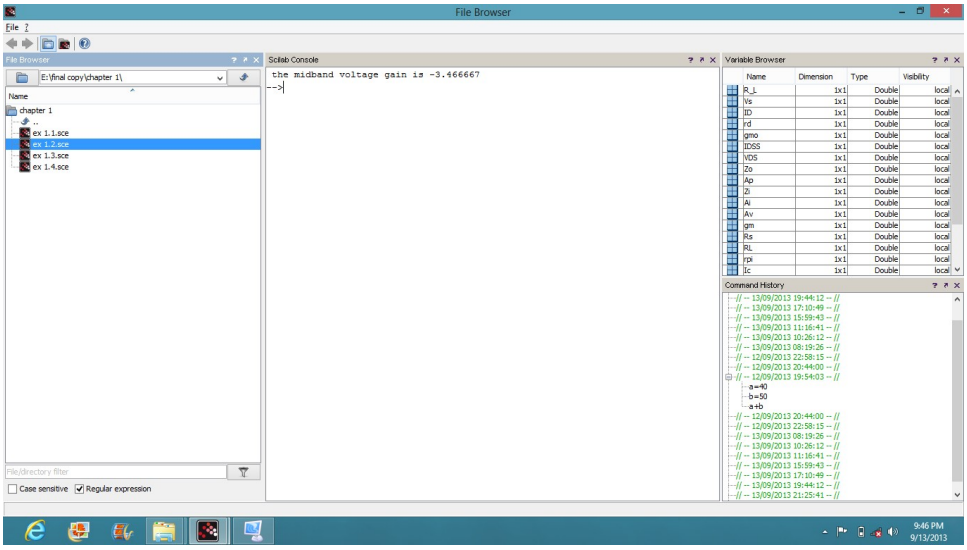

Figure 2.4: SSA Ex 2 4

```
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
```

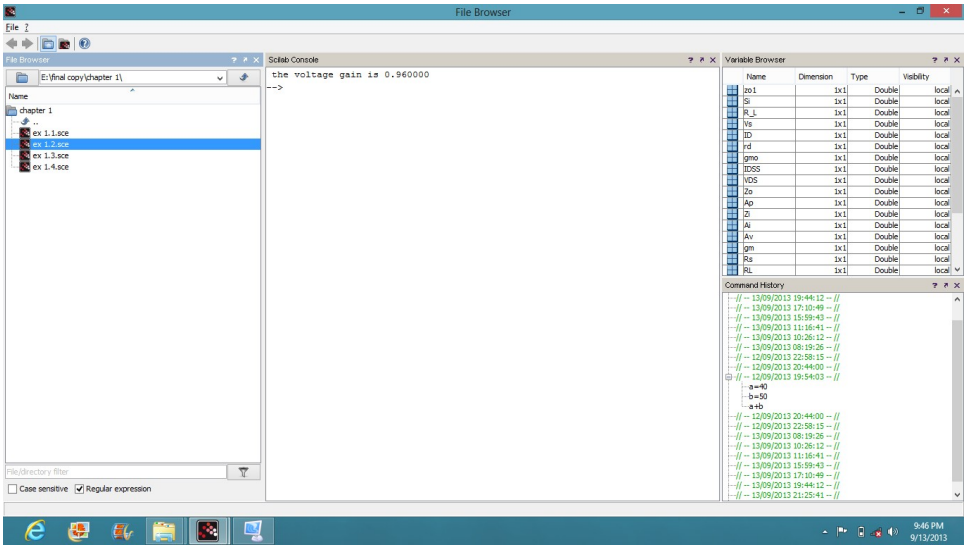

Figure 2.5: SSA Ex 2 5

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

Scilab code Exa 2.6 SSA Ex 2 6

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

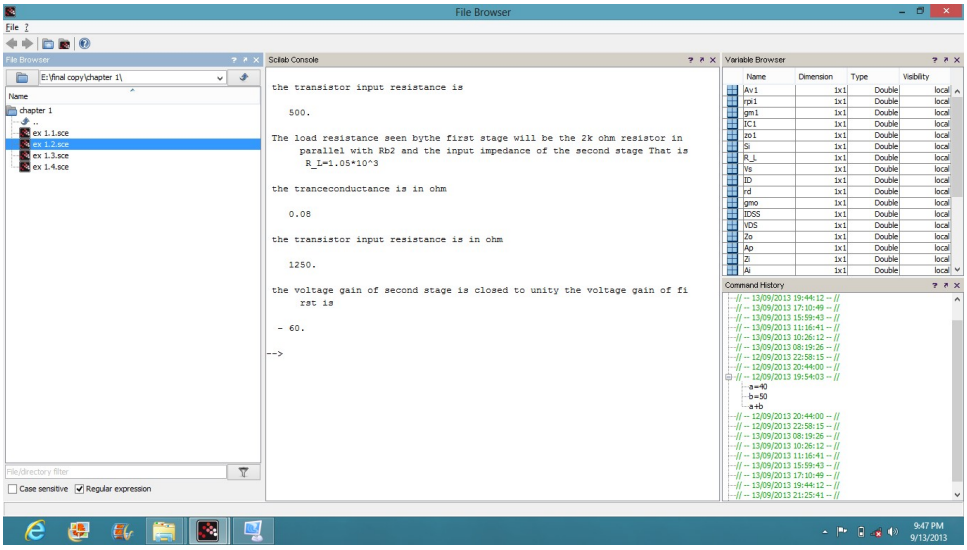

Figure 2.6: SSA Ex 2 6

```
    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')
11 R_L=1.05*10^3
12 Rs=500//source resistance
13 IC1=2*10^-3//collector bias current
14 gm1=40*IC1//tranceconductance
15 disp(gm1,'the tranceconductance is in ohm ')
16 rpi1=B/gm1//transistor input resistance
17 disp(rpi1,'the transistor input resistance is in ohm
     ')
18 Av1=-gm1*R_L*(rpi1/(rpi1+Rs))//the voltage gain of
    first
19 disp(Av1,'the voltage gain of second stage is closed
     to unity the voltage gain of first is ')
```

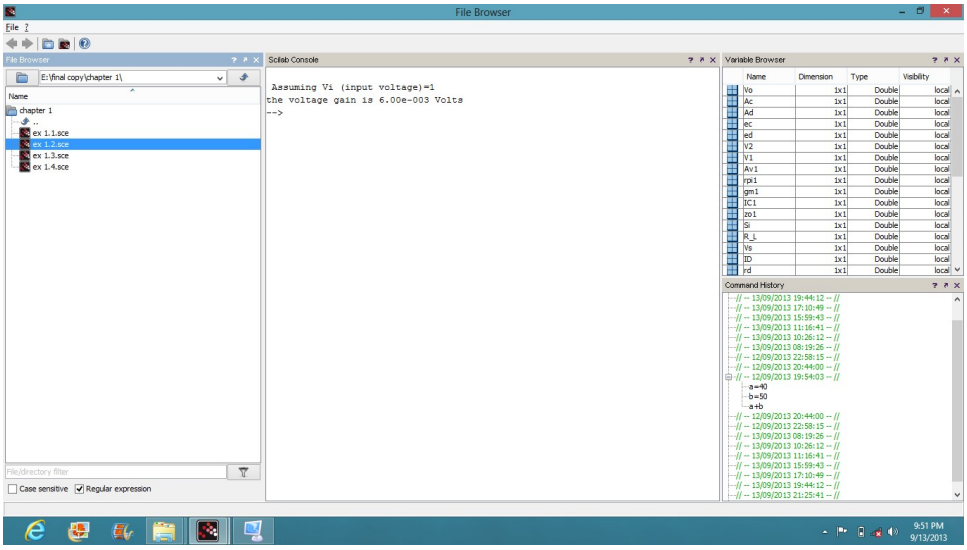

Figure 2.7: SSA Ex 2 8

Scilab code Exa 2.8 SSA Ex 2 8

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

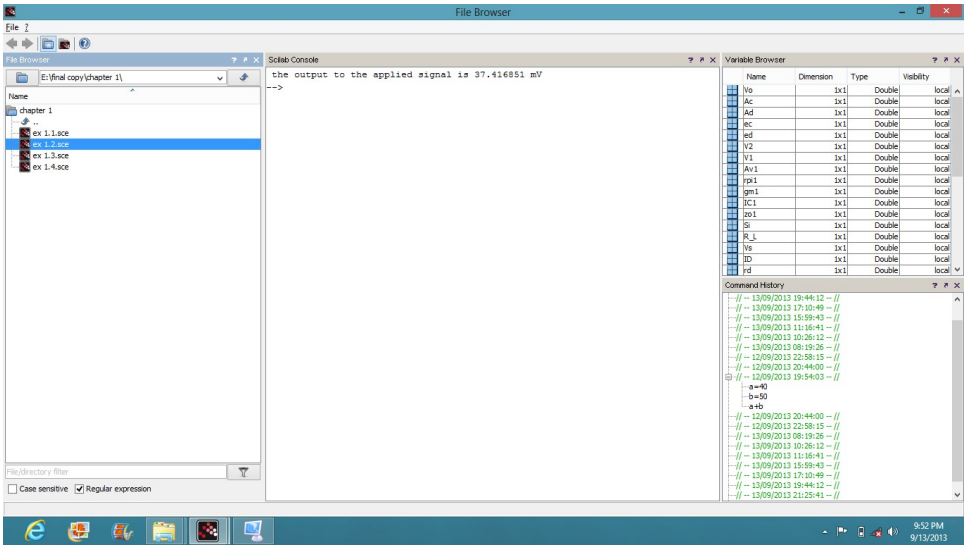

Figure 2.8: SSA Ex 2 9

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
```

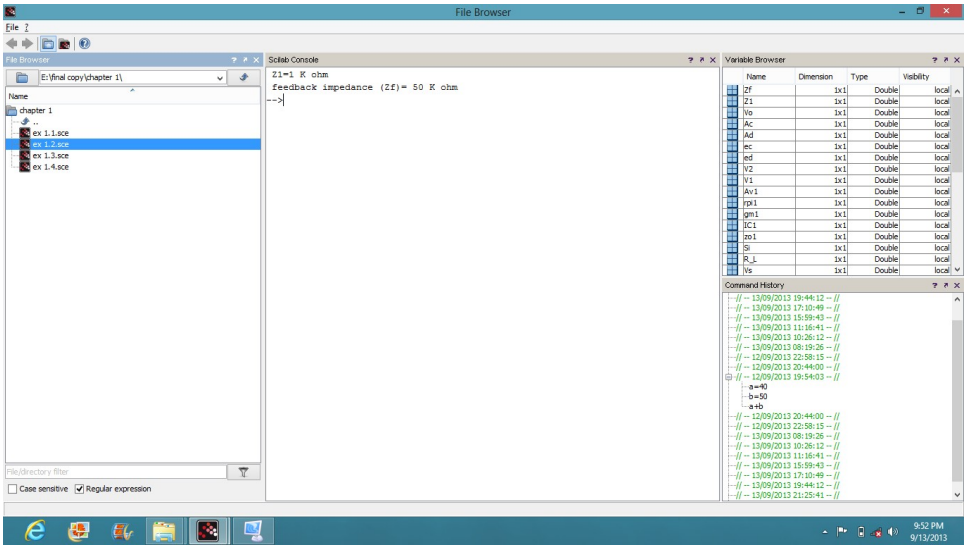

Figure 2.9: SSA Ex 2 10

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

Scilab code Exa 2.10 SSA Ex 2 10

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

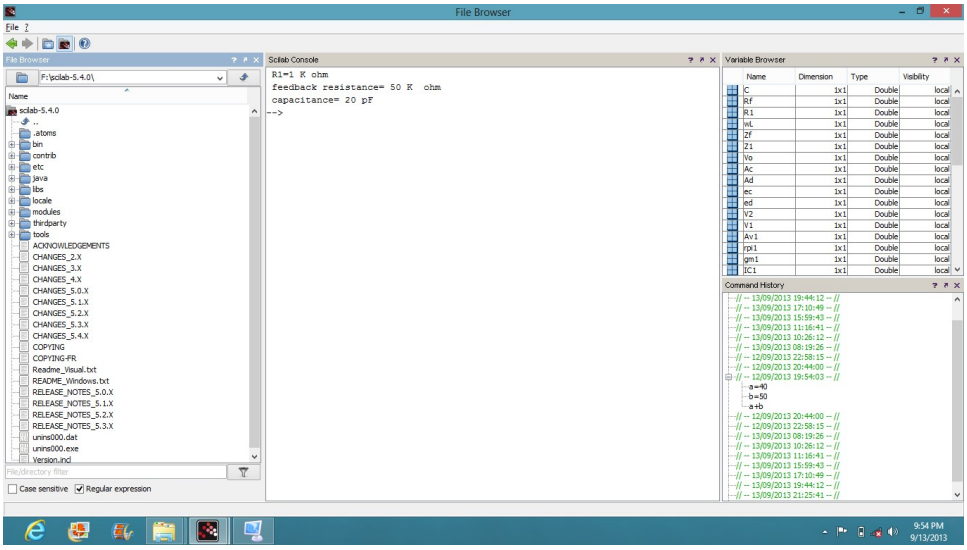

Figure 2.10: SSA Ex 2 11

Scilab code Exa 2.11 SSA Ex 2 11

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

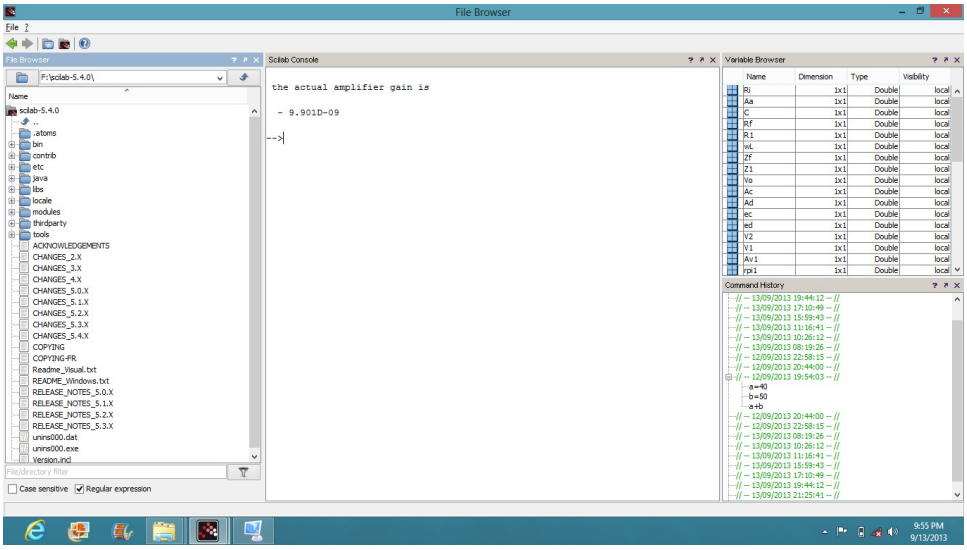

Figure 2.11: SSA Ex 2 12

Scilab code Exa 2.12 SSA Ex 2 12

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

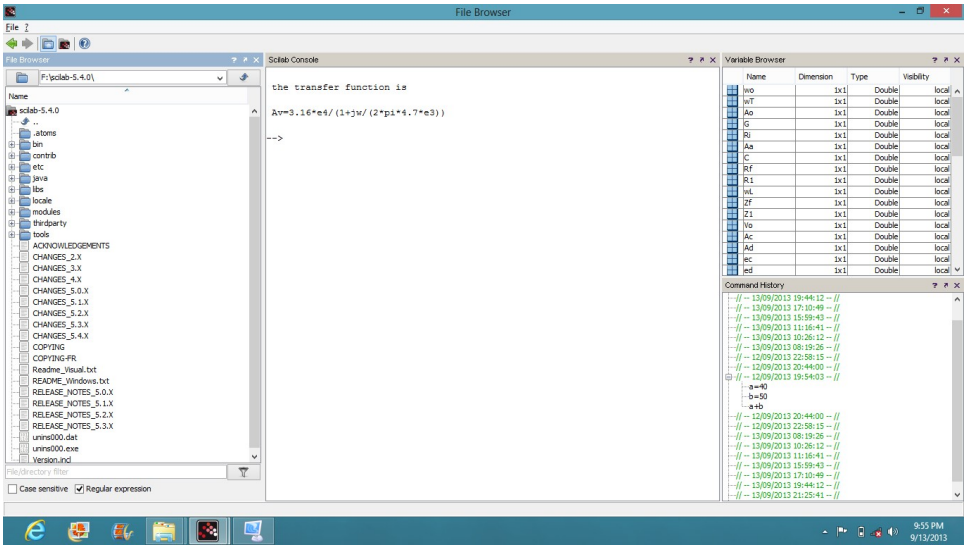

Figure 2.12: SSA Ex 2 13

Scilab code Exa 2.13 SSA Ex 2 13

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

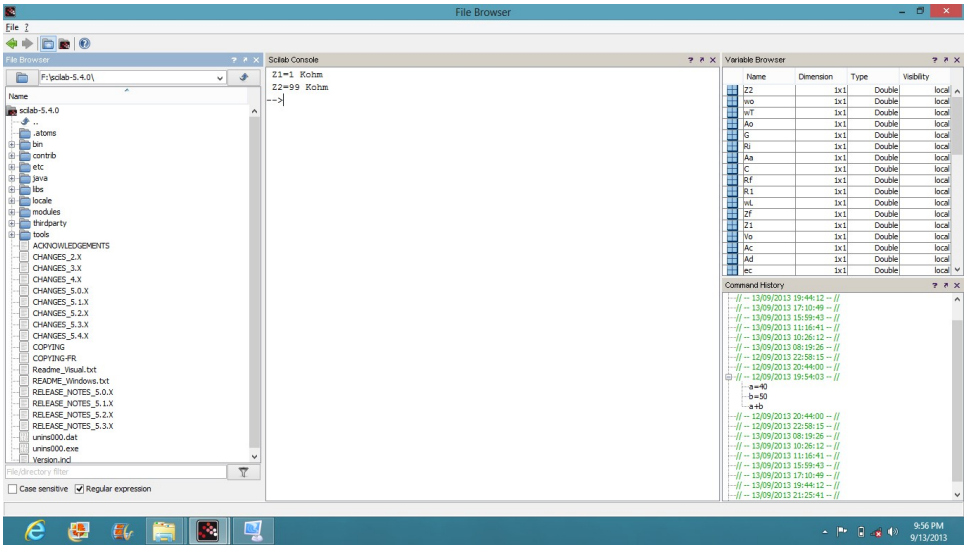

Figure 2.13: SSA Ex 2 14

Scilab code Exa 2.14 SSA Ex 2 14

```
1 clc
2 //Chapter 2:Small Signal Amplifiers
3 //example 2.14 page no 57
4 //given
5 Z1=1*10^3//assuming impedance value for required
    specification
6 Av=100//voltage gain
7 Z2=(Av-1)*Z1
8 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

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

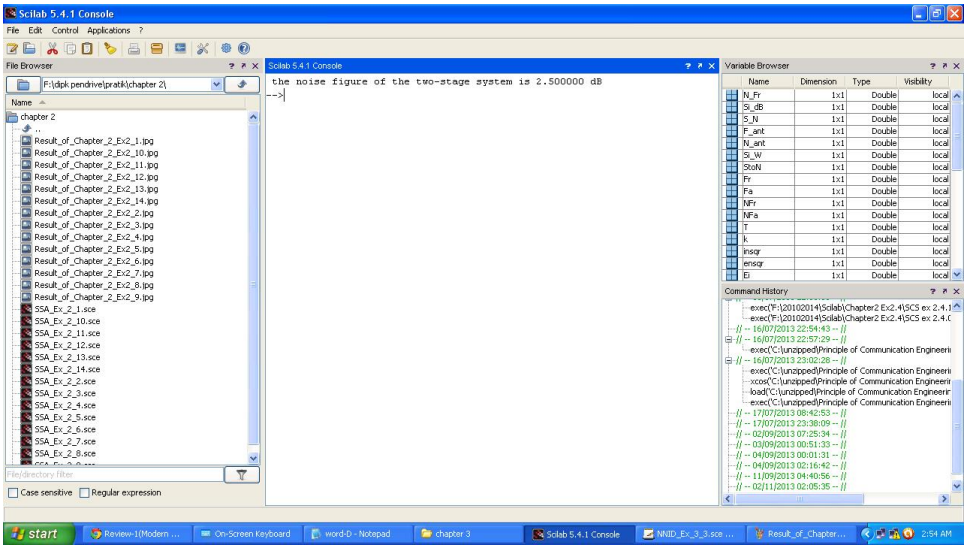

Figure 3.1: NNID Ex 3 3

Scilab code Exa 3.4 NNID Ex 3 4

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

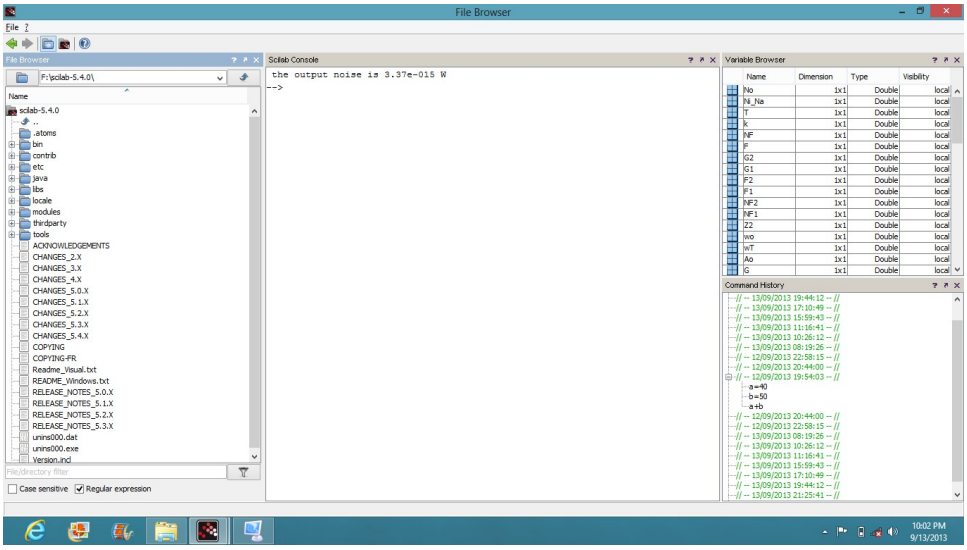

Figure 3.2: NNID Ex 3 4

Scilab code Exa 3.5 NNID Ex 3 5

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

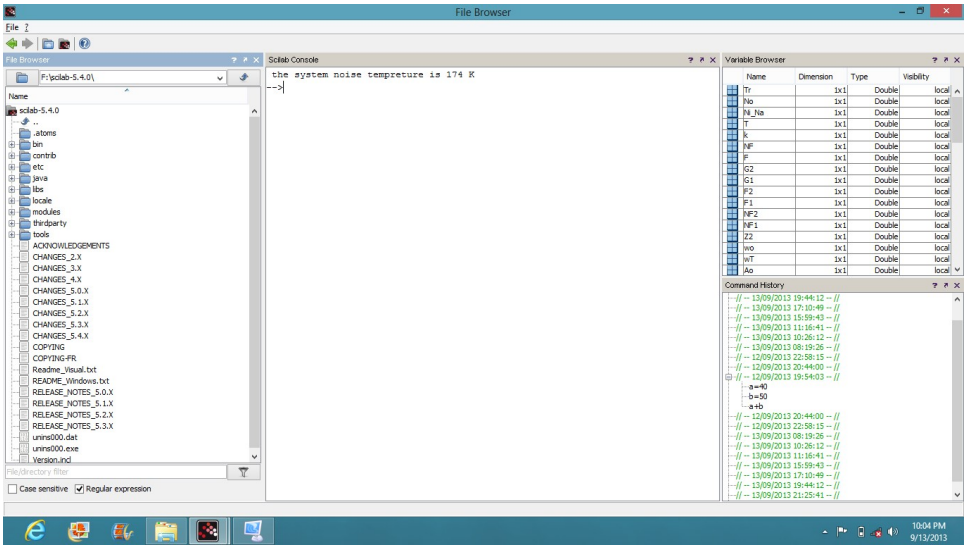

Figure 3.3: NNID Ex 3 5

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)
```

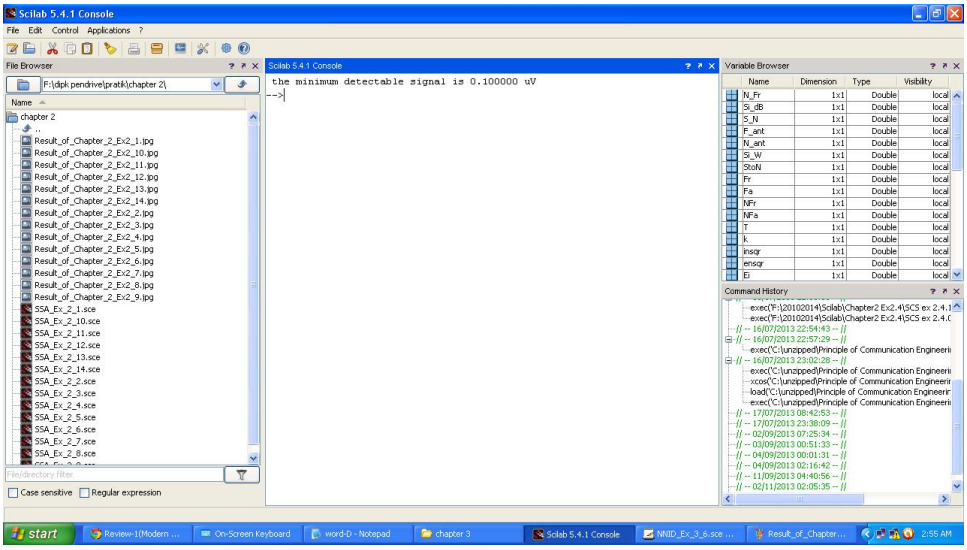

Figure 3.4: NNID Ex 3 6

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',
```

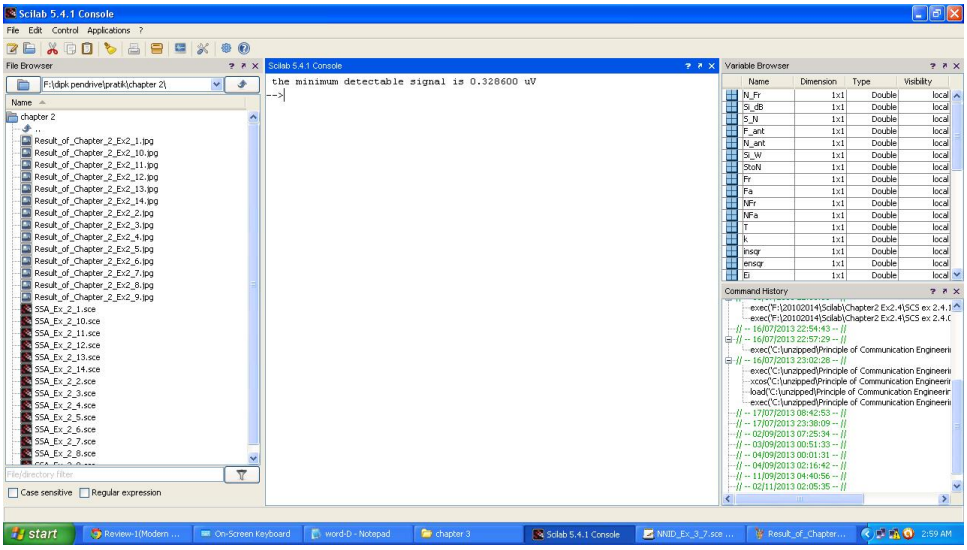

Figure 3.5: NNID Ex 3 7

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

Scilab code Exa 3.8 NNID Ex 3 8

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

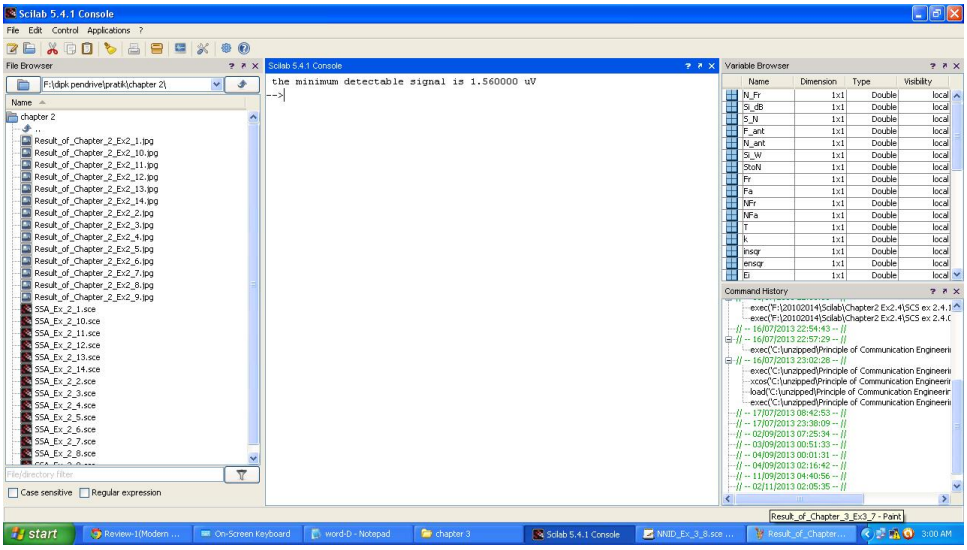

Figure 3.6: NNID Ex 3 8

```
    consider the performance of this receiver when it
     is connected to an antenna with a noise figure
    of 20dB
11  N_ant=20//antenna noise figure
12  N_Fr=4//receiver noise figure
13  F_ant=10^(N_ant/10)//antenna noise factor
14  Fr=10^(N_Fr/10)//receiver noise factor
15  S_N=10//output signal to noise ratio
16  Si_W=(S_N)*(F_ant+Fr-1)*k*T*B//available input power
       in Watts
17  Ei=sqrt(Si_W*4*Rs)//minimum detectable signal
18  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
```

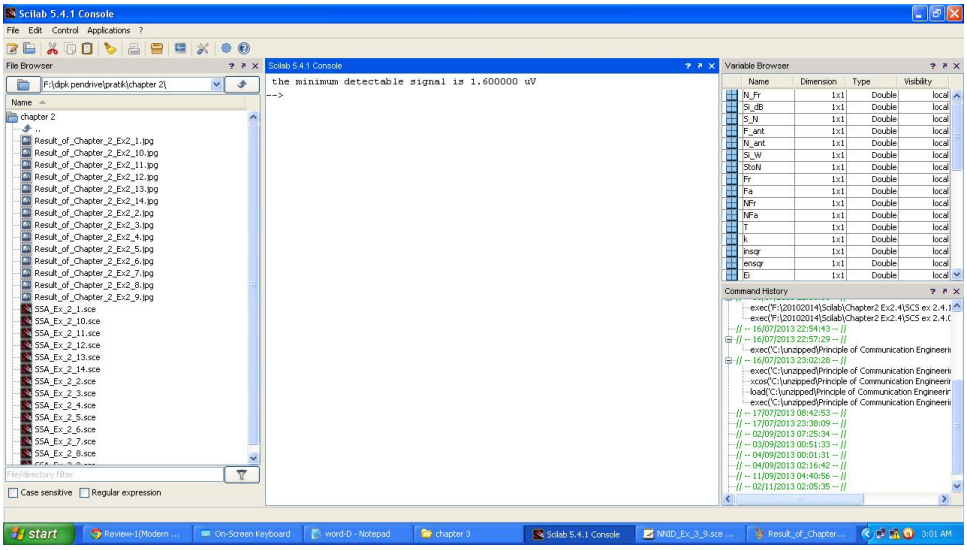

Figure 3.7: NNID Ex 3 9

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

Scilab code Exa 3.11 NNID Ex 3 11

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

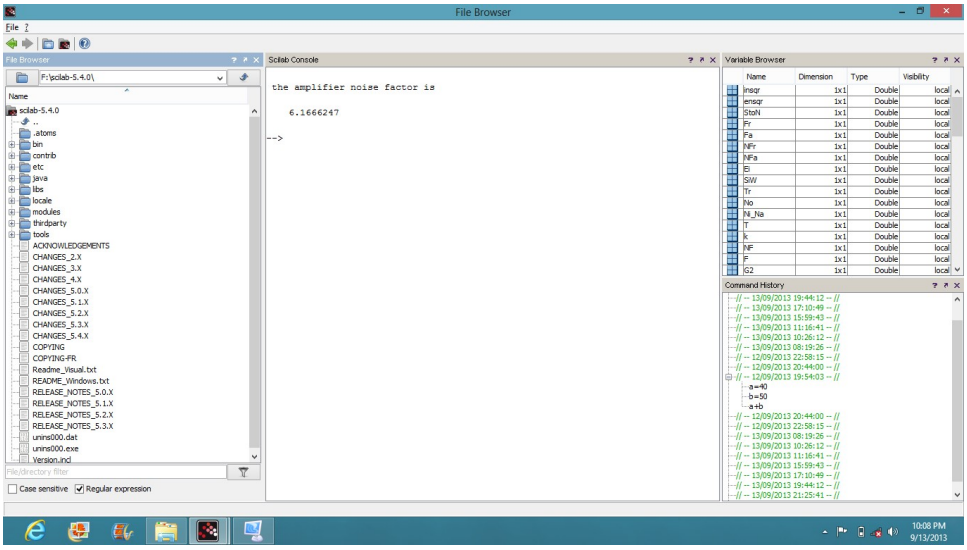

Figure 3.8: NNID Ex 3 10

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

Scilab code Exa 3.12 NNID Ex 3 12

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

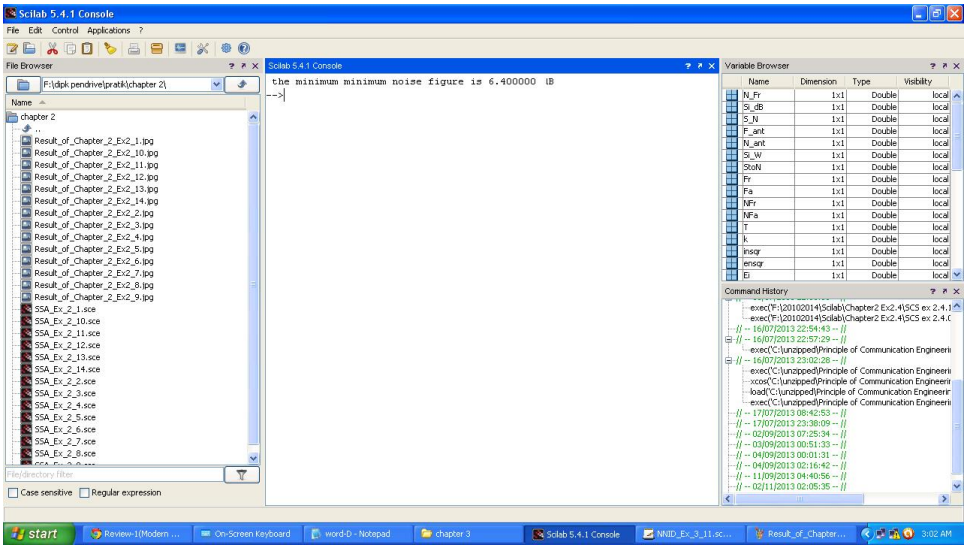

Figure 3.9: NNID Ex 3 11

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

Scilab code Exa 3.13 NNID Ex 3 13

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

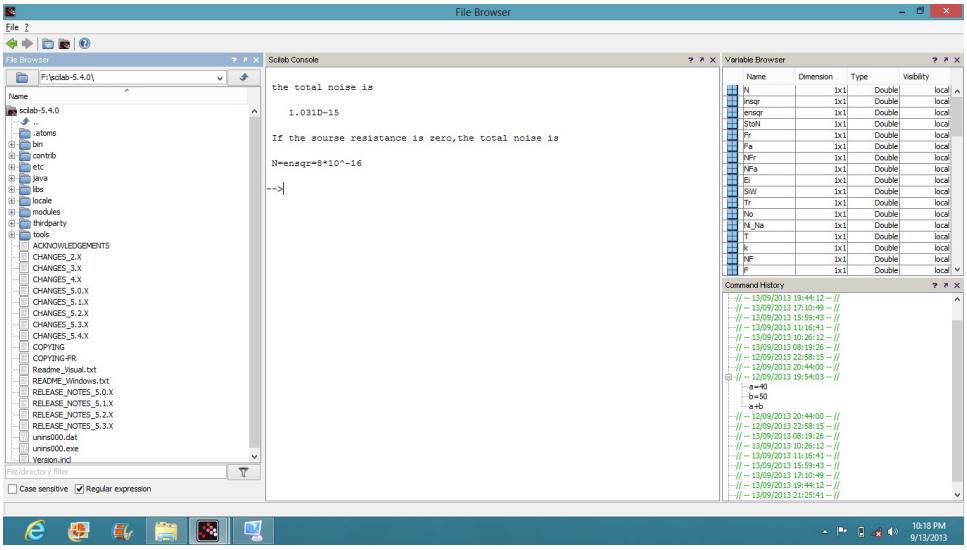

Figure 3.10: NNID Ex 3 12

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

Scilab code Exa 3.14 NNID Ex 3 14

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

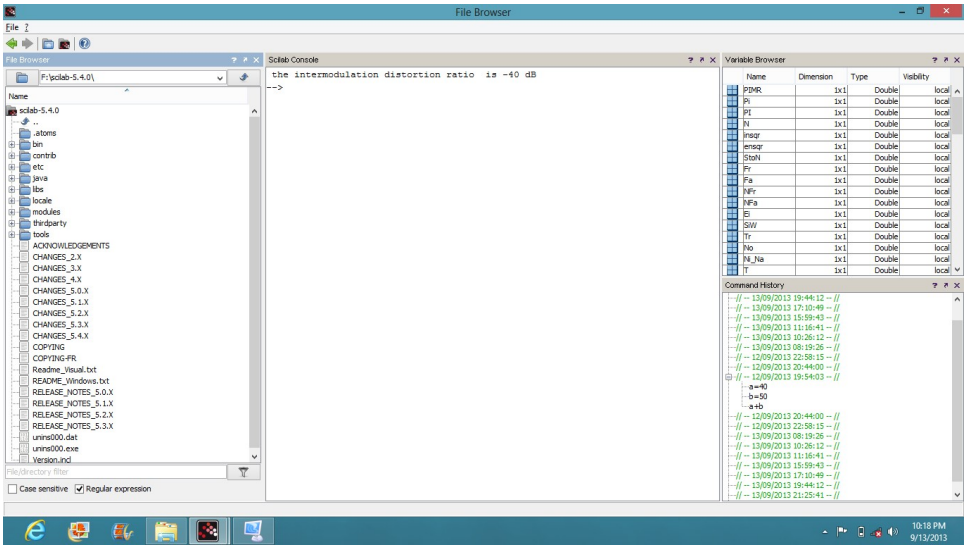

Figure 3.11: NNID Ex 3 13

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

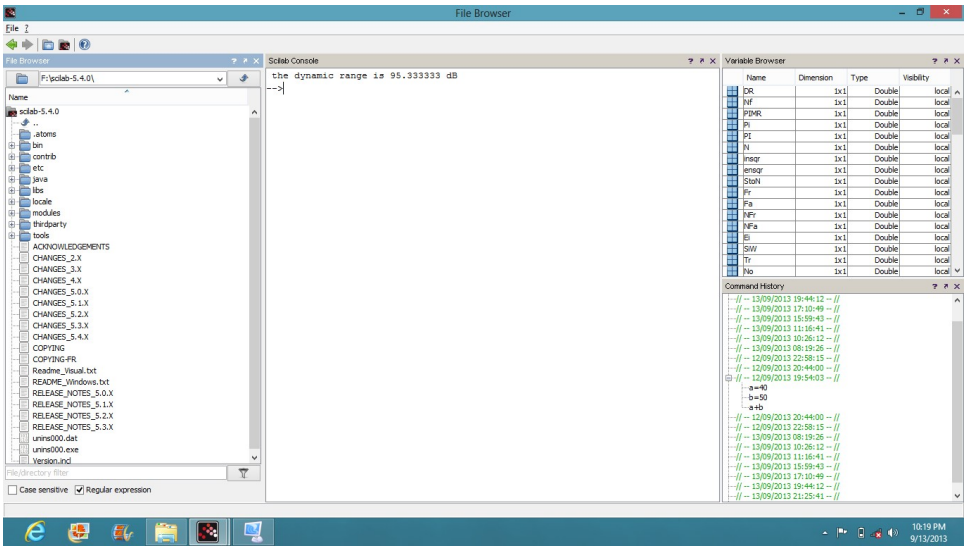

Figure 3.12: NNID Ex 3 14

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

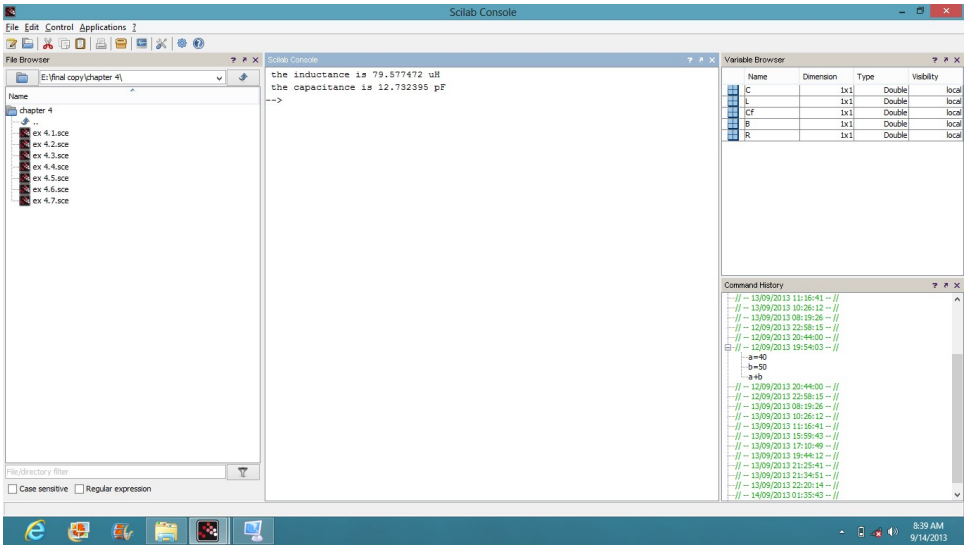

Figure 4.1: FSNT Ex 4 1

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

Scilab code Exa 4.3 FSNT Ex 4 3

```
1 clc
```

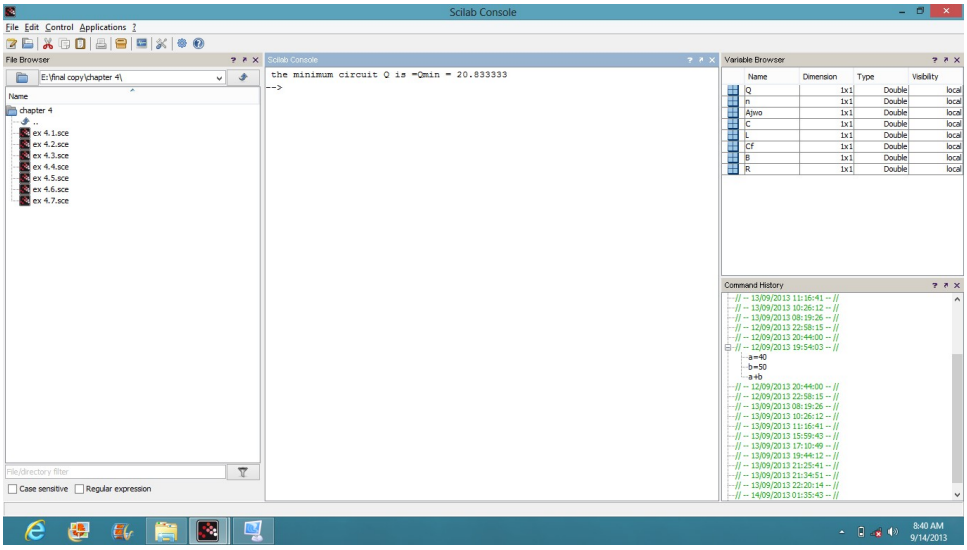

Figure 4.2: FSNT Ex 4 2

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

Scilab code Exa 4.4 FSNT Ex 4 4

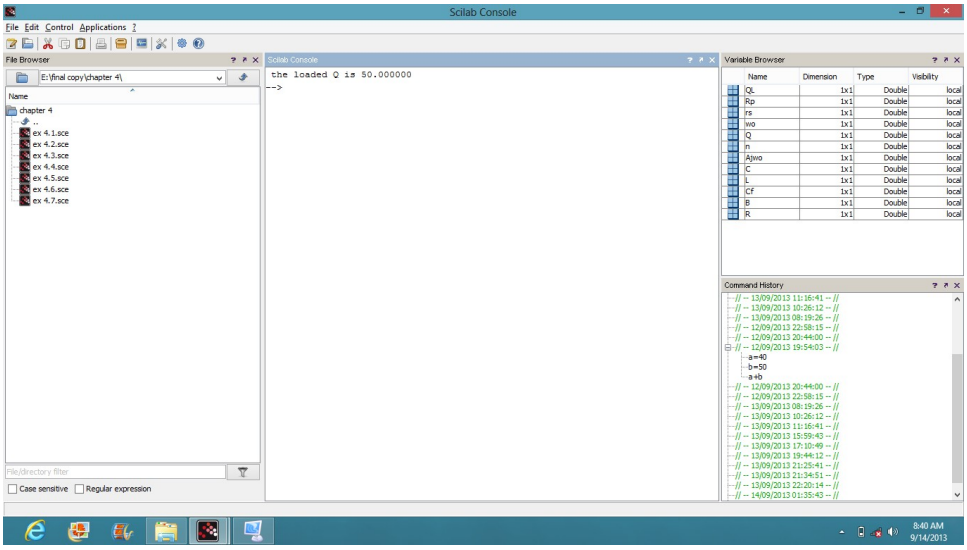

Figure 4.3: FSNT Ex 4 3

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

Scilab code Exa 4.6 FSNT Ex 4 6

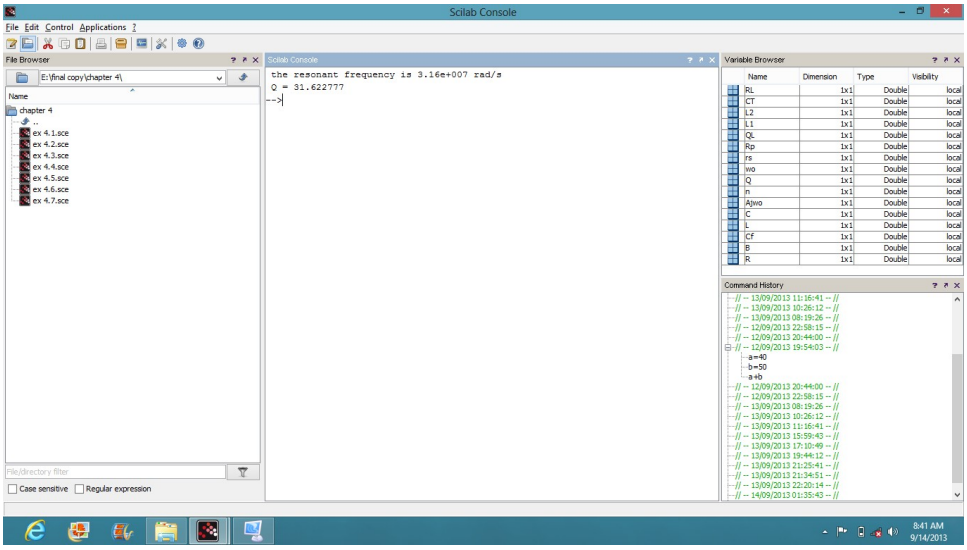

Figure 4.4: FSNT Ex 4 4

```
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)
```

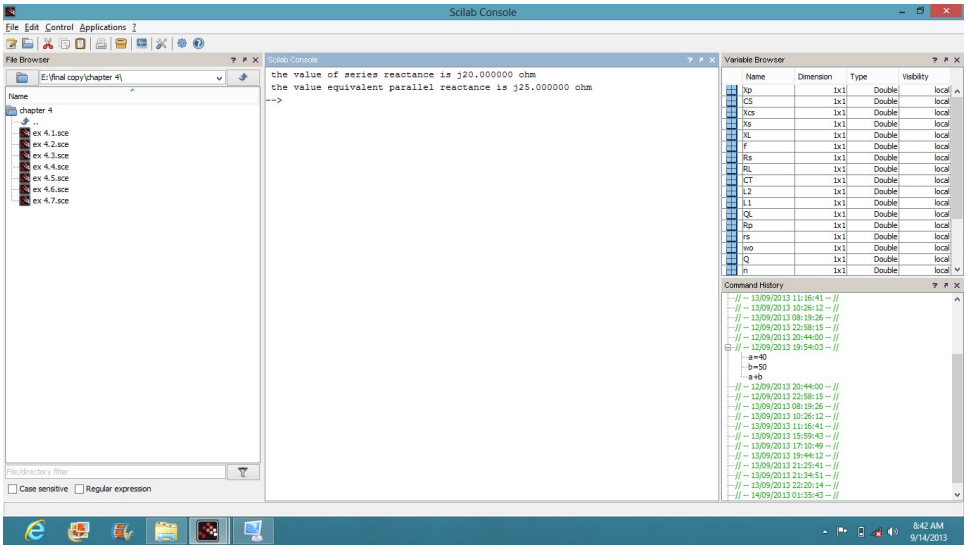

Figure 4.5: FSNT Ex 4 6

Scilab code Exa 4.7 FSNT Ex 4 7

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

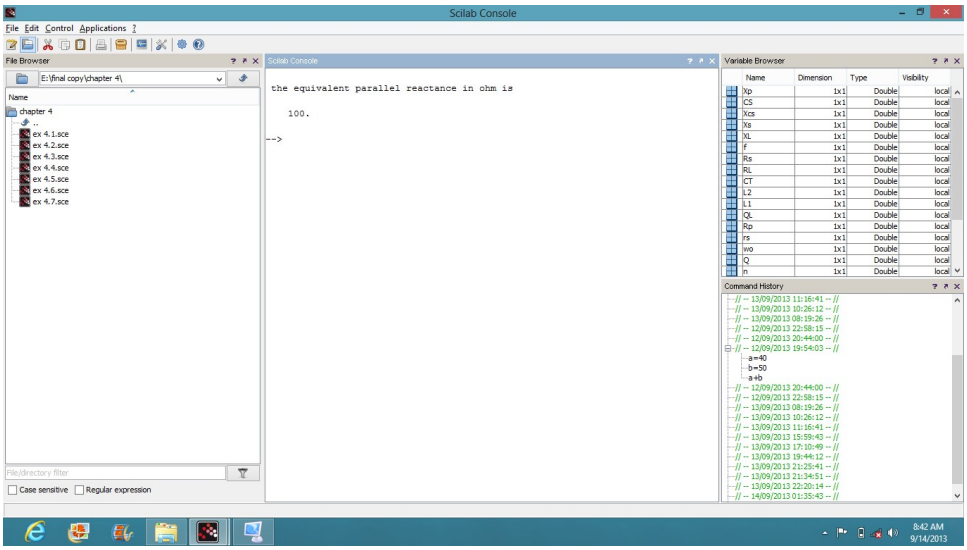

Figure 4.6: FSNT Ex 4 7

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)
```

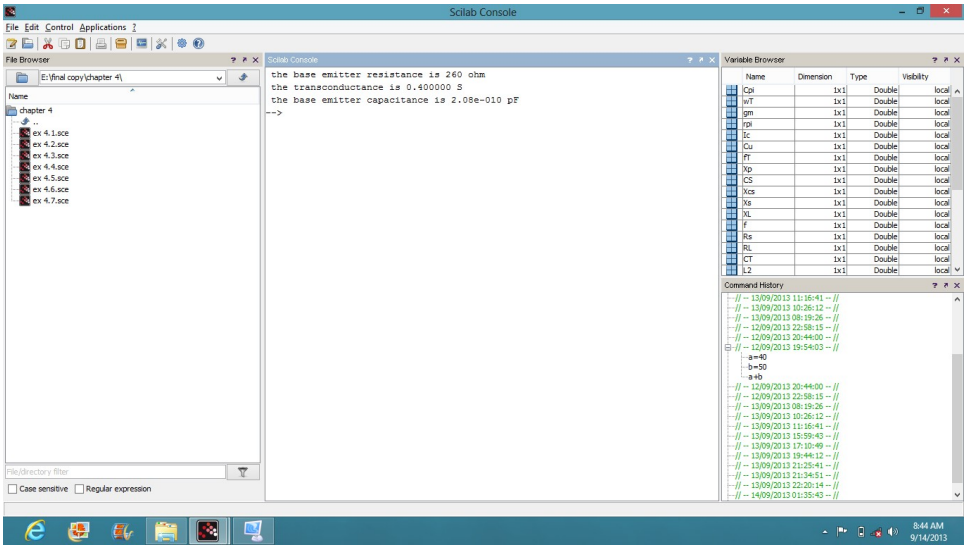

Figure 5.1: HFAAGC Ex 5 1

Scilab code Exa 5.2 HFAAGC Ex 5 2

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

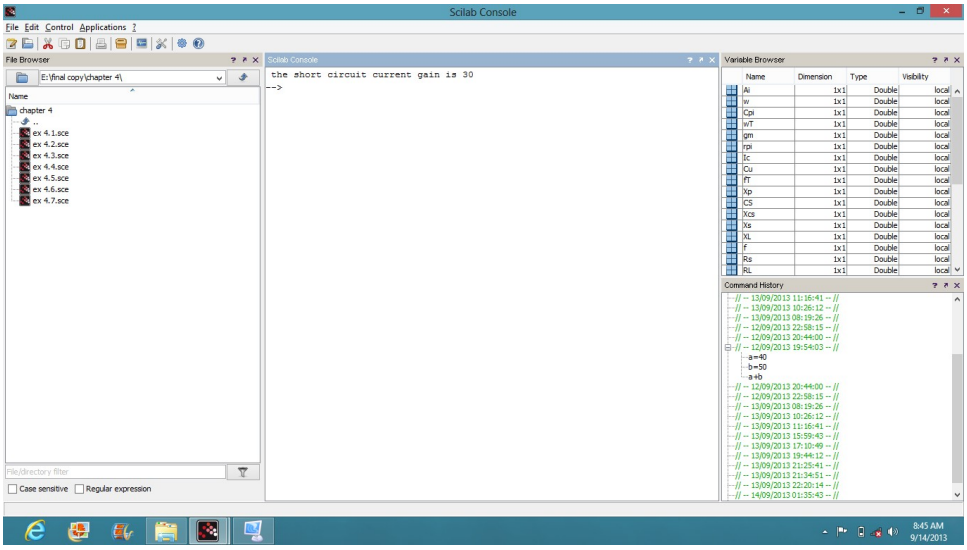

Figure 5.2: HFAAGC Ex 5 2

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)
```

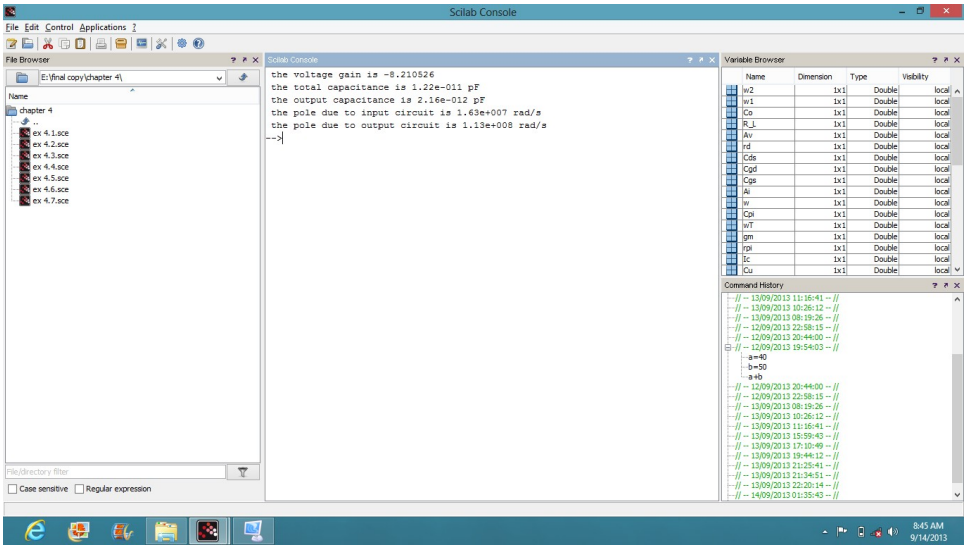

Figure 5.3: HFAAGC Ex 5 3

```
14 CT=Cgs+Cgd*(1+gm*R_L)//total capacitance
15 Co=Cds+(Cgd*(1+gm*R_L)/(gm*R_L))//output capacitance
16 w1=(R*CT)^-1//pole due to input circuit
17 w2=(RL*Co)^-1//pole due to output circuit
18 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

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

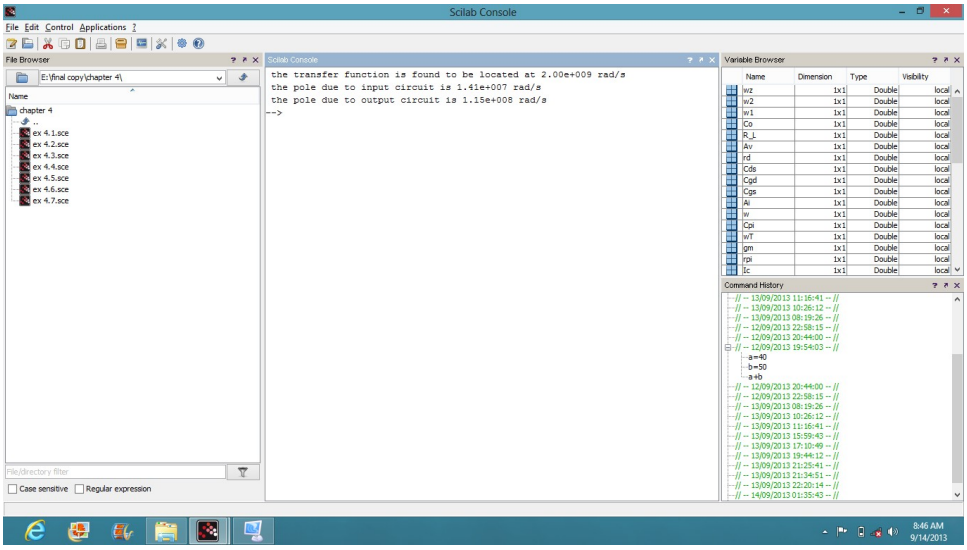

Figure 5.4: HFAAGC Ex 5 4

```
4  //given
5  gm=2*10^-3//transconductance
6  Cgs=5*10^-12//equivalent Miller's input capacitance
7  Cgd=10^-12//equivalent Miller's output capacitance
8  Cds=10^-12
9  R=5*10^3
10 R_L=4.1*10^3
11 wz=2*10^9
12 CT=Cgs+Cgd*(1+gm*R_L)//total capacitance
13 Co=Cds+(Cgd*(1+gm*R_L)/(gm*R_L))//output capacitance
14 w1=(R*CT)^-1//pole due to input circuit
15 w2=(R_L*Co)^-1//pole due to output circuit
16 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

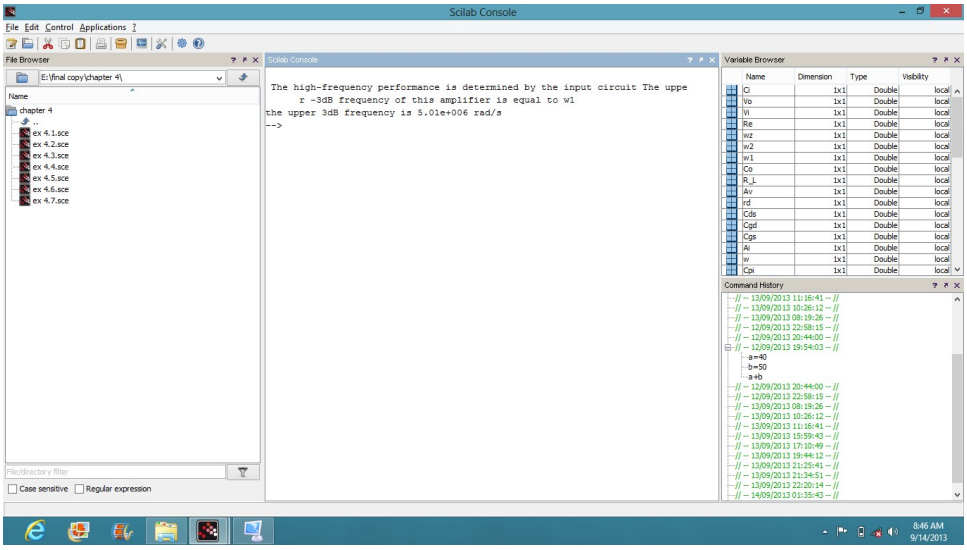

Figure 5.5: HFAAGC Ex 5 5

```
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)
```

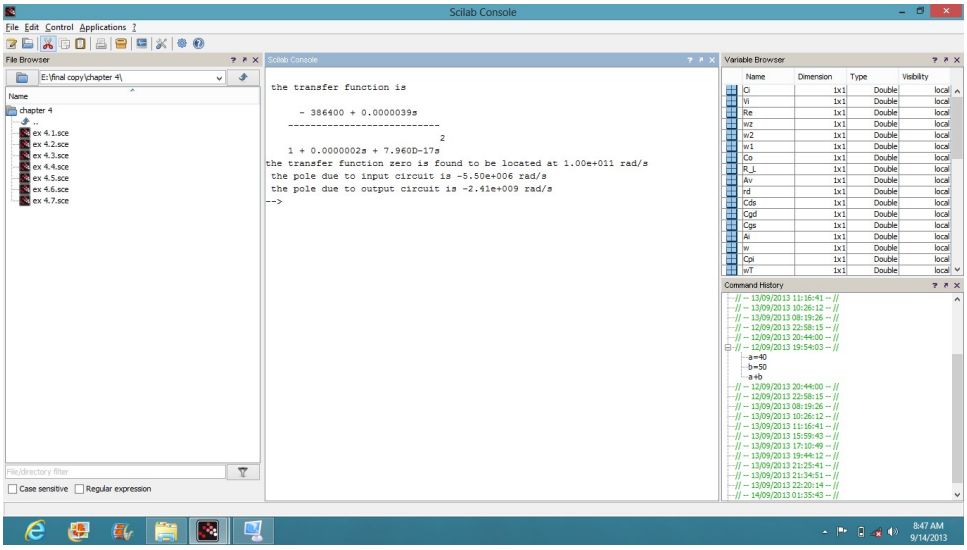

Figure 5.6: HFAAGC Ex 5 6

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
```

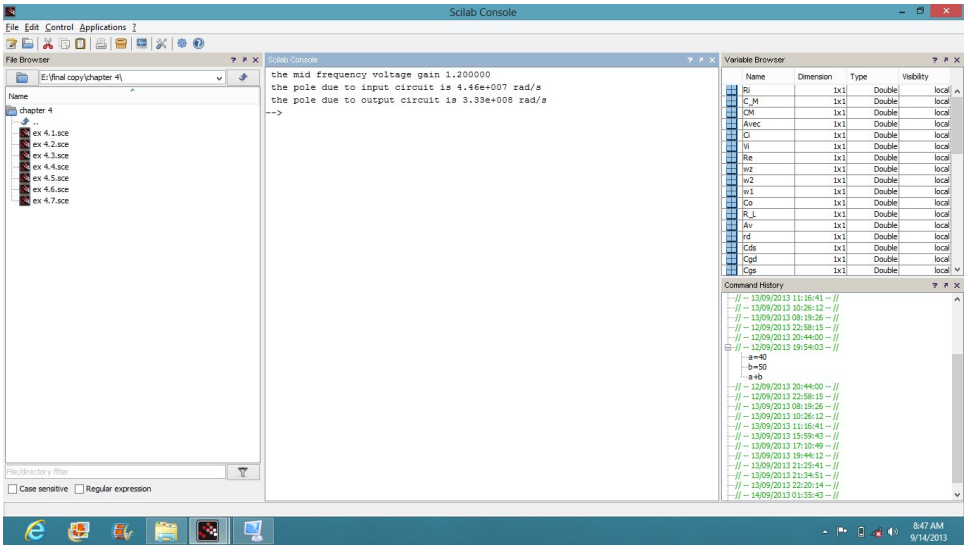

Figure 5.7: HFAAGC Ex 5 7

```
14 CT=(206+CM)*10^-12//toatl capacitance
15 R=(500^-1+300^-1+260^-1)^-1
16 w1=(R*CT)^-1//pole due to input circuit)
17 w2=(RL*Co)^-1//pole due to output circuit
18 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

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

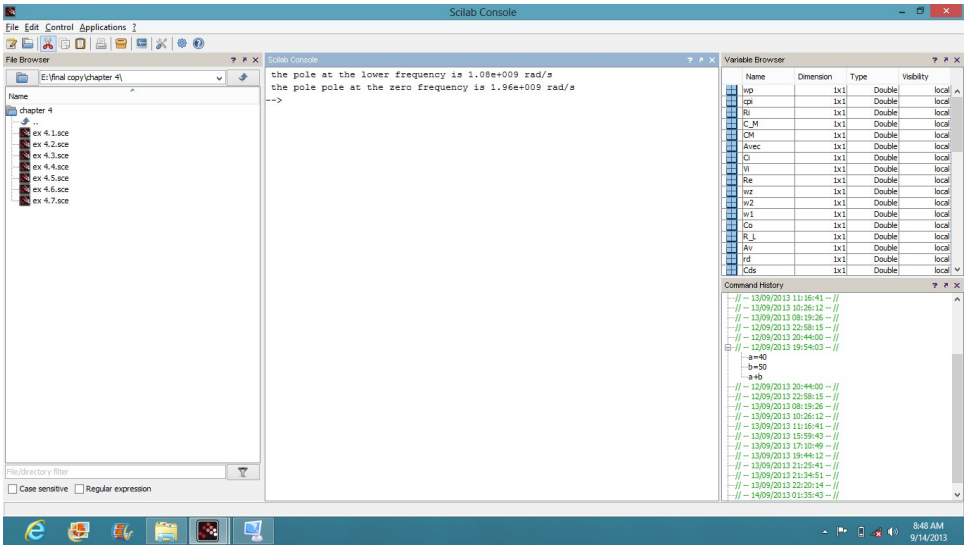

Figure 5.8: HFAAGC Ex 5 8

```
5  Rs=500//source resistance
6  rpi=260
7  gm=0.4//transconductance
8  RL=600//load resistance
9  cpi=206*10^-12
10 wp=(Rs+rpi+(1+gm*rpi)*RL)/(rpi*cpi*(Rs+RL))//pole at
       the lower frequency
11 wz=(1+gm*rpi)/(rpi*cpi)//pole at the zero frequency
12 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

```
1 clc
```

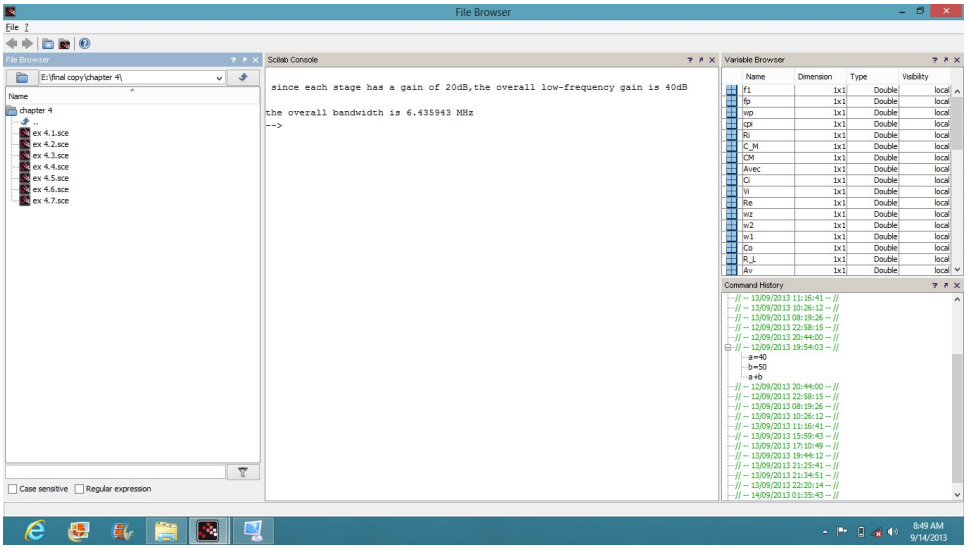

Figure 5.9: HFAAGC Ex 5 10

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

Scilab code Exa 5.11 HFAAGC Ex 5 11

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

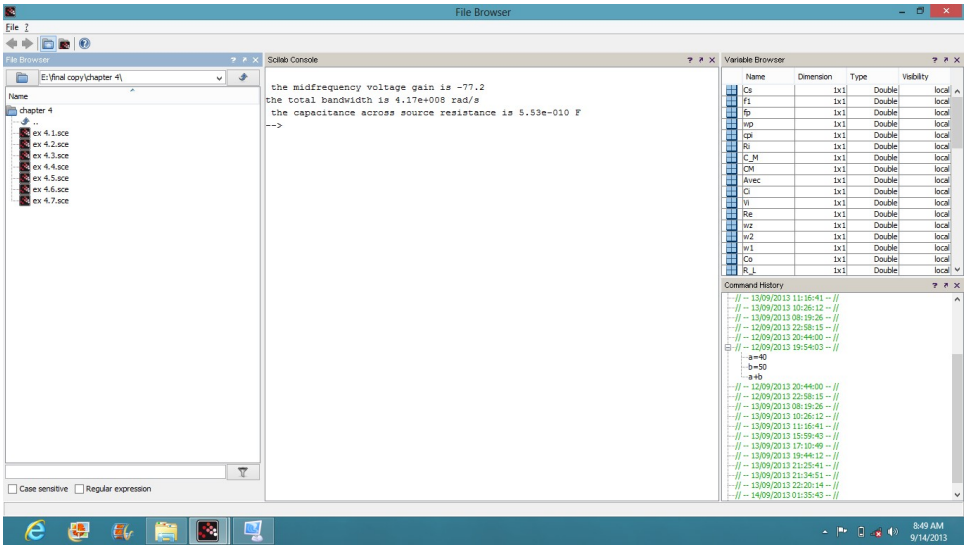

Figure 5.10: HFAAGC Ex 5 11

```
3  //example 5.11 page no 181
4  //given
5  rpi=237
6  CM=1166*10^-12//miller capacitance
7  Co=4*10^-12//equivalent miller capacitance reflected
       at output side
8  Rs=500//source resistance
9  RL=600//load resistance
10 Cs=rpi*CM/Rs//capacitance across source resistance
11 B=(RL*Co)^-1//total bandwidth
12 disp('the midfrequency voltage gain is -77.2')
13 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

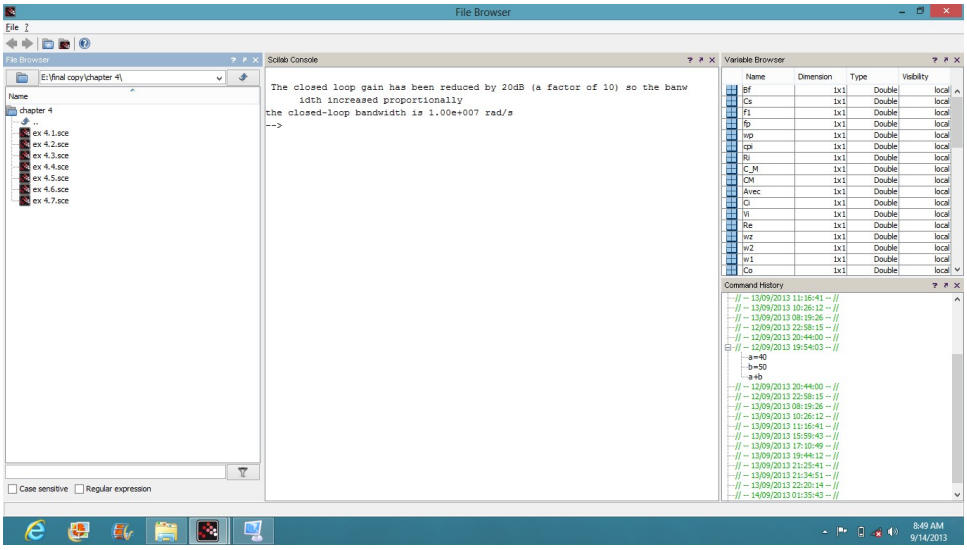

Figure 5.11: HFAAGC Ex 5 12

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

Scilab code Exa 5.13 HFAAGC Ex 5 13

```
1 clc
```

```
2 //Chapter 5:High Frequency amplifiers and automatic
    gain control
3 //Example 5.13 page no 184
4 //Example on emitter feedback
5 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'
    )
6 gm=0.4//transconductance
7 rpi=237//base emitter resistance
8 RL=600//load resistance (values of resistance are
    taken from the figure)
9 Rs=500//source resistance
10 Av=gm*RL*rpi/(rpi+Rs)//Voltage gain
11 B=0.84*10^6//Bandwidth (The value of Bandwidth is
    taken from the Graph firure 5.51)
12 GB=Av*B//Gain bandwidth product
13 mprintf('The gain bandwidth product is %3.2e Hz ',GB
    )
```

Scilab code Exa 5.14 HFAAGC Ex 5 14

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

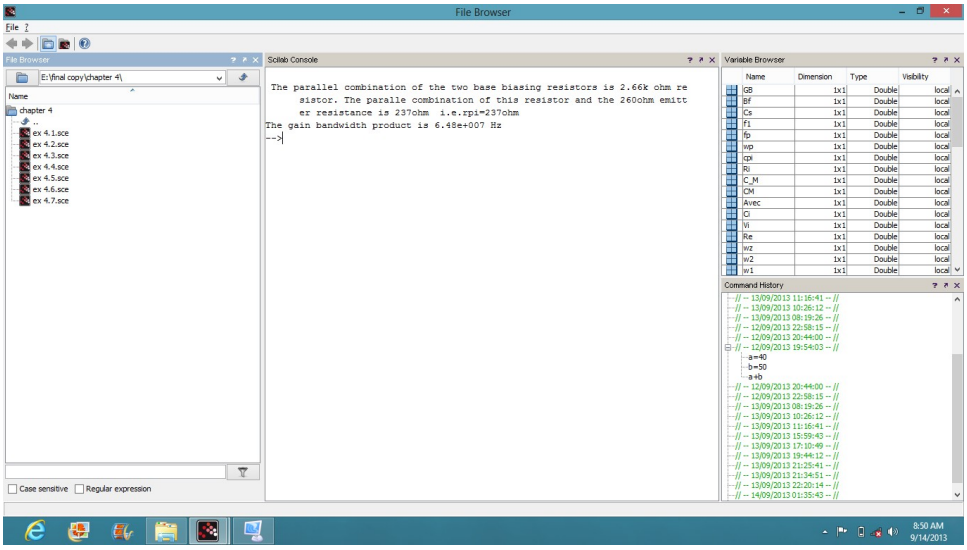

Figure 5.12: HFAAGC Ex 5 13

```
9 disp('GB=Av*B')
10 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

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

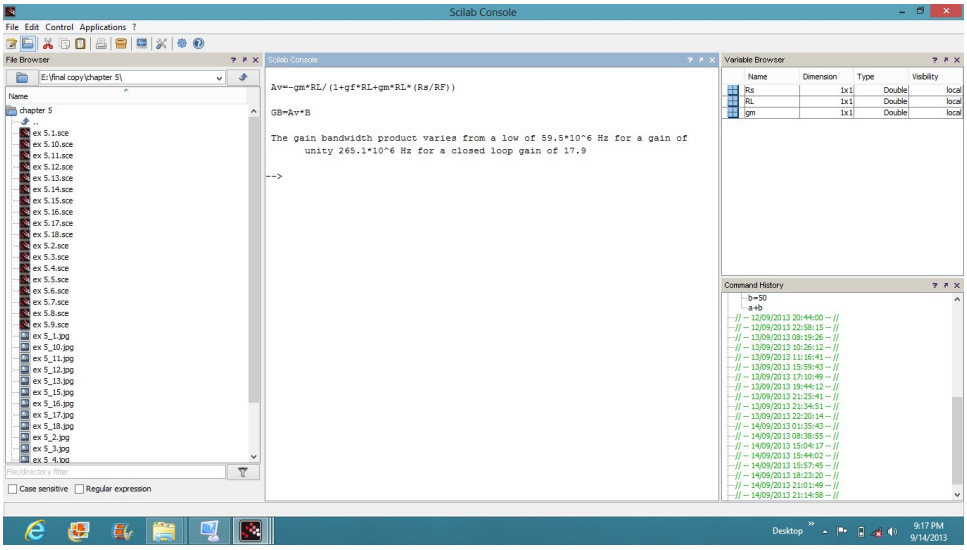

Figure 5.13: HFAAGC Ex 5 14

```
7  Av1=1//for no turns ratio voltage gain is approx
       unity
8  B1=79.4*10^6//bandwidth
9  GB1=Av1*B1//Gain bandwidth product
10 m2=4//i.e. for turns ratio is 4
11 Av2=m2/2//voltage gain
12 B2=11.22*10^6//bandwidth
13 GB2=Av2*B2//Gain bandwidth product
14 m3=6//i.e. for turns ratio is 6
15 Av3=m3/2//voltage gain
16 B3=4.67*10^6//bandwidth
17 GB3=Av3*B3//Gain bandwidth product
18 m4=10//i.e. for turns ratio is 10
19 Av4=m4/2//voltage gain
20 B4=1.6*10^6//bandwidth
21 GB4=Av4*B4//Gain bandwidth product
22 m5=20//i.e. for turns ratio is 20
23 Av5=m5/2//voltage gain
24 B5=4.22*10^5//bandwidth
25 GB5=Av5*B5//Gain bandwidth product
```

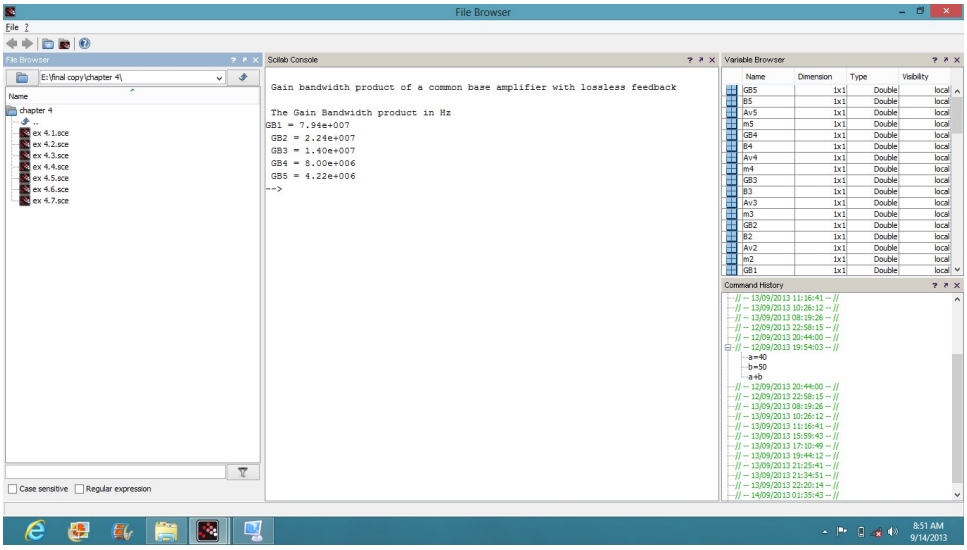

Figure 5.14: HFAAGC Ex 5 15

```
26 disp('The Gain Bandwidth product in Hz')
27 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

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

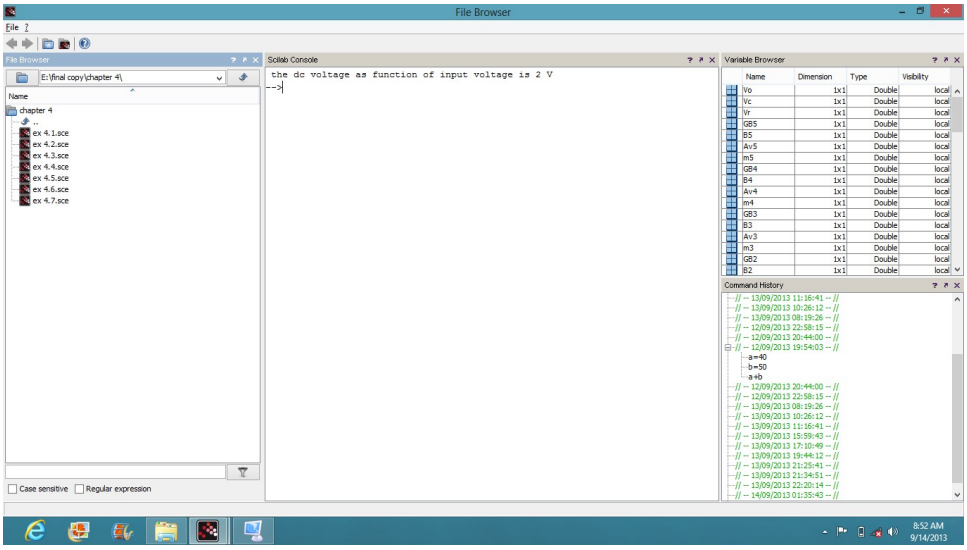

Figure 5.15: HFAAGC Ex 5 18

```
9 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

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

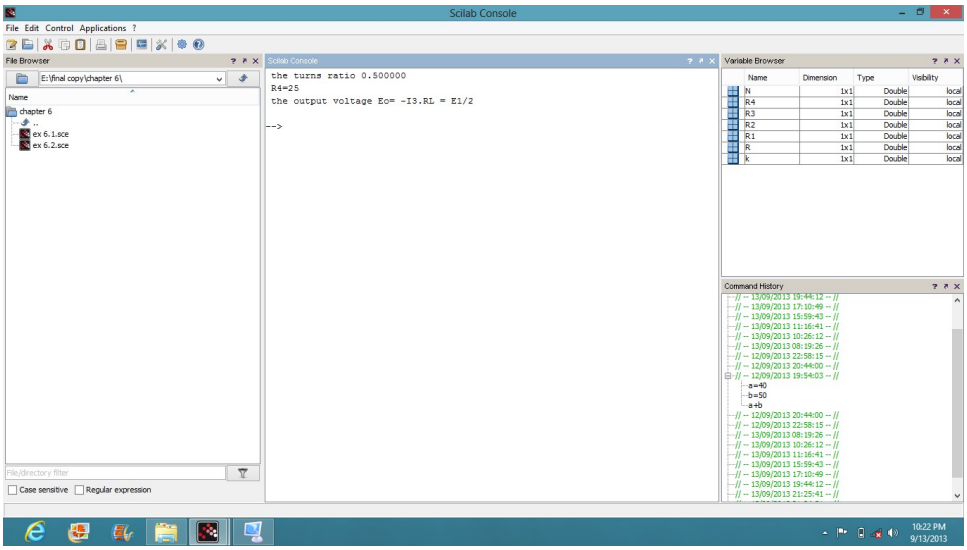

Figure 6.1: HTLT Ex 6 2

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,
```

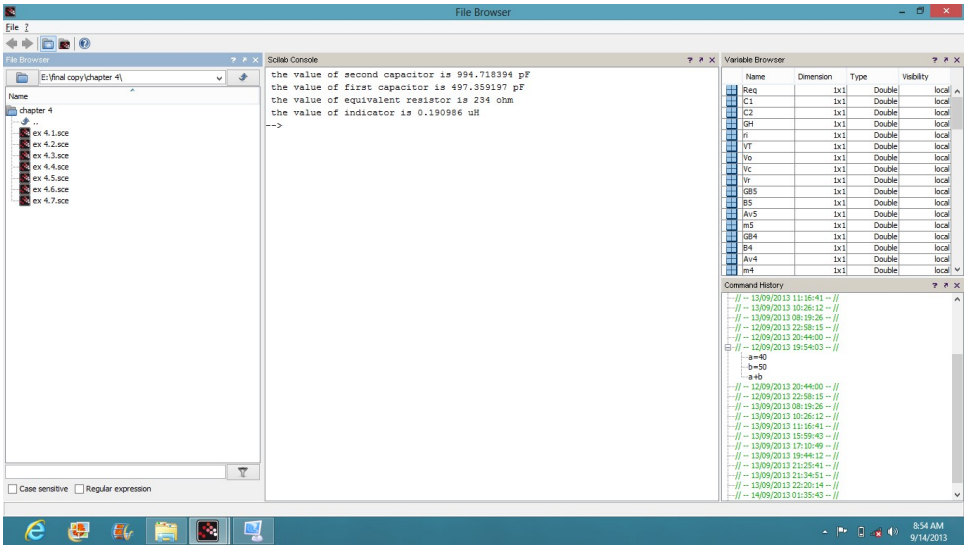

Figure 7.1: Oscillators Ex 7 1

```
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
```

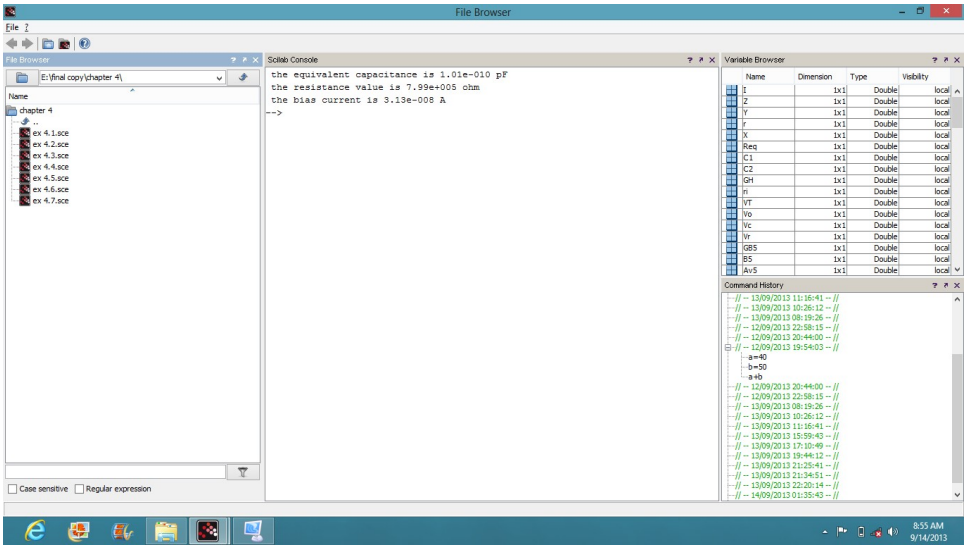

Figure 7.2: Oscillators Ex 7 2

```
12 Y=(1+B)/(((2*%pi*f)^2)*C1*C2)
13 Z=L/C1
14 rpi=(Y-Z)*r^-1//resistance
15 gm=rpi^-1//transconductance
16 I=gm/40//bias current
17 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

```
1 clc
2 //Chapter 7:Conditions for Oscillation
3 //example 7.3
4 //given
5 rpi=1000
```

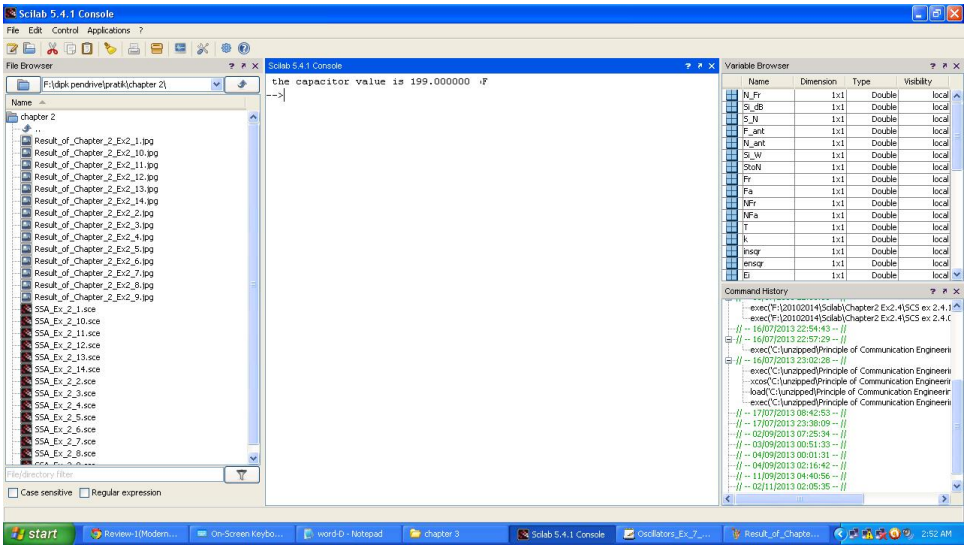

Figure 7.3: Oscillators Ex 7 3

```
6  C1=200*10^-12
7  r=3.14//series resistance
8  C_1=C1/(1+(r/rpi))//capacitance
9
10 mprintf('the capacitor value is %f pF',round(C_1*1
       e12))
```

Scilab code Exa 7.4 Oscillators Ex 7 4

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

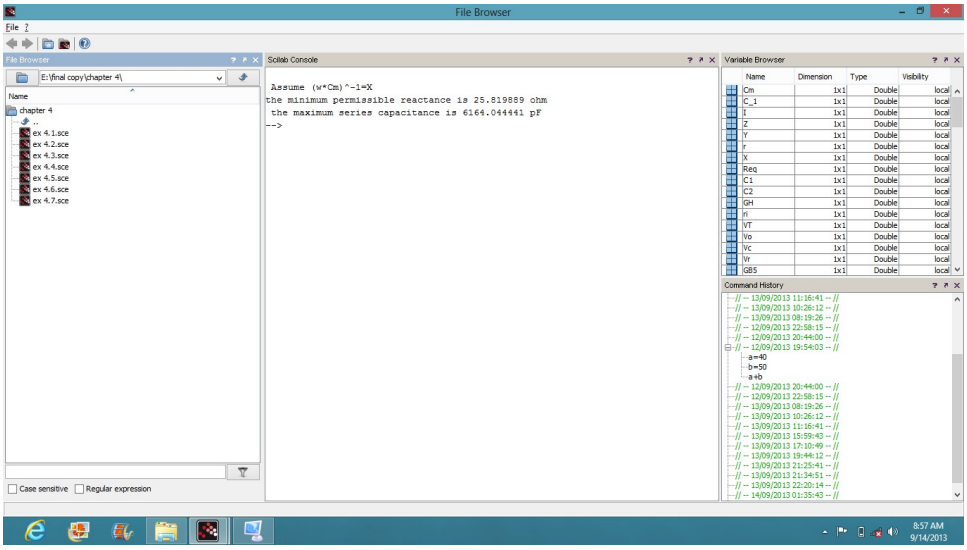

Figure 7.4: Oscillators Ex 7 4

```
8  disp('Assume (w*Cm)^-1=X')
9  X=sqrt(r/gm)//minimum permissible reactance
10 Cm=(2*%pi*f*X)^-1//maximum series capacitance
11 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

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

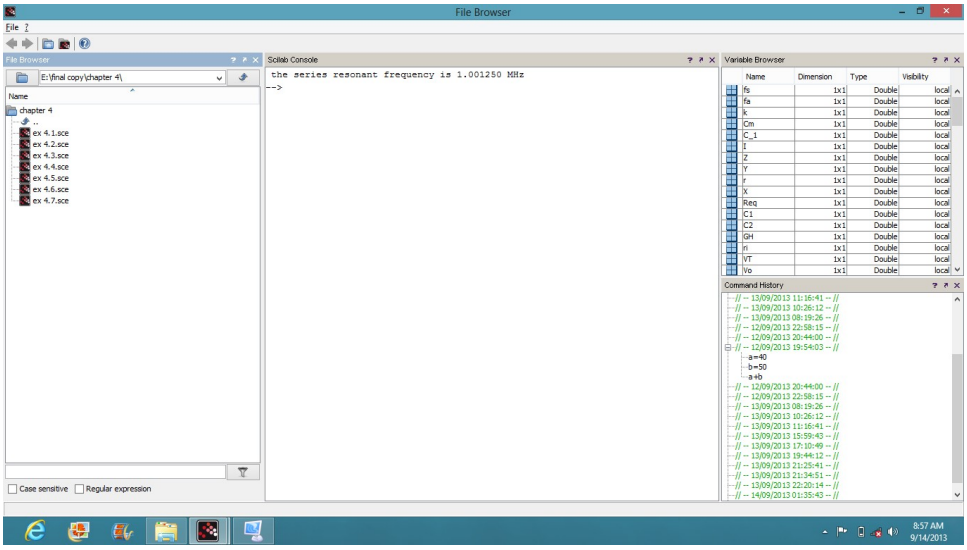

Figure 7.5: Oscillators Ex 7 5

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

Scilab code Exa 7.6 Oscillators Ex 7 6

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

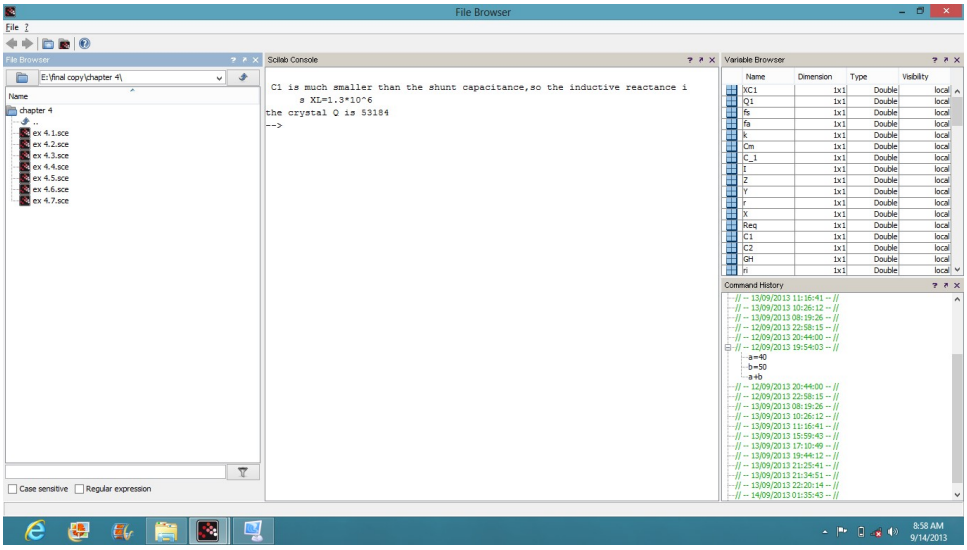

Figure 7.6: Oscillators Ex 7 6

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

Scilab code Exa 7.7 Oscillators Ex 7 7

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

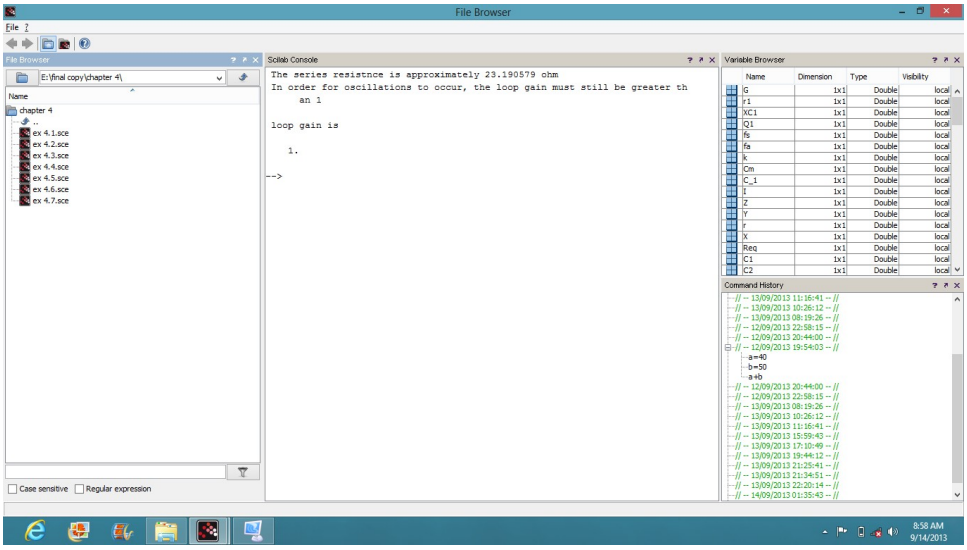

Figure 7.7: Oscillators Ex 7 7

```
6  //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.
7  gm=1.5*10^-3//transconductance
8  C1=64*10^-12
9  C2=64*10^-12
10 r1=gm/((2*%pi*f)^2*C1*C2)//series resistance of the
     crystal
11 mprintf('The series resistnce is approximately %f
     ohm ',r1)
12 disp('In order for oscillations to occur, the loop
     gain must still be greater than 1')
13 G=gm*((2*%pi*f*C1)^-1)^2/r1//loop gain
14 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
```

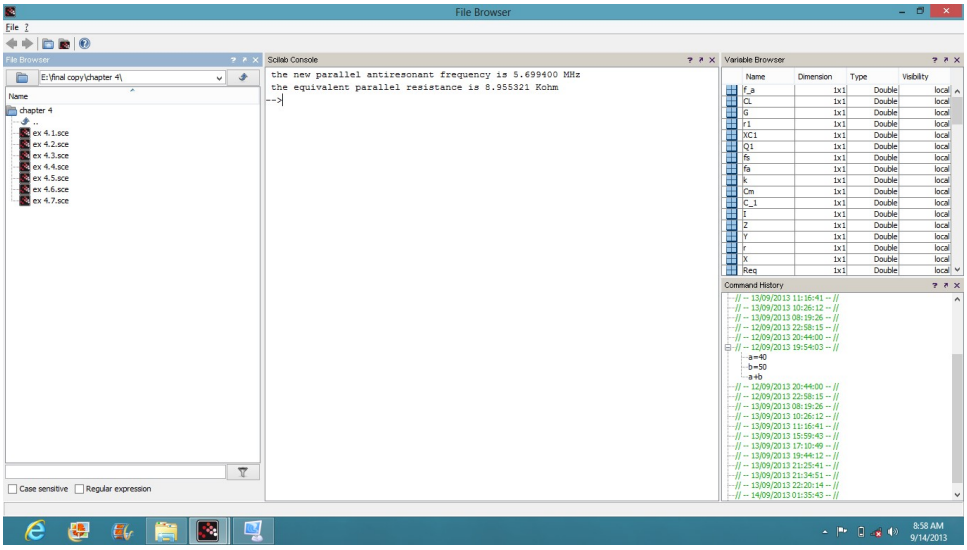

Figure 7.8: Oscillators Ex 7 8

```
11 C1=(2*%pi*f*XC1)^-1//value of first capacitor
12 C2=(2*%pi*f*XC2)^-1//value of second capacitor
13 mprintf('the value of first capacitor is %3.2e pF\n
     the value of second capacitor is %3.2e pF\n ',C1,
     C2)
14 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 ')
15 XC_2=Rs/(gm*100)//new value of reactance
16 XL=100+XC_2//inductive reactance
17 L=XL/(2*%pi*f)//value of inductor
18 mprintf('the value of inductor is %3.2e H',L)
```

Scilab code Exa 7.11 Oscillators Ex 7 11

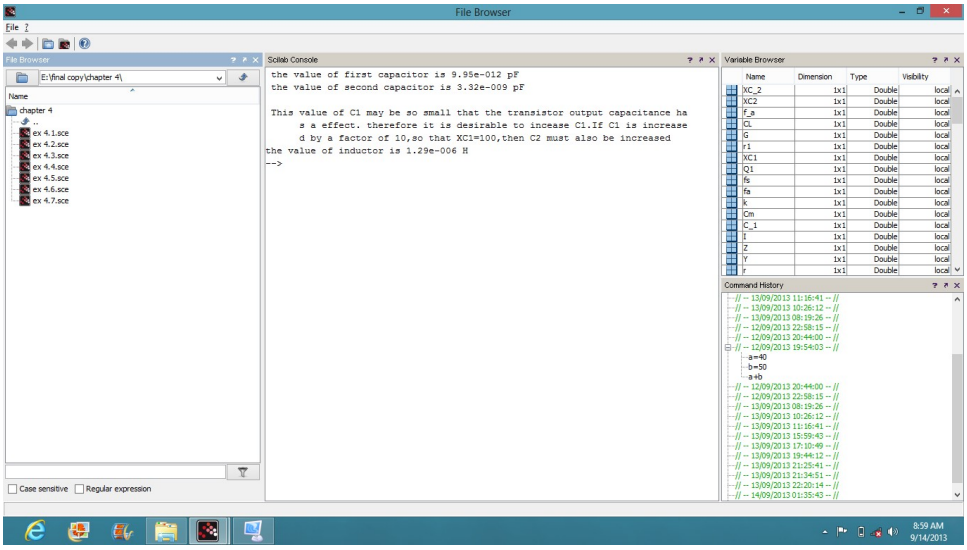

Figure 7.9: Oscillators Ex 7 9

```
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)
```

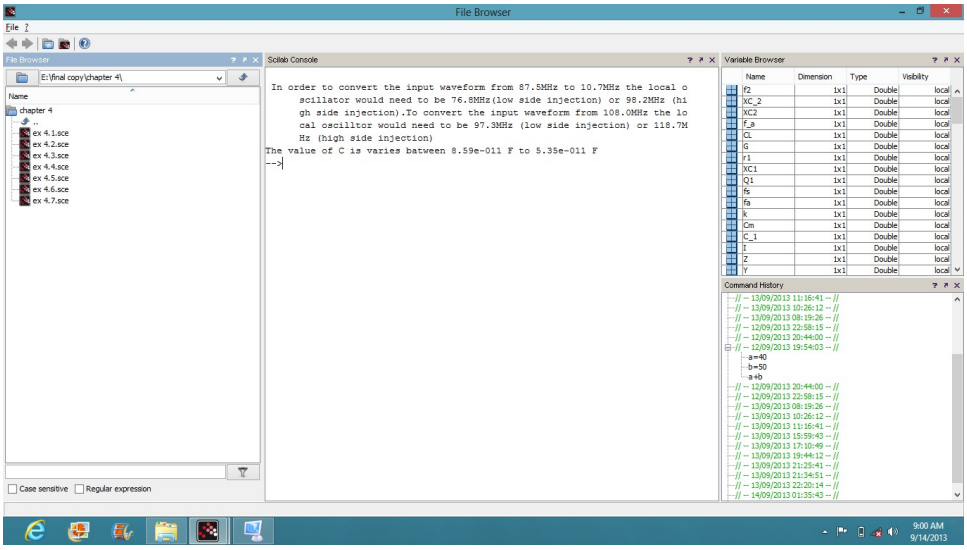

Figure 7.10: Oscillators Ex 7 11

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
   )
```

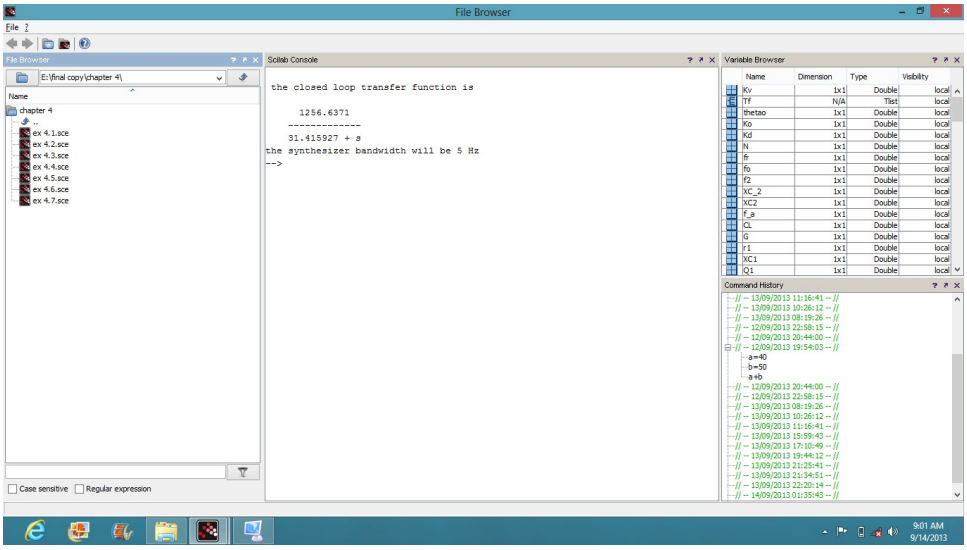

Figure 8.1: PLL Ex 8 1

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)
```

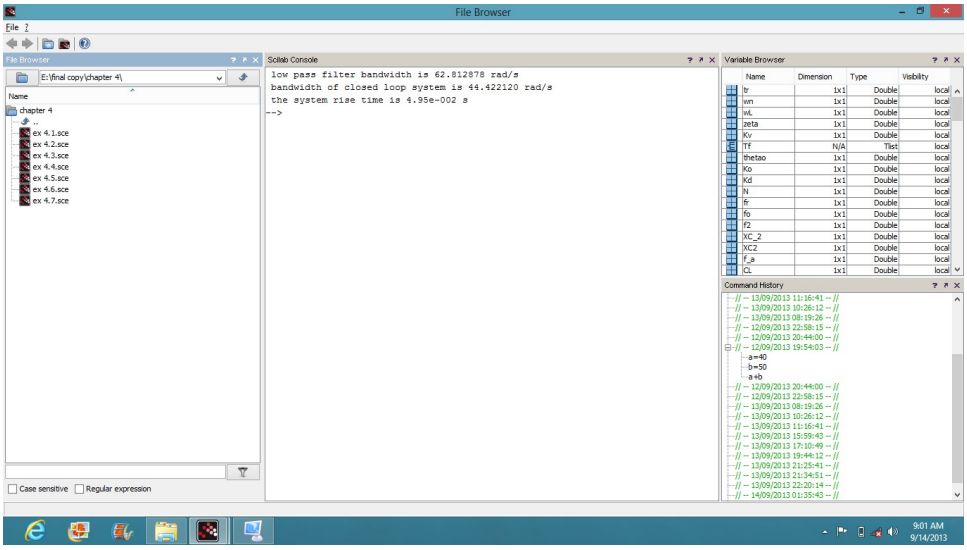

Figure 8.2: PLL Ex 8 2

Scilab code Exa 8.4 PLL Ex 8 4

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

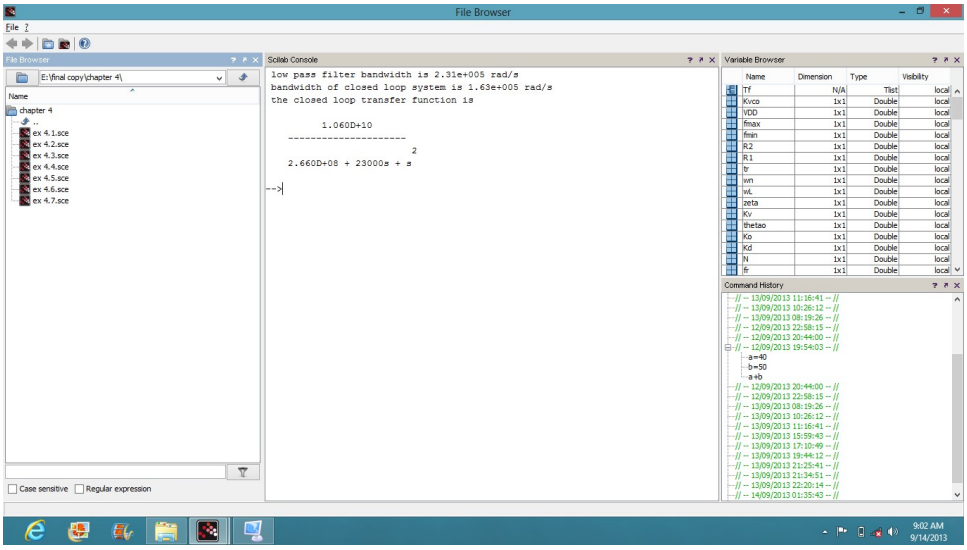

Figure 8.3: PLL Ex 8 4

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

Chapter 9

Phase Locked Loop Analysis

Scilab code Exa 9.1 PLLA Ex 9 1

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

Scilab code Exa 9.2 PLLA Ex 9 2

```
1 clc
```

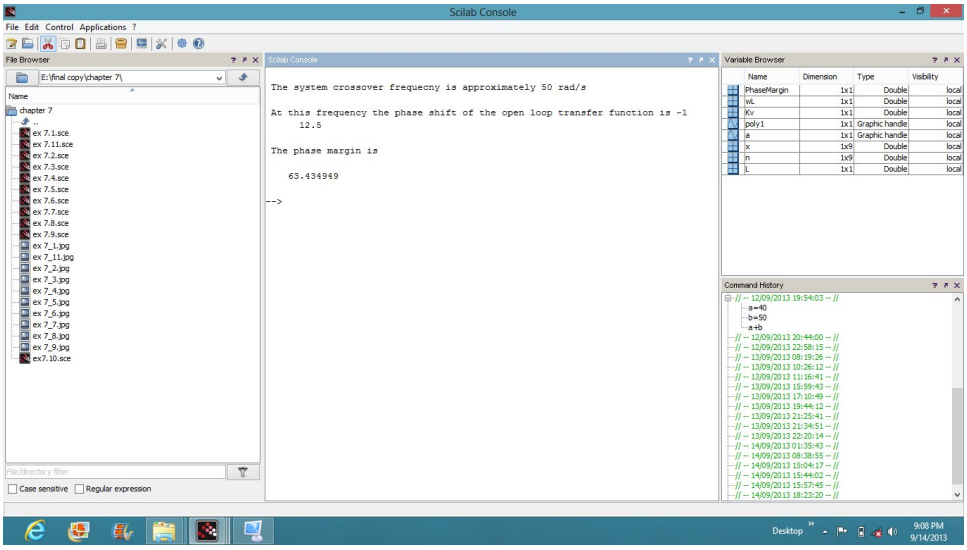

Figure 9.1: PLLA Ex 9 1

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

Scilab code Exa 9.3 PLLA Ex 9 3

```
1 clc
2 close
3 //chapter 9: Stability Analysis
```

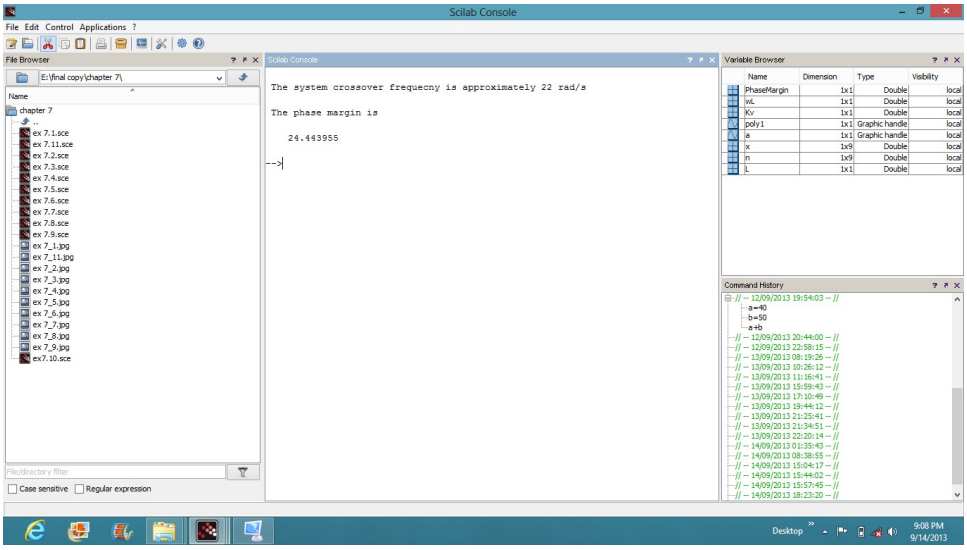

Figure 9.2: PLLA Ex 9 2

```
4  //Example 9.3 page no 361
5  //given
6  clear
7  wL=258
8  s=poly(0,'s')
9  h=syslin('c',(100/(s*(s/wL+1)^2 )))
10 clf();bode(h,1,1000);
11 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')
12 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')
```

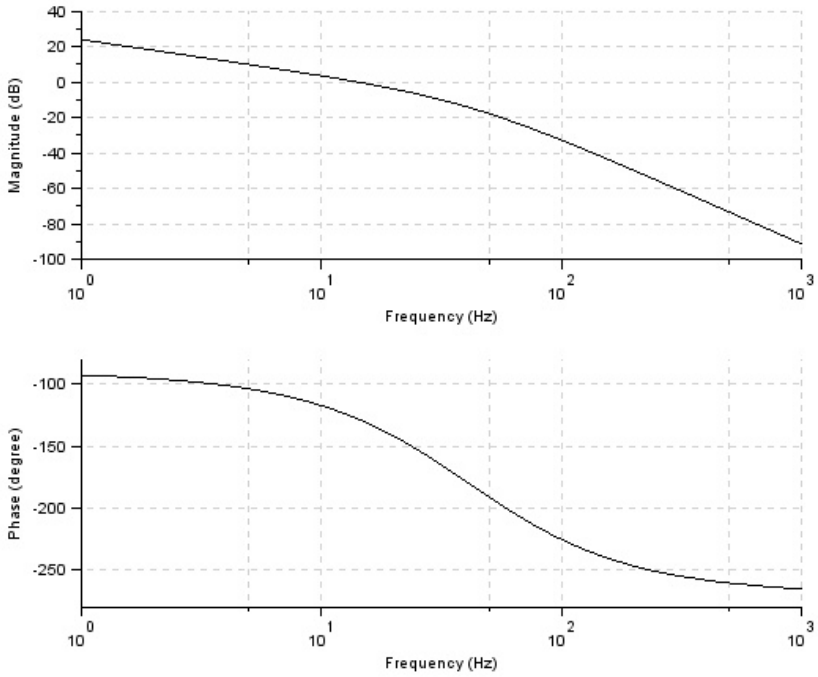

Figure 9.3: PLLA Ex 9 3

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);
```

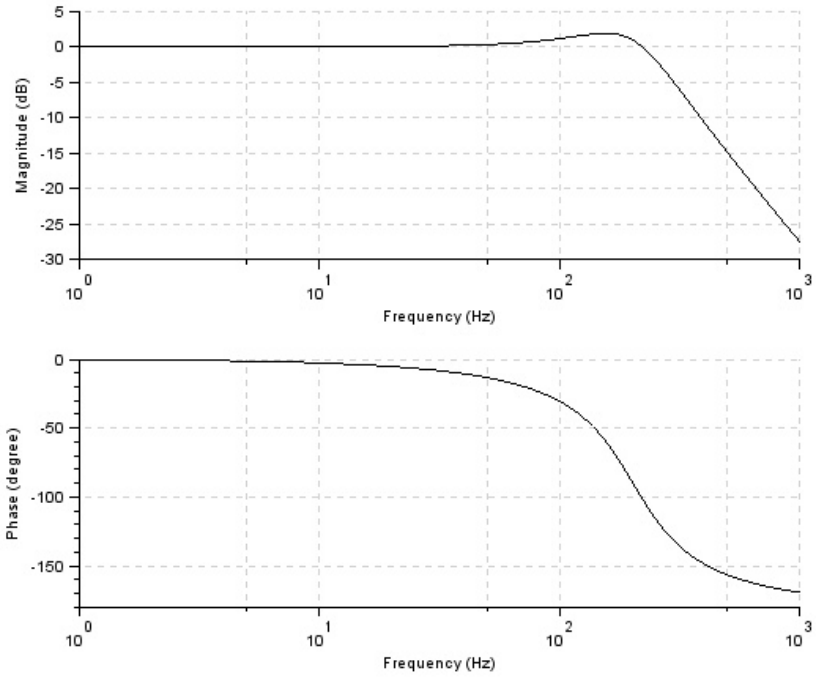

Figure 9.4: PLLA Ex 9 4

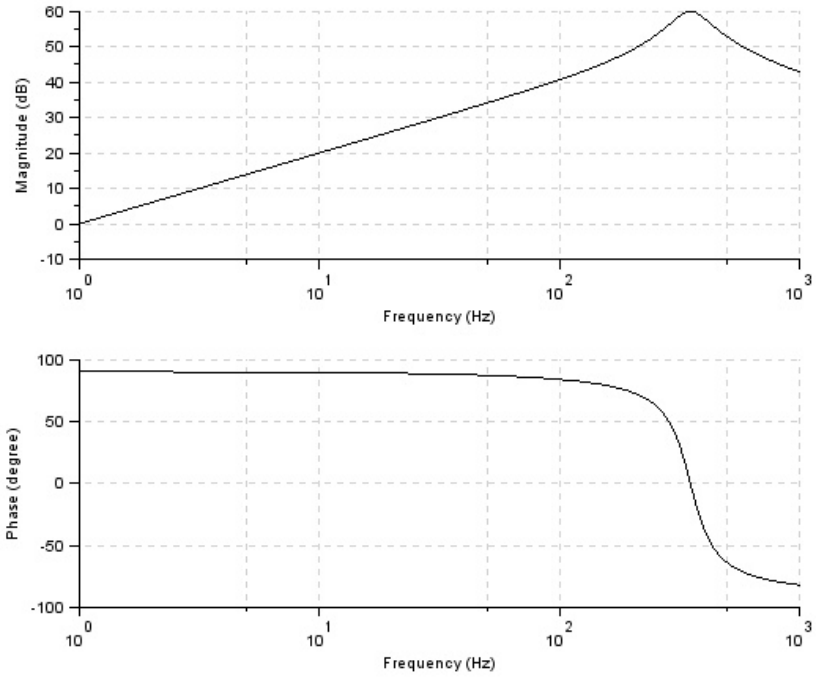

Figure 9.5: PLLA Ex 9 5

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
```

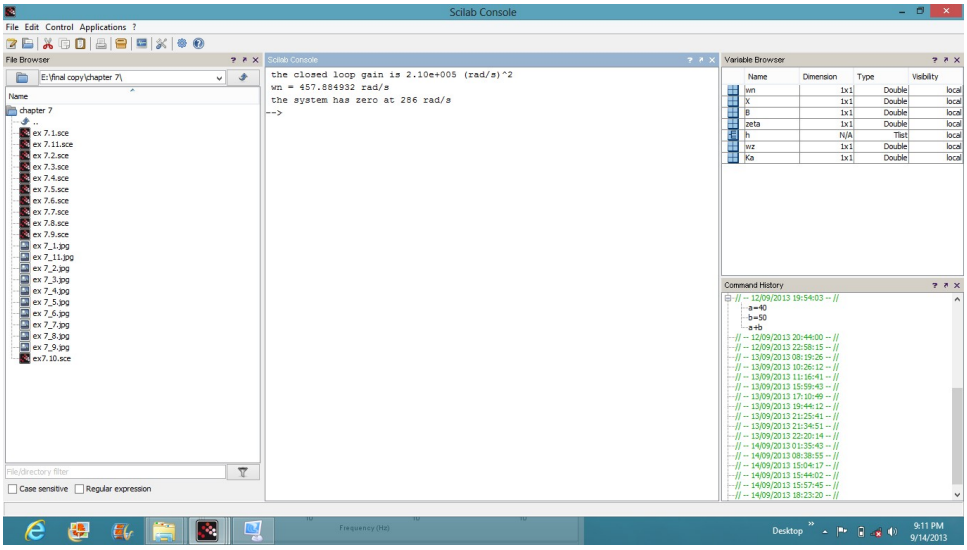

Figure 9.6: PLLA Ex 9 6

```
    zero is placed at ')
11 Wz=Wc/sqrt(a)//systems zero
12 Wp=a*Wz//systems pole
13 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

```
1 clc
2 //Chapter 9:Phase locked loop Analysis
3 //Example 9.9 page no 380
4 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 ,')
```

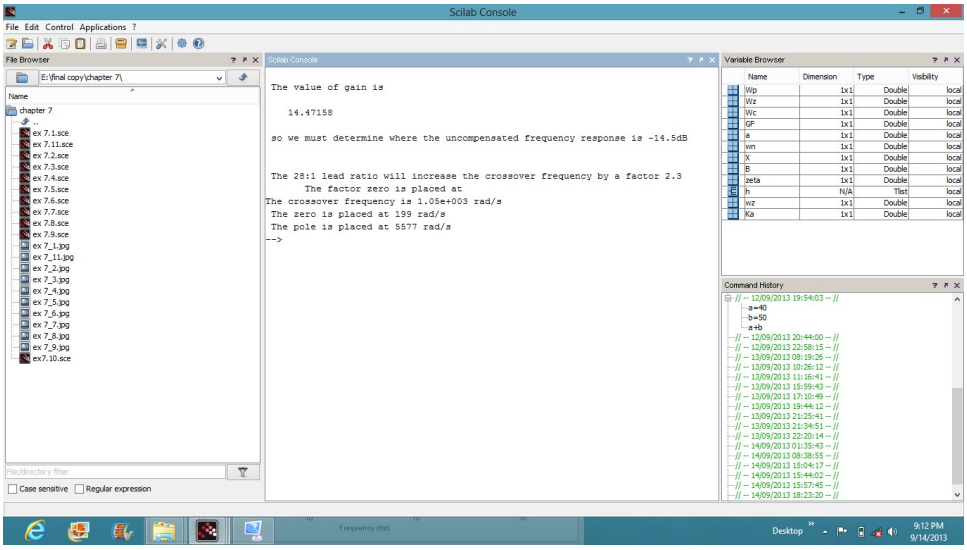

Figure 9.7: PLLA Ex 9 7

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

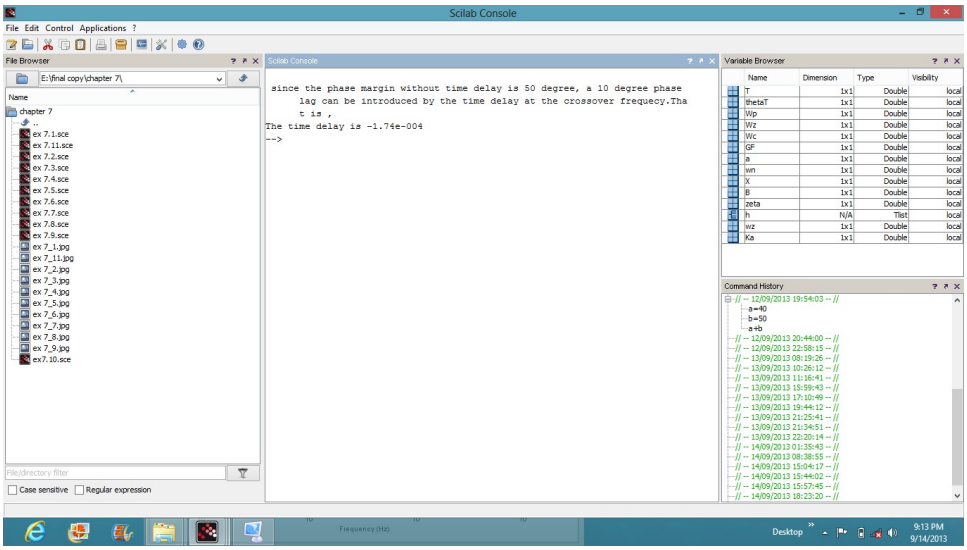

Figure 9.8: PLLA Ex 9 9

Chapter 10

Frequency Synthesizers

Scilab code Exa 10.3 FS Ex 10 3

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

Scilab code Exa 10.4 FS Ex 10 4

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

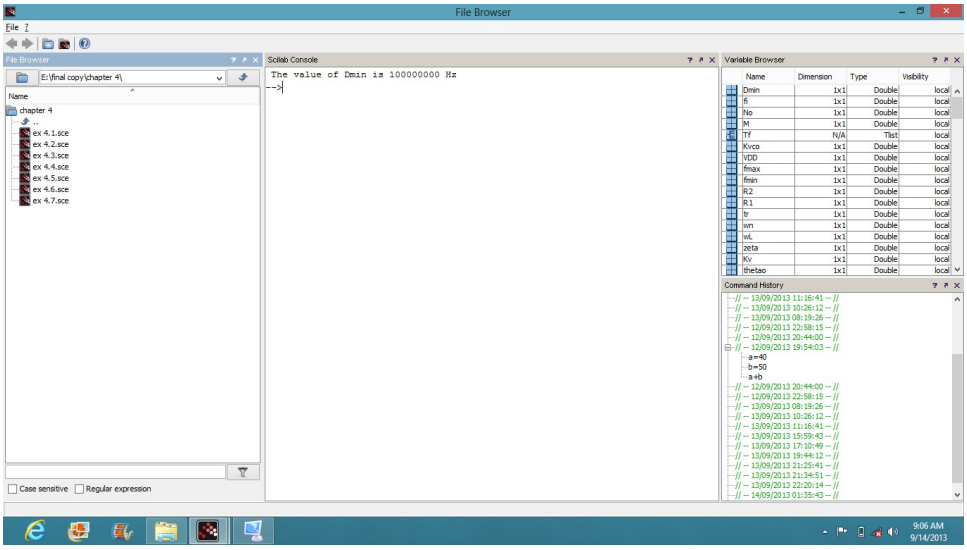

Figure 10.1: FS Ex 10 3

```
7 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:')
8 N=(fo/fr)/P//finding N for A=0
9 disp('For this value of N,find A by ')
10 A=(fo/fr)-92*P
11 mprintf('N = %d \n A = %d ',N,A)
```

Scilab code Exa 10.5 FS Ex 10 5

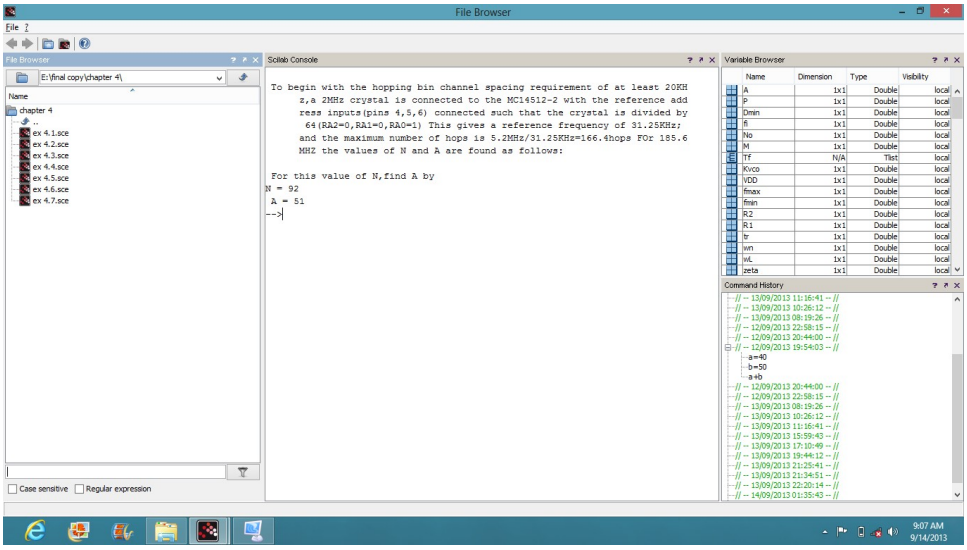

Figure 10.2: FS Ex 10 4

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

Scilab code Exa 10.7 FS Ex 10 7

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

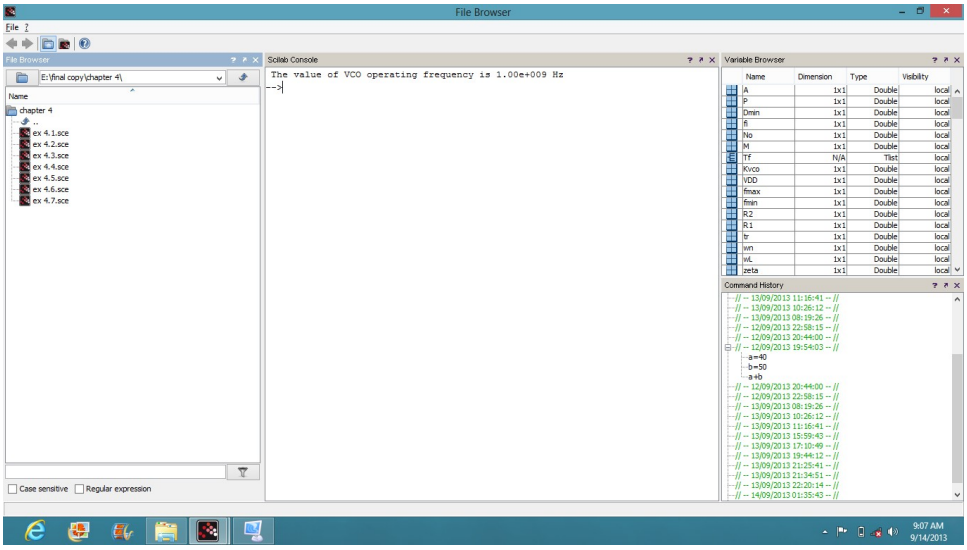

Figure 10.3: FS Ex 10 5

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

Scilab code Exa 10.8 FS Ex 10 8

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

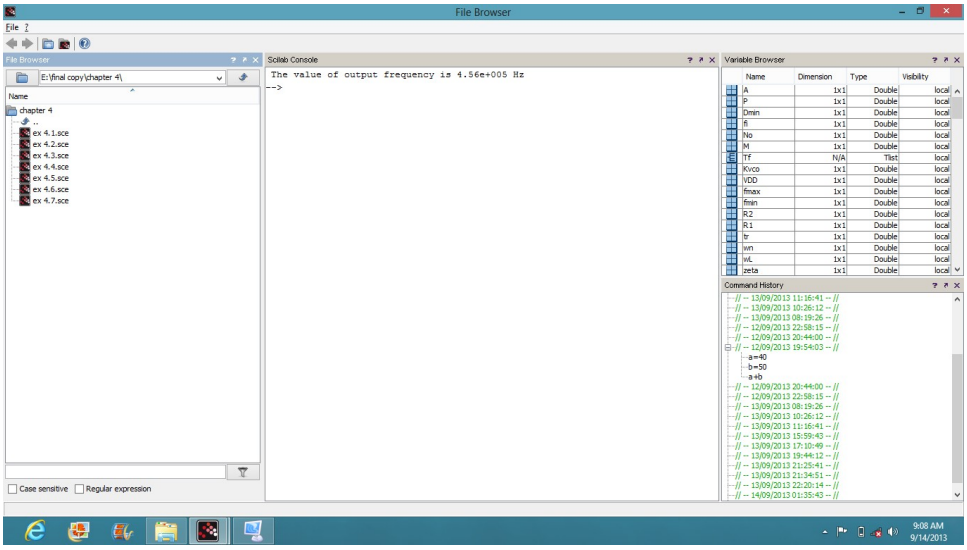

Figure 10.4: FS Ex 10 7

Scilab code Exa 10.11 FS Ex 10 11

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

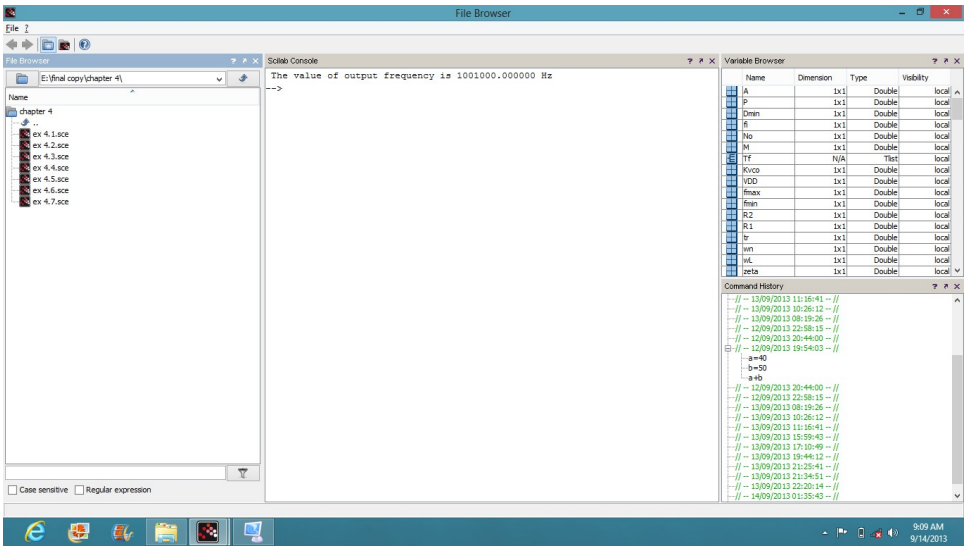

Figure 10.5: FS Ex 10 8

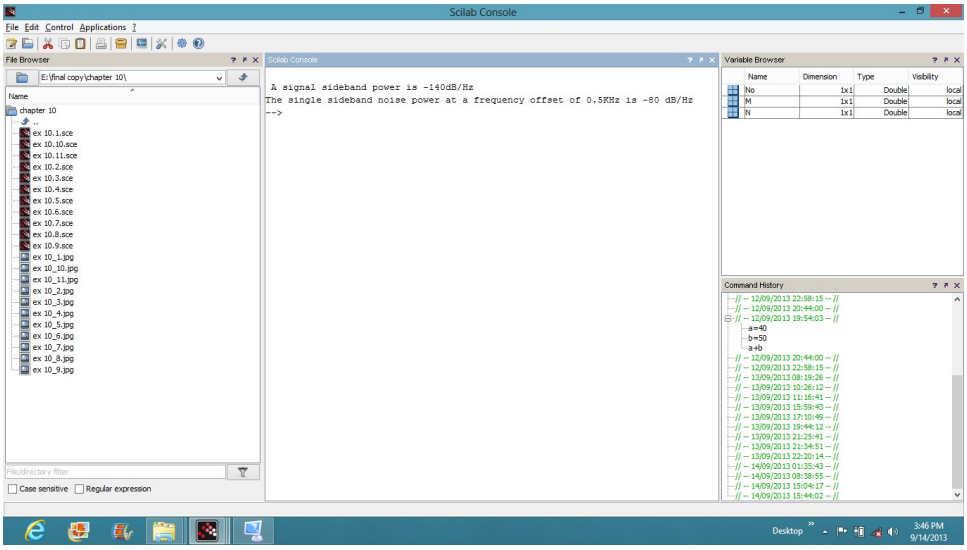

Figure 10.6: FS Ex 10 11

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)')
```

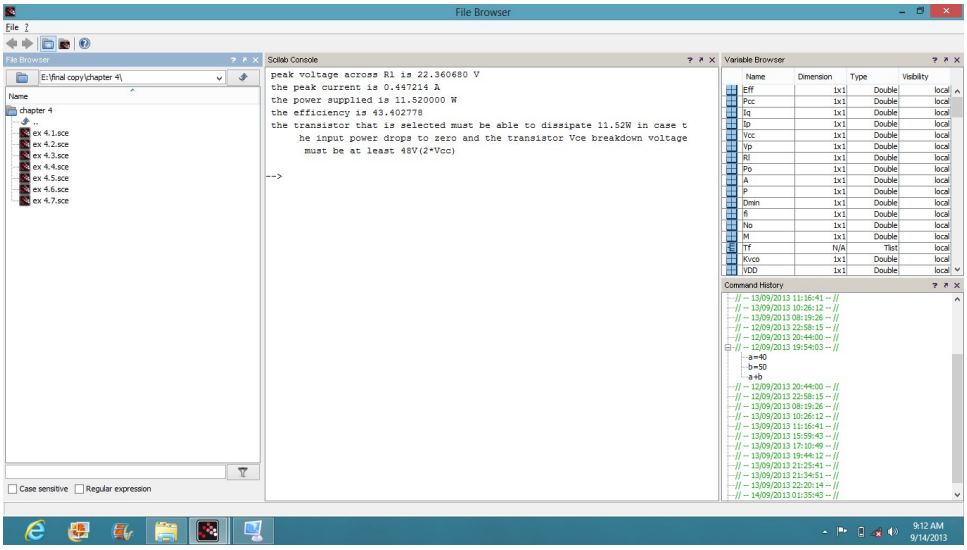

Figure 11.1: PA Ex 11 1

Scilab code Exa 11.2 PA Ex 11 2

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

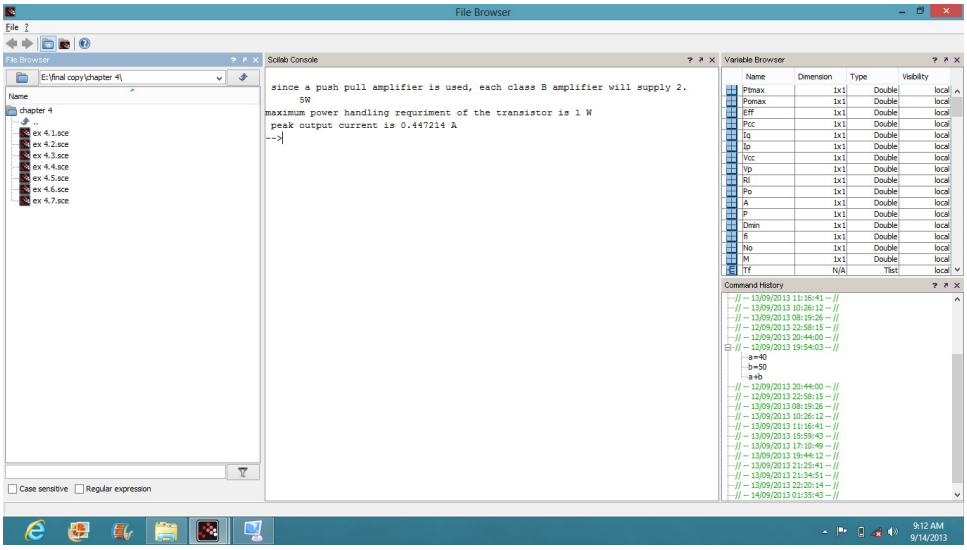

Figure 11.2: PA Ex 11 2

```
    requriment of the transistor
12 I=sqrt((4*Pomax)/Rl)//peak output current
13 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

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

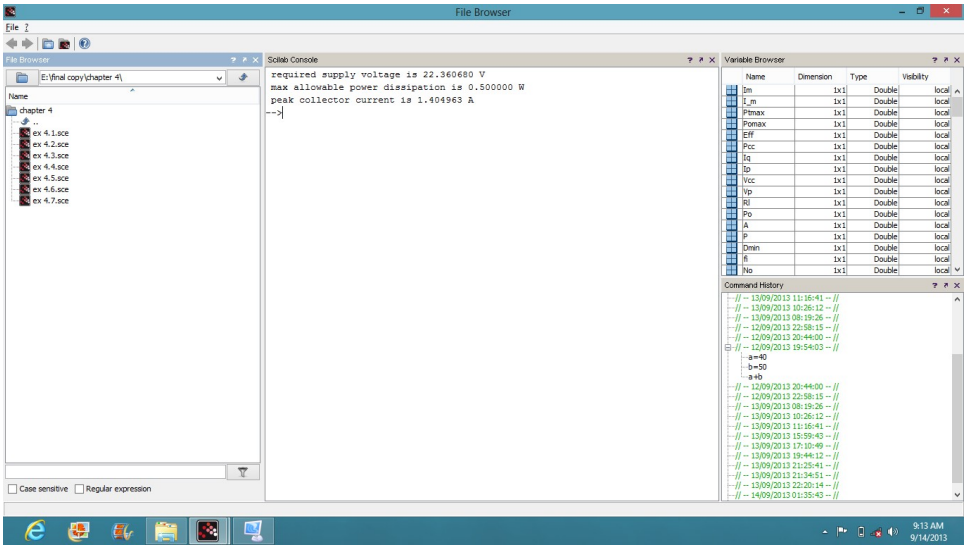

Figure 11.3: PA Ex 11 3

```
9  Ptmax=0.1*Po//allowable power dissipation
10 I_m=0.5
11 Im=(2*%pi*Vcc*I_m)/Rl//peak collector current
12 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

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

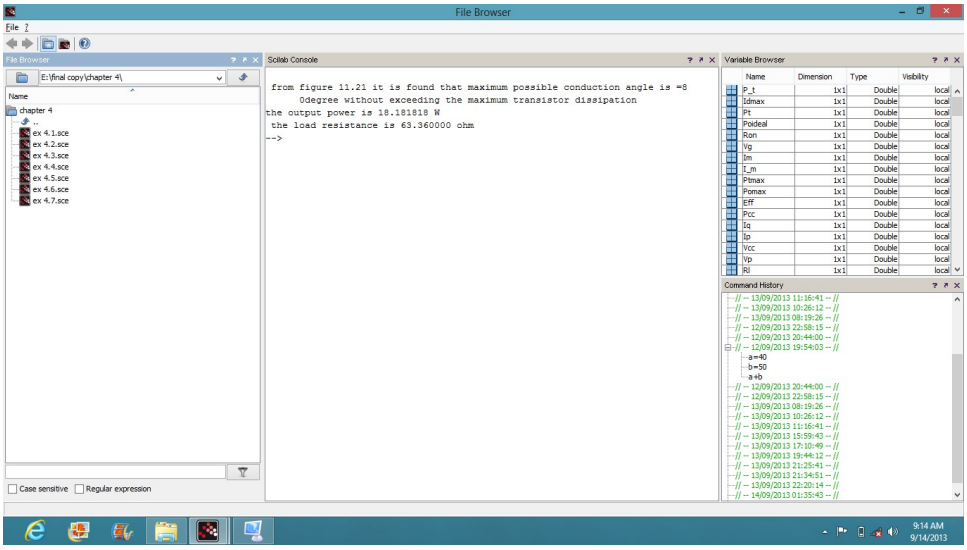

Figure 11.4: PA Ex 11 4

```
8  P_t=(4*%pi*Pt)/(Vcc*Idmax)//the normalised max
       transistor dissipation
9  disp('from figure 11.21 it is found that maximum
       possible conduction angle is =80degree without
       exceeding the maximum transistor dissipation')
10 Po=Pt/0.22//output power
11 Rl=Vcc^2/(2*Po)//load resistance
12 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

```
1  clc
2  //Chapter 11:Power amplifiers
3  //example 11.5 page no 477
4  //given
```

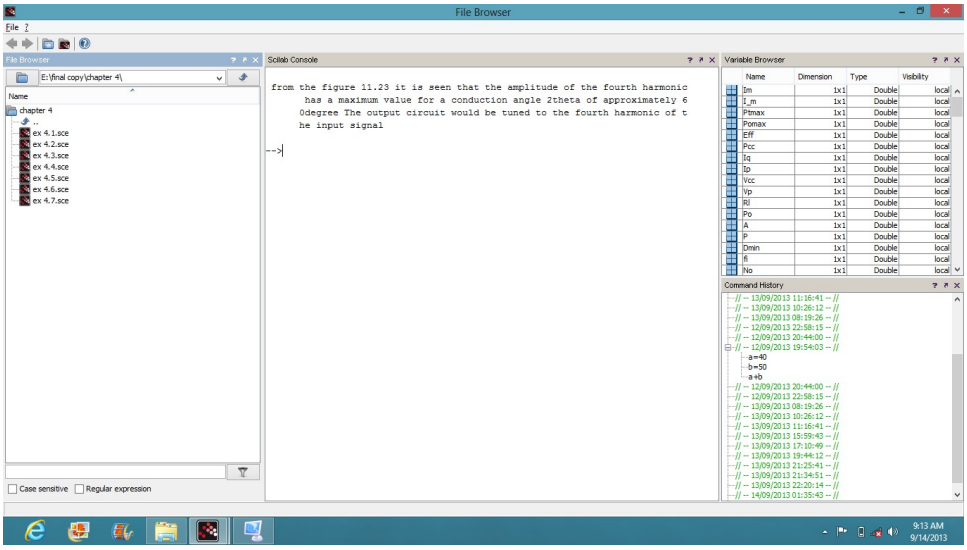

Figure 11.5: PA Ex 11 5

```
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

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

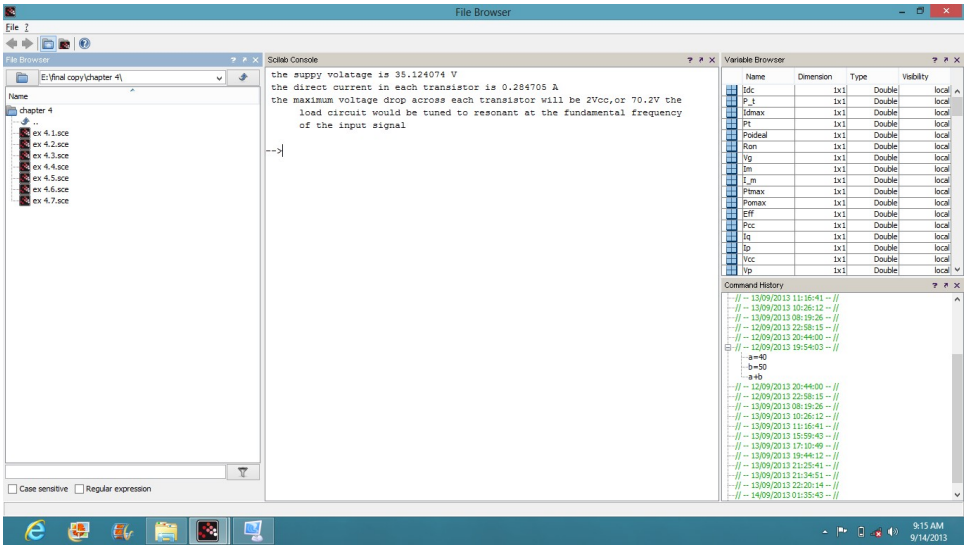

Figure 11.6: PA Ex 11 6

```
8 Idc=4*Vcc/(Rl*%pi^2)//direct current in each
    transistor
9 mprintf('the suppy volatage is %f V \n the direct
    current in each transistor is %f A',Vcc,Idc)
10 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

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

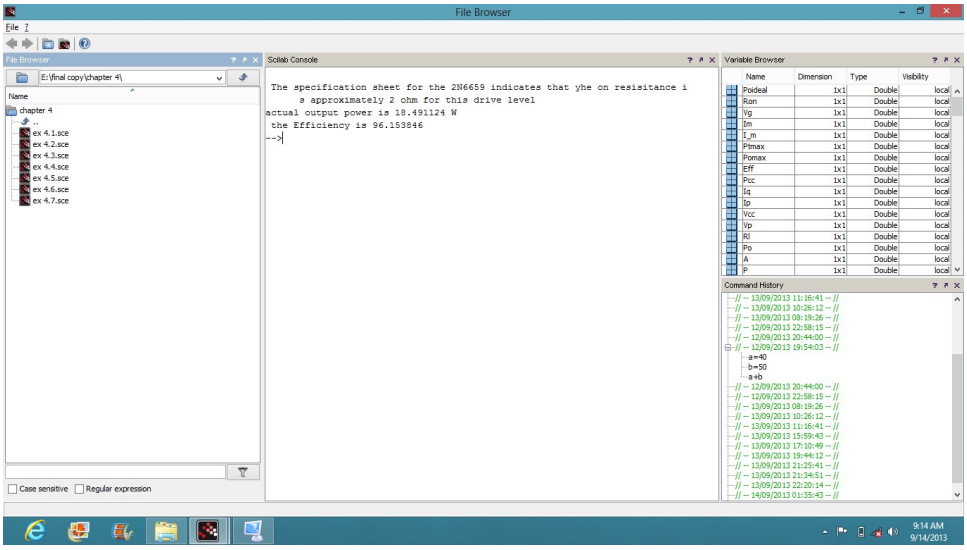

Figure 11.7: PA Ex 11 7

```
6  Rl=50//load resistance in ohms(it should have been
       given in the problem but its missing)
7  disp('The specification sheet for the 2N6659
       indicates that yhe on resisitance is
       approximately 2 ohm for this drive level')
8  Ron=2
9  Poideal=20
10 Po=Poideal*((Rl/(Rl+Ron))^2)//actual output power
11 Eff=Rl*100/(Rl+Ron)//Efficiency
12 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
```

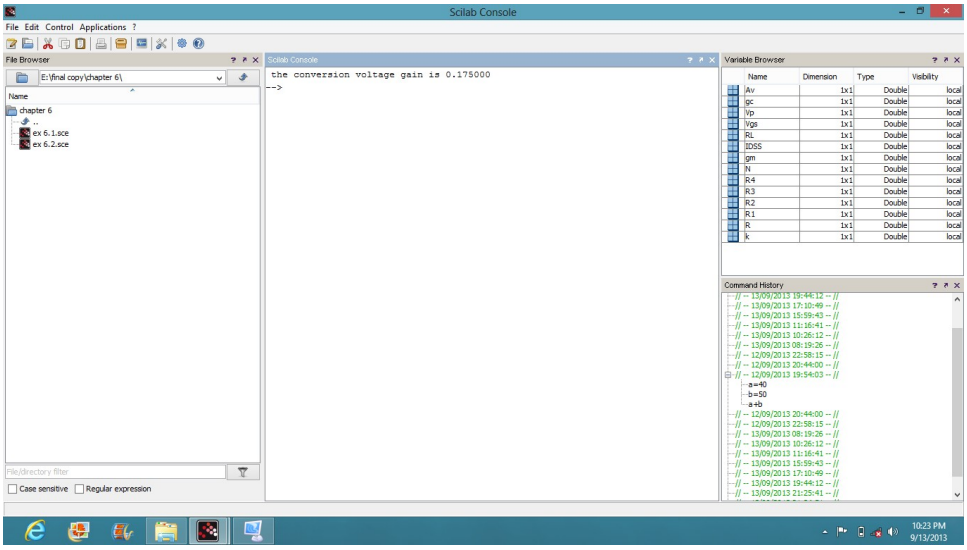

Figure 12.1: MD Ex 12 2

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

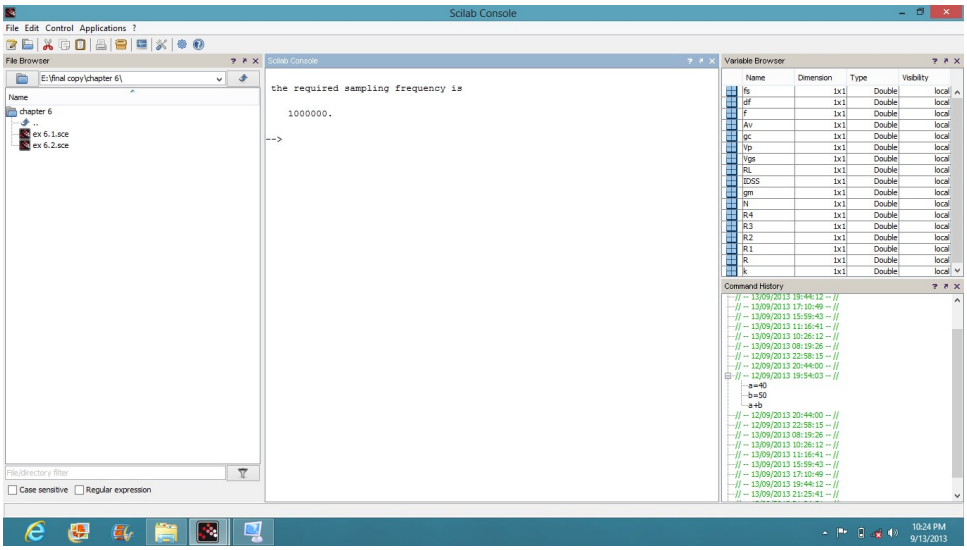

Figure 12.2: MD Ex 12 4