Scilab Textbook Companion for Electric Drives Concepts And Applications by Vedam Subrahmanyam[1]

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July 31, 2019

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

Book Description

Title: Electric Drives Concepts And Applications

Author: Vedam Subrahmanyam

Publisher: Tata McGraw Hill Publication, New Delhi

Edition: 2

Year: 2011

ISBN: 9780070701991

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

Characteristics of Electric motor

Scilab code Exa 1.1 Find the speed of the motor

```
1 //Electric Drives  concepts and application by V.
    Subrahmanyam
2 //Publisher:Tata McGraw-Hill
3 //Edition:Second
4 //Ex1_1
5 clc;
6 clear;
7 V=500;// voltage v
8 N1=900;// speed in rpm
9 Ia1=45;//armature current in A
10 Ia2=21;//armature current in A
11 R=8;// resistance in ohm
12 Ra=1;//armature resistance in ohm
13 Eb1=V-(Ia1*Ra);
14 Eb2=V-(9*Ia2);
15 N2=N1*(Eb2/Eb1);
16 disp(N2,'New speed in rpm is :');
```

Figure 1.1: Find the speed of the motor

Figure 1.2: Calculate the initial breaking torque

Scilab code Exa 1.2 Calculate the initial breaking torque

```
1 //Electric Drives:concepts and application by V.
    Subrahmanyam
2 //Publisher:Tata McGraw-Hill
3 //Edition:Second
4 //Ex1_2
5 clc;
6 clear;
7 V1=400;//supply voltage is V
8 I1=70;//Current in A
```

```
N1=78.5;//speed in rad/sec
R1=0.3;//resistance in ohm
I2=90;//current in A
N2=31.4;//Speed in rpm
Eb1=V1-(I1*R1);
T1=(Eb1*I1)/N1;
V2=V1+Eb1;
R2=(V2/I2)-R1;
T2=(Eb1*I2)/N1;
Eb2=(Eb1*N2)/N1;
I=(V1+Eb2)/R2;
T=(Eb2+I)/N2;
disp(T,'The initial breaking torque in Nm is:')
//Calculation error in the textbook
```

Scilab code Exa 1.3 Find the resistance needed to reduce the speed

```
//Electric drives concepts and application by V.
   Subrahmanyam
//Publisher:Tata McGraw-Hill
//Edition:Second
//Ex1_3
clc;
clear;
V=250;//supply voltage V
Ia1=40;//Armature current in A
R1=0.6;//Resistance in ohm
N1=2.828;//speed in rpm
N2=2;//speed in rpm
Ia2=((Ia1)^2/N1)^(1/2);
Eb1=V-(Ia1*R1);
Eb=(Ia1/Ia2)*N2;
Eb2=Eb1/Eb;
```

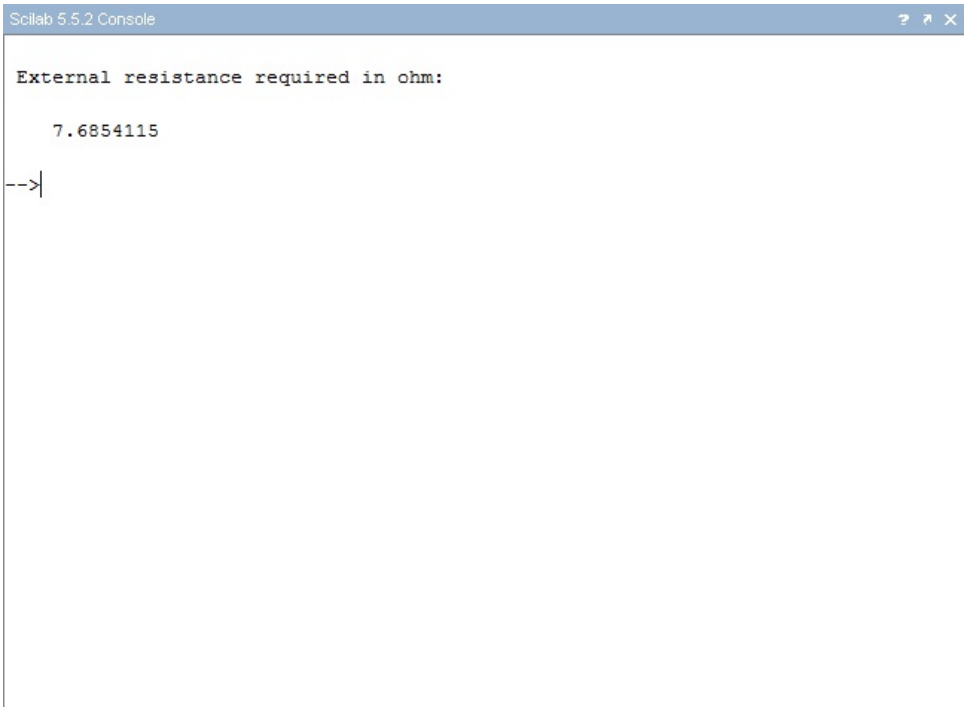

Figure 1.3: Find the resistance needed to reduce the speed

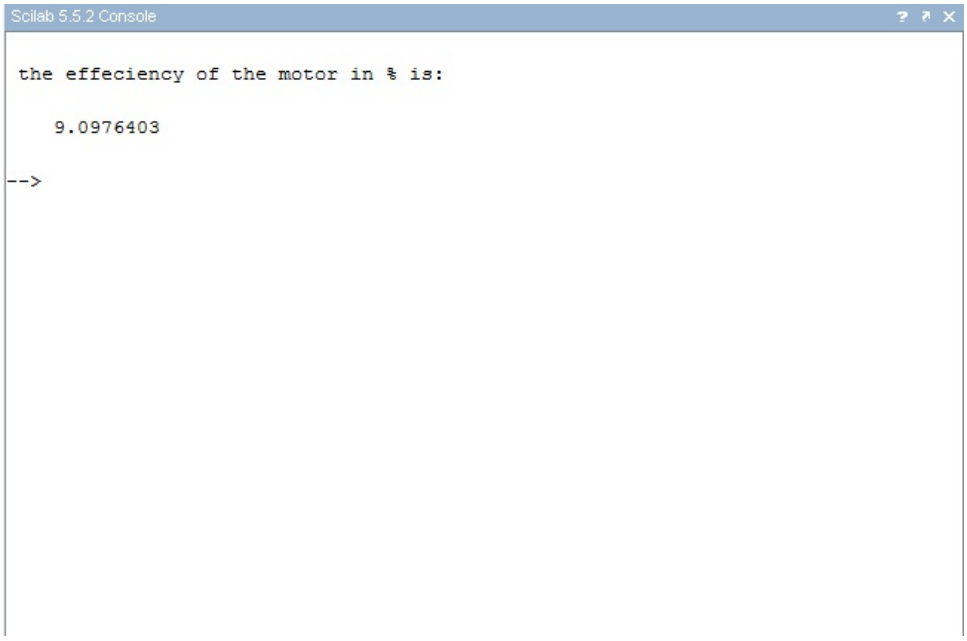

Figure 1.4: Calculate the effeciency

```
16 R2=(V-Eb2)/Ia2;
17 disp(R2,'External resistance required in ohm:')
```

Scilab code Exa 1.4.a Calculate the effeciency

```
1 //Electric Drives:concepts and applications by V.
    subrahmanyam
2 //Publisher:Tata McGraw-Hill
3 //Edition:Second
4 //Ex1_4a
5 clc;
6 clear;
7 V=440;// voltage in V
8 Ia=80;// Current in A
```

```
Na=1200;//Speed in rpm
Na1=125.6;// Speed in rad/sec
R1=0.55;// Resistance in ohm
R2=110;// Resistance in ohm
N0=600;// Speed in rpm
N01=62.8;//Speed in rpm
Nf=300;// Speed in rpm
Nf1=31.4;// Speed in rpm
Rsh=1.256;// Resistance in ohm
E=V-(Ia*R1);
K=E/Na1;
E1=K*N01;
Tf=K*Ia;
E2=E1*(Nf/N0);
V2=E2+(Ia*R1);
Is=(V2/Rsh)+Ia;
Il=Is+(V/R2);
Pi=V*Il;
Po=Tf*Nf1;
Eff=(Po/Pi)*100;
disp(Eff,'the effeciency of the motor in % is:')
```

Scilab code Exa 1.4.b Calculate the no load and full load speeds

```
//Electric Drives:concepts and applications by V.
   subrahmanyam
//Publisher:Tata McGraw-Hill
//Edition:Second
//Ex1_4b
clc;
clear;
V=440;//voltage in V
K=3.153;
```

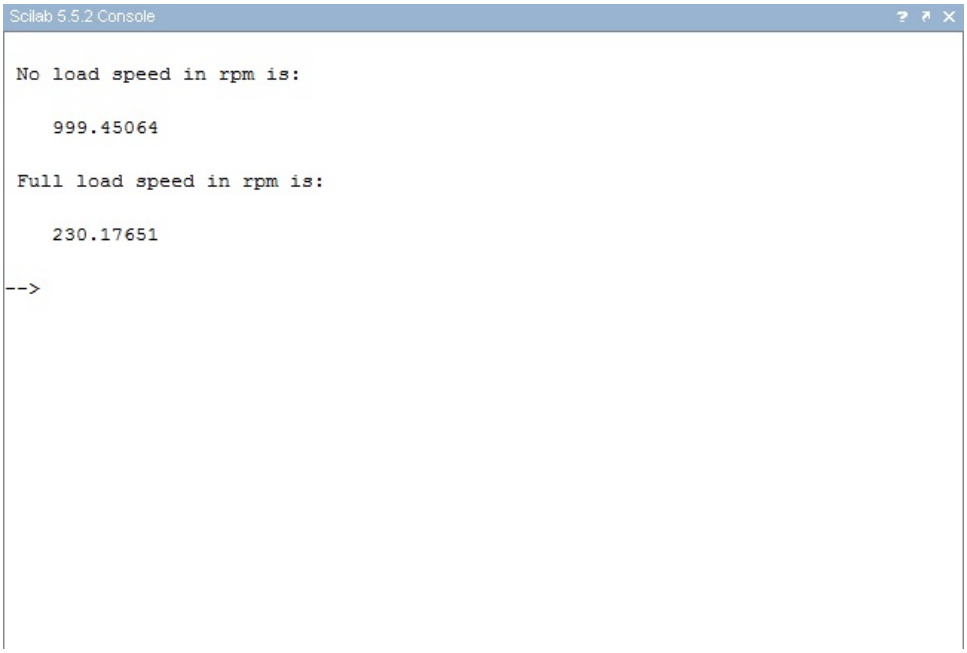

Figure 1.5: Calculate the no load and full load speeds

```
Ia=80;// Current in A
Rs=2;//Resistance in ohm
Rsh=1.5;//Resistance in ohm
R1=0.55;//Resistance in ohm
Alpha=(Rs/Rsh);
Vo=(V/Alpha);
No=(Vo/K);
N=((60*No)/(2*%pi));
disp(N,'No load speed in rpm is:')
V2=((V/Rs)-Ia)/((1/Rs)+(1/Rsh));
E2=V2-(Ia*R1);
N2=N*(E2/Vo);
disp(N2,'Full load speed in rpm is:')
```

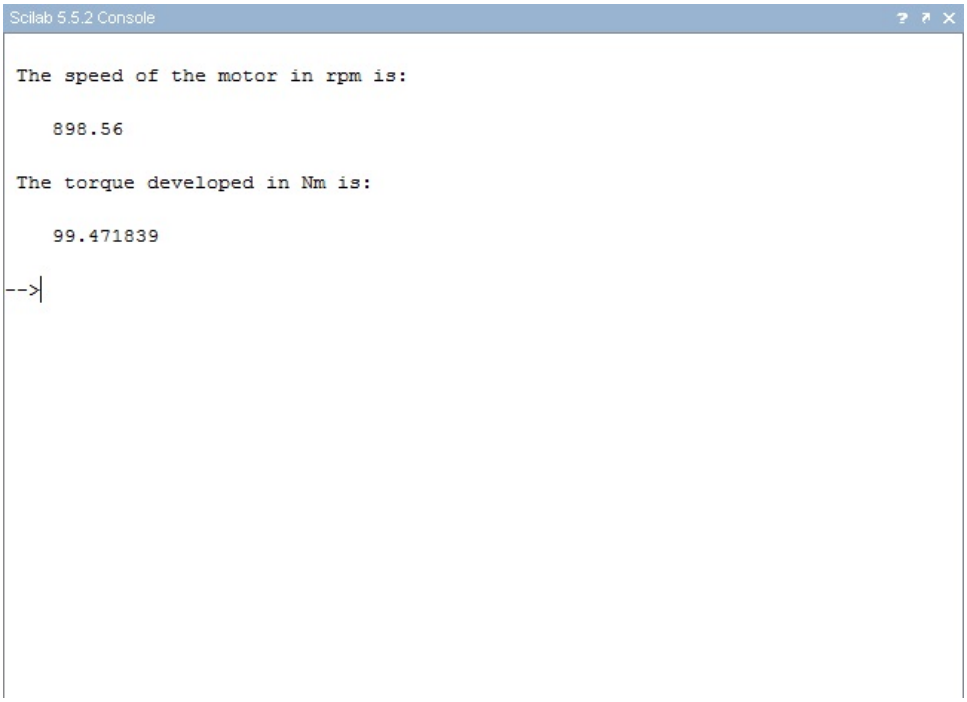

Figure 1.6: Determine the speed and torque developed

Scilab code Exa 1.5.a Determine the speed and torque developed

```
1 //Electric Drives:concepts and applications by V.
    subrahmanyam
2 //Publisher:Tata McGraw-Hill
3 //Edition:Second
4 //Ex1_5a
5 clc;
6 clear;
7 V=250;// voltage in V
8 Ra=0.4;// Resistance in ohm
9 Na=480;//Speed in rpm
10 Va=125;// voltage in V
11 Ia=40;//Current in A
12 Vi=V-(Ra*Ia);
13 N=Na*(Vi/Va);
14 disp(N,'The speed of the motor in rpm is:')
15 N1=(2*%pi*N)/60;
16 T=(Vi*Ia)/N1;
17 disp(T,'The torque developed in Nm is:')
```

Scilab code Exa 1.5.b Determine the resistance and torque developed

```
1 //Electric Drives:concepts and applications by V.
    subrahmanyam
2 //Publisher:Tata McGraw-Hill
3 //Edition:Second
4 //Ex1_5b
5 clc;
6 clear;
7 V=250;// voltage in V
8 I=40;//Current in A
9 Ra=0.4;//Resistance in ohm
```

Figure 1.7: Determine the resistance and torque developed

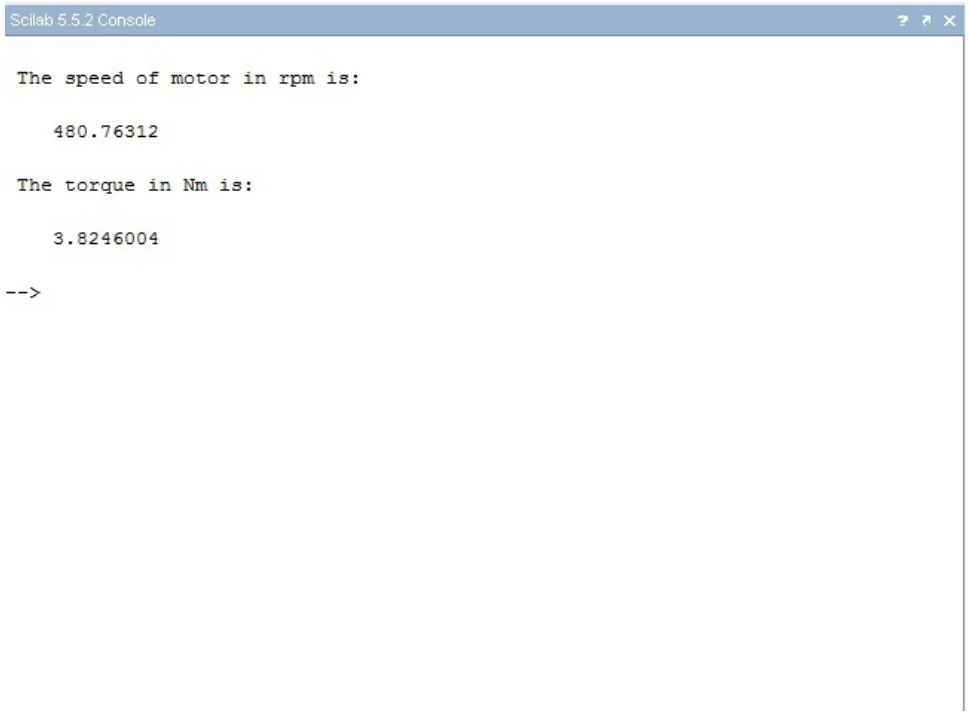

Figure 1.8: Determine the speed and torque of the motor

```
10 Eb=125;// voltage in V
11 Na=50.24;//Speed in rpm
12 Re=(V-Eb-(I*Ra))/I;
13 disp(Re,'The value of resistance in ohm:')
14 T=(Eb*I)/Na;
15 disp(T,'The torque developed in Nm is:')
16 //Result vary due to error in calculation of torque
     in the textbook
```

Scilab code Exa 1.6 Determine the speed and torque of the motor

```
1 //Electric Drives:concepts and applications by V.
    subrahmanyam
2 //Publisher:Tata McGraw-Hill
3 //Edition:Second
4 //Ex1_6
5 clc;
6 clear;
7 V=250;// voltage in V
8 I=40;//Current in A
9 R1=2.725;// Resistance in ohm
10 R2=3.5;// Resistance in ohm
11 Rf=0.15;// Resistance in ohm
12 N=480;//Speed in rpm
13 V1=V-I*(R1+Rf);
14 Ir=(V1/R2);
15 Ia=I-Ir;
16 Eb=V1-(Ia*Rf);
17 Nm=N*(V1/Eb);
18 disp(Nm,'The speed of motor in rpm is:')
19 //Result vary due to 125V is used instead of 135V in
    the textbook
20 T=(Eb*Ia)/(2*%pi*Nm/60);
21 disp(T,'The torque in Nm is:')
```

Scilab code Exa 1.7 Determine the speed and torque of the motor

```
1 //Electric Drives:concepts and applications by V.
    subrahmanyam
2 //Publisher:Tata McGraw-Hill
3 //Edition:Second
4 //Ex1_7
5 clc;
6 clear;
```

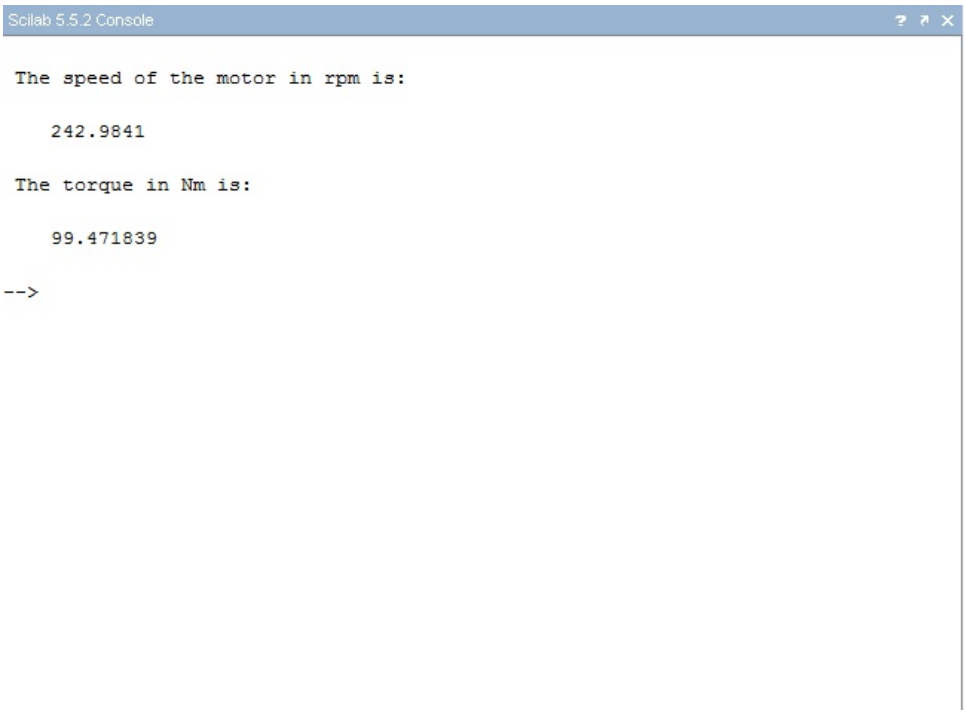

Figure 1.9: Determine the speed and torque of the motor

```
V=250;// voltage in V
I=40;//Current in A
Ro=0.4;// Resistance in ohm
R1=2.725;// Resistance in ohm
R2=3.5;// Resistance in ohm
Eb=125;// voltage in V
Na=480;//Speed in rpm
Na1=50.24;//Speed in rad/sec
R=((1/R1)+(1/R2));
Vm=(V-(I*R1))/(R*R1);
Em=Vm-(I*Ro);
N=(Em/Eb)*Na;
disp(N,'The speed of the motor in rpm is:')
N1=(2*%pi*N)/60;
Il=(V-Vm)/R1;
Po=Em*I;
T=Po/N1;
disp(T,'The torque in Nm is:')
```

Scilab code Exa 1.8 Determine the speed and torque of the motor

```
//Electric Drives:concepts and applications by V.
   subrahmanyam
//Publisher:Tata McGraw-Hill
//Edition:Second
//Ex1_8
clc;
clear;
V=250;// voltage in V
I=40;//Current in A
R1=0.91;// Resistance in ohm
Rs=0.95;// Resistance in ohm
Eb=125;// voltage in V
```

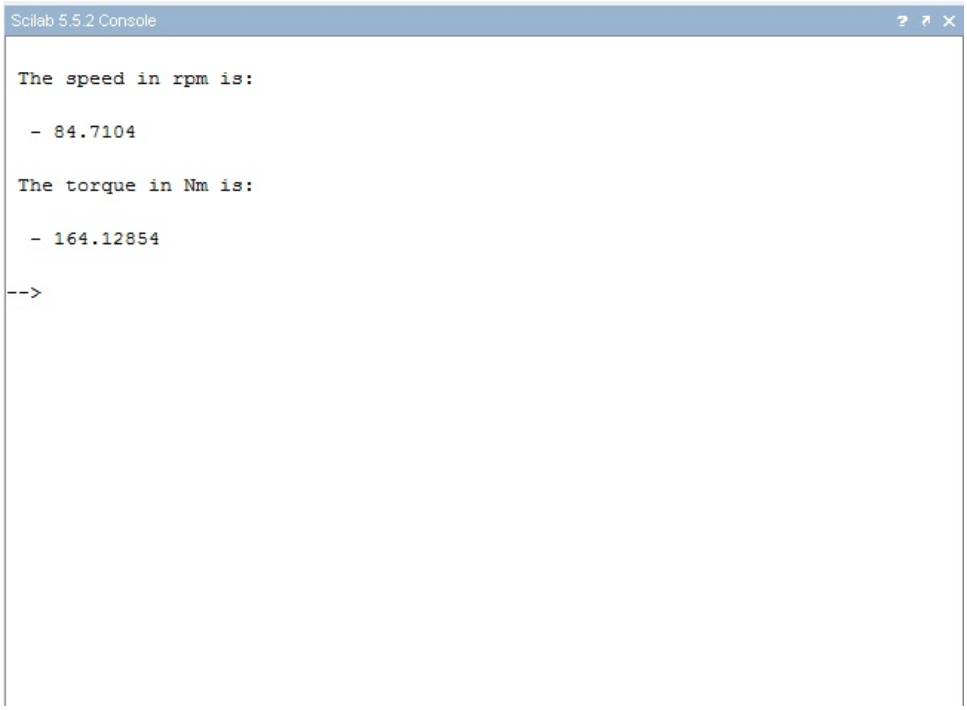

Figure 1.10: Determine the speed and torque of the motor

Figure 1.11: Compute direct on line starting torque and by a star delta starter

```
12 N1=480;//Speed in rpm
13 Vm=Rs*I;
14 Ia=I-((V-Vm)/2);
15 Em=-Vm-(Ia*R1);
16 N=-(Em/Eb)*N1;
17 disp(N,'The speed in rpm is:')
18 N2=-(2*%pi*N)/60;
19 T=(Em*Ia)/N2;
20 disp(T,'The torque in Nm is:')
```

Scilab code Exa 1.10 Compute direct on line starting torque and by a star delta st

```
1 //Electric Drives:concepts and applications by V.
    subrahmanyam
2 //Publisher:Tata McGraw-Hill
3 //Edition:Second
4 //Ex1_10
5 clc;
6 clear;
7 Sf=0.04;//Full load slip in %
8 Ist=1;//Starting current in A
9 If1=Ist/8;
10 T=(8)^2*Sf;
11 disp(T,"Direct on line starting torque in Nm is:")
12 S=T/3;
13 disp(S,"By Star/delta starter:")
```

Scilab code Exa 1.11 Determine the torque

```
1 //Electric Drives:concepts and applications by V.
    subrahmanyam
2 //Publisher:Tata McGraw-Hill
3 //Edition:Second
4 //Ex1_11
5 clc;
6 clear;
7 Sf1=0.04;//Full load slip in %
8 x=(8*3)^(1/2);
9 Tst=(x)^2*Sf1;
10 S=Sf1/2;
11 T=(8)^2*S;
12 disp(T,"Torque in Nm is:")
```

Figure 1.12: Determine the torque

Figure 1.13: Determine the torque

Scilab code Exa 1.12 Determine the torque

```
1 //Electric Drives:concepts and applications by V.
    subrahmanyam
2 //Publisher:Tata McGraw-Hill
3 //Edition:Second
4 //Ex1_12
5 clc;
6 clear;
7 Sf=0.04;//Full load slip in %
8 I=5;//Current in A
9 Tst=(I)^2*Sf;
10 x=((2/I)*100)^(1/2);
11 T=(2/I)^2*(I)^2*Sf;
12 disp(T,"Torque in Nm is:")
```

Scilab code Exa 1.13 Compute the impedence of motor and the breaking torque

```
1 //Electric Drives:concepts and applications by V.
    subrahmanyam
2 //Publisher:Tata McGraw-Hill
3 //Edition:Second
4 //Ex1_13
5 clc;
6 clear;
7 V=500;//Voltage in V
8 r1=0.13;//resistance in ohm
9 r2=0.32;//resistance in ohm
10 x1=0.6*%i;//reactance in ohm
11 x2=1.48*%i;//reactance in ohm
```

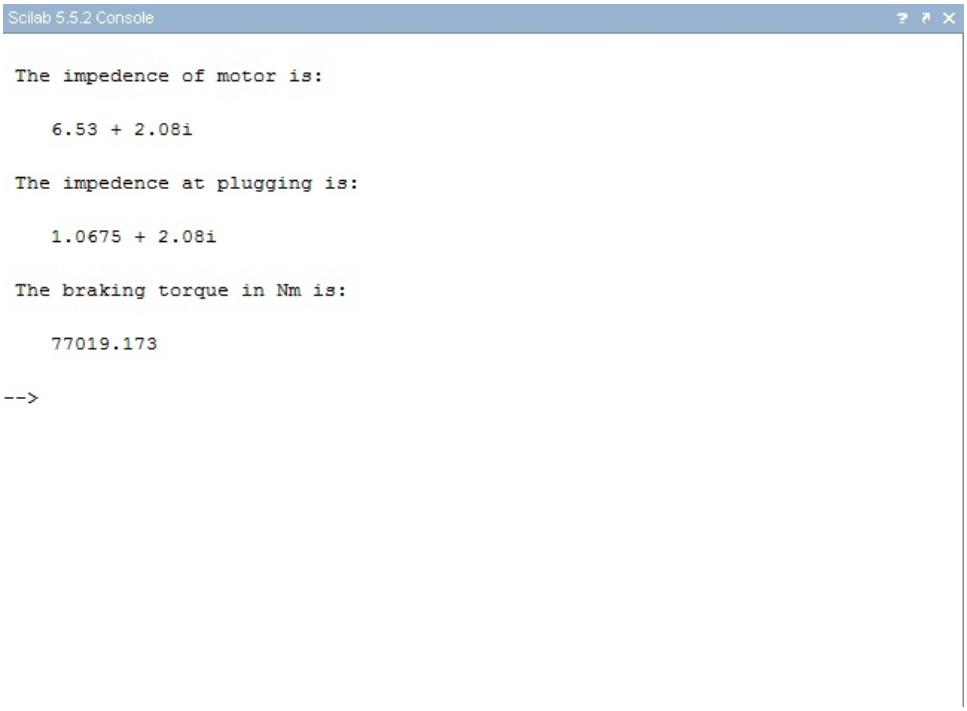

Figure 1.14: Compute the impedence of motor and the breaking torque

```
12 rm=250;//resistance in ohm
13 xm=20;//reactance in ohm
14 S=0.05;//Full load slip in %
15 Z2=r1+x1+(r2/S)+x2;
16 disp(Z2,"The impedence of motor is:")
17 I2=(V/(sqrt(3)*(6.853)));
18 T1=3*(I2)^2*(r2/S);
19 Sb=2-S;
20 Sf=2-S+r1;
21 Zb=r1+x1+(Sb/Sf)+x2;
22 disp(Zb,"The impedence at plugging is:")
23 I=(V/(sqrt(3)*(2.336)));
24 T2=3*(I)^2*(Sb/Sf);
25 T=T1+T2;
26 disp(T,"The braking torque in Nm is:")
```

Chapter 3

Converters for Feeding Electric Motors

Scilab code Exa 3.1 Determine the current in the load

```
1 //Electric Drives:concepts and applications by V.
    subrahmanyam
2 //Publisher:Tata McGraw-Hill
3 //Edition:Second
4 //Ex3_1
5 clc;
6 clear;
7 Rd=2;//Resistance in ohm
8 Eb=150;//Back emf in V
9 Vs=400;//Supply voltage in V
10 Alpha=0.52;//angle in radian
11 Vdia=((2*sqrt(2)*Vs*cos(Alpha))/%pi);
12 Id=(Vdia-Eb)/Rd;
13 Irms=Id/sqrt(2);
14 disp(Id,"Current in the load in A is:")
```

Figure 3.1: Determine the current in the load

Figure 3.2: Determine the firing angle of the converter

Scilab code Exa 3.2 Determine the firing angle of the converter

```
1 //Electric Drives:concepts and applications by V.
    subrahmanyam
2 //Publisher:Tata McGraw-Hill
3 //Edition:Second
4 //Ex3_2
5 clc;
6 clear;
7 Vs=400;//Supply voltage in V
8 Id=80.88;//Current in A
```

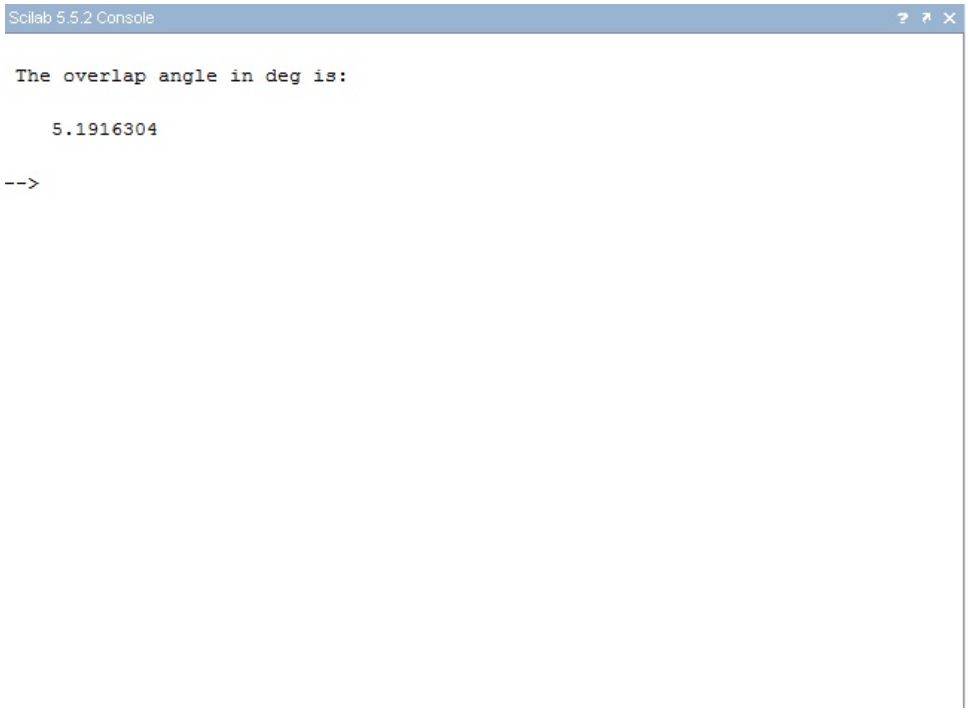

Figure 3.3: Determine the overlap angle

```
Rd=2;//Resistance in ohm
Eb=-150;//Back emf in V
Vdia=Id*Rd+Eb;
a=acos((Vdia*%pi)/(2*sqrt(2)*Vs));
Alpha=(a*180)/%pi;
disp(Alpha,"The firing angle in degree is:")
```

Scilab code Exa 3.3 Determine the overlap angle

```
//Electric Drives:concepts and applications by V.
   subrahmanyam
//Publisher:Tata McGraw-Hill
```

```
3 //Edition:Second
4 //Ex3_3
5 clc;
6 clear;
7 Id=80.88;//Current in A
8 Rd=2;//Resistance in ohm
9 Xc=0.628;//Reactance in ohm
10 Vs=400;//Supply voltage in V
11 Eb=150;//Back emf in V
12 Z=Id*(Rd+(Xc/%pi));
13 a=acos((Z-Eb)/(0.9*Vs));
14 Alpha=(a*180)/%pi;
15 c=cos(Alpha);
16 d=-c/11;
17 b=(Id*Xc*2)/(%pi*Vs);
18 X=d-b;
19 e=acos(X);
20 f=(e*180)/%pi;
21 u=f-Alpha;
22 disp(u,"The overlap angle in deg is:")
```

Scilab code Exa 3.4 Determine the average value of converter voltage and current a

```
1 //Electric Drives:concepts and applications by V.
    subrahmanyam
2 //Publisher:Tata McGraw-Hill
3 //Edition:Second
4 //Ex3_4
5 clc;
6 clear;
7 Vs=200;//Supply voltage in V
8 Rd=12.5;//Resistance in ohm
9 Xc=0.5;//Reactance in ohm
```

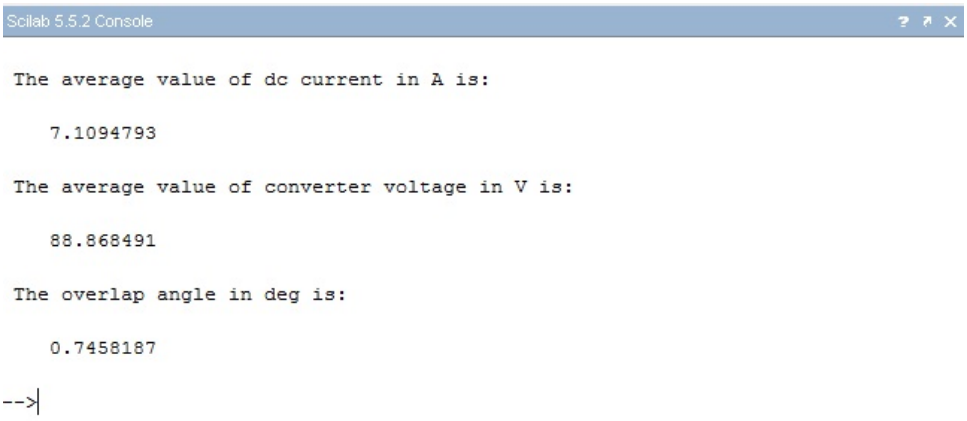

Figure 3.4: Determine the average value of converter voltage and current and overlap angle

```
pf=0.5;//Powerfactor
Vdia=0.9*Vs*pf;
Id=Vdia/(Rd+(Xc/%pi));
disp(Id,"The average value of dc current in A is:")
Vd=Id*Rd;
disp(Vd,"The average value of converter voltage in V
    is:")
Vc=Vdia-Vd;
X=pf-((Vc*2)/Vs);
c=acos(X);
d=(c*180)/%pi;
u=d-60;
disp(u,"The overlap angle in deg is:")
//Result vary due to error in calculation of overlap
    angle in the textbook
```

Scilab code Exa 3.5 Determine the average value of load current and overlap angle

```
//Electric Drives:concepts and applications by V.
   subrahmanyam
//Publisher:Tata McGraw-Hill
//Edition:Second
//Ex3_5
clc;
clear;
f=50;//Frequency in Hz
Rd=2.5;//Resistance in ohm
Lc=0.005;//Inductance in mH
Vs=220;//Supply voltage in V
pf=1;//Powerfactor
pf1=0.866;//Powerfactor
Xc=2*%pi*f*Lc;
Z=Rd+((2*Xc)/%pi);
```

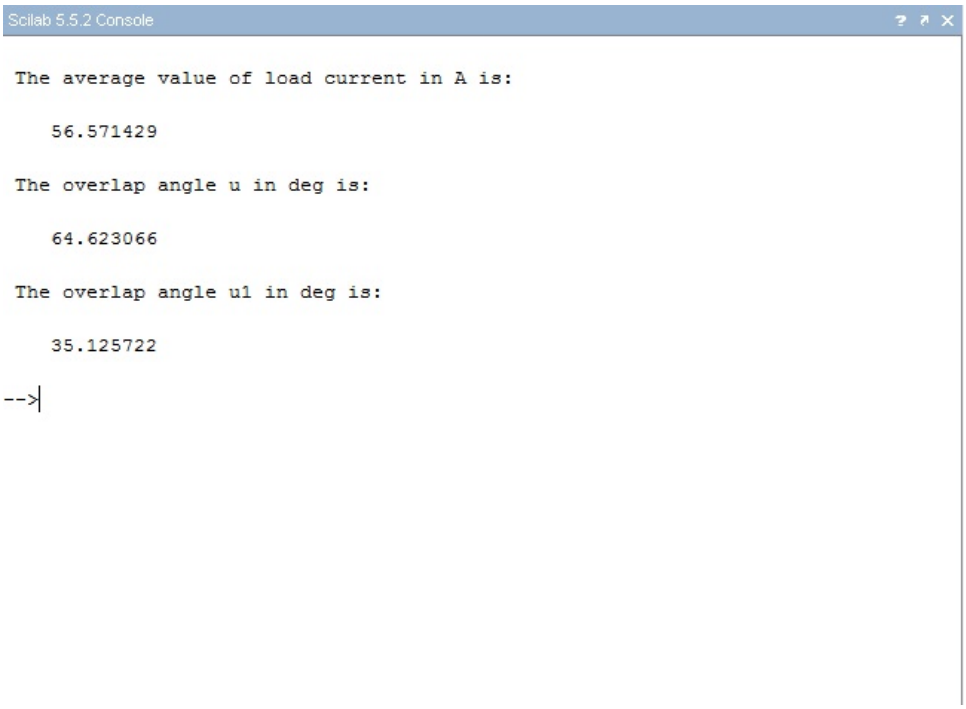

Figure 3.5: Determine the average value of load current and overlap angle

```
15 Vdia=0.9*Vs*pf;
16 Id=Vdia/Z;
17 disp(Id,"The average value of load current in A is:"
     )
18 Vd=Id*Rd;
19 Vdc=Vdia-Vd;
20 a=(1-((Vdc*2)/Vdia));
21 b=acos(a);
22 u=(b*180)/%pi;
23 disp(u,"The overlap angle u in deg is:")
24 Vdia1=0.9*Vs*pf1;
25 Id1=Vdia1/Z;
26 Vd1=Id1*Rd;
27 Vdc1=Vdia1-Vd1;
28 V=pf1-((Vdc1*2)/Vs);
29 c=acos(V);
30 d=(c*180)/%pi;
31 u1=d-30;
32 disp(u1,"The overlap angle u1 in deg is:")
33 //Result vary due to error in calculation of overlap
       angle in the textbook
```

Scilab code Exa 3.6 Determine the overlap angle

```
1 //Electric Drives:concepts and applications by V.
     subrahmanyam
2 //Publisher:Tata McGraw-Hill
3 //Edition:Second
4 //Ex3_6
5 clc;
6 clear;
7 Vs=220;//Supply voltage in V
8 f=50;//Frequency in Hz
```

Figure 3.6: Determine the overlap angle

```
Eb=-200;//Back emf in V
Rd=3;//Resistance in ohm
Vdc=200;// voltage in V
Xc=0.314;//Reactance in ohm
L=0.001;//Inductance in mH
pf=-0.5;//Powerfactor
Vdia=0.9*Vs*pf;
Id=(Vdia-Eb)/(Rd+((2*Xc)/%pi));
Vd=Id*Rd+Eb;
a=-pf+((Vd*2)/Vdc);
b=acos(a);
c=(b*180)/%pi;
u=c-120;
disp(u,"The overlap angle in deg is:")
//Result vary due to error in calculation of overlap
    angle in the textbook
```

Scilab code Exa 3.7 Determine the overlap angle

```
//Electric Drives:concepts and applications by V.
   subrahmanyam
//Publisher:Tata McGraw-Hill
//Edition:Second
//Ex3_7
clc;
clear;
Id=50;//Current in A
Vs=220;//Supply voltage in V
Vdio=257.4;// voltage in V
f=50;//Frequency in Hz
L=0.0015;//Inductance in mH
pf=0.866;//Powerfactor
Xc=2*%pi*f*L;
```

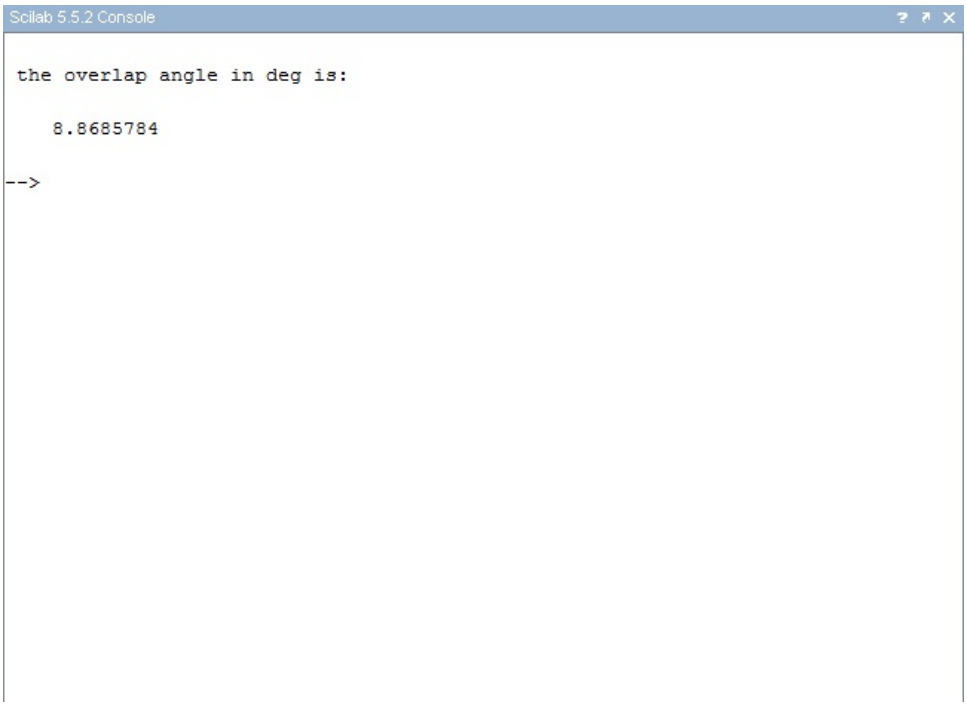

Figure 3.7: Determine the overlap angle

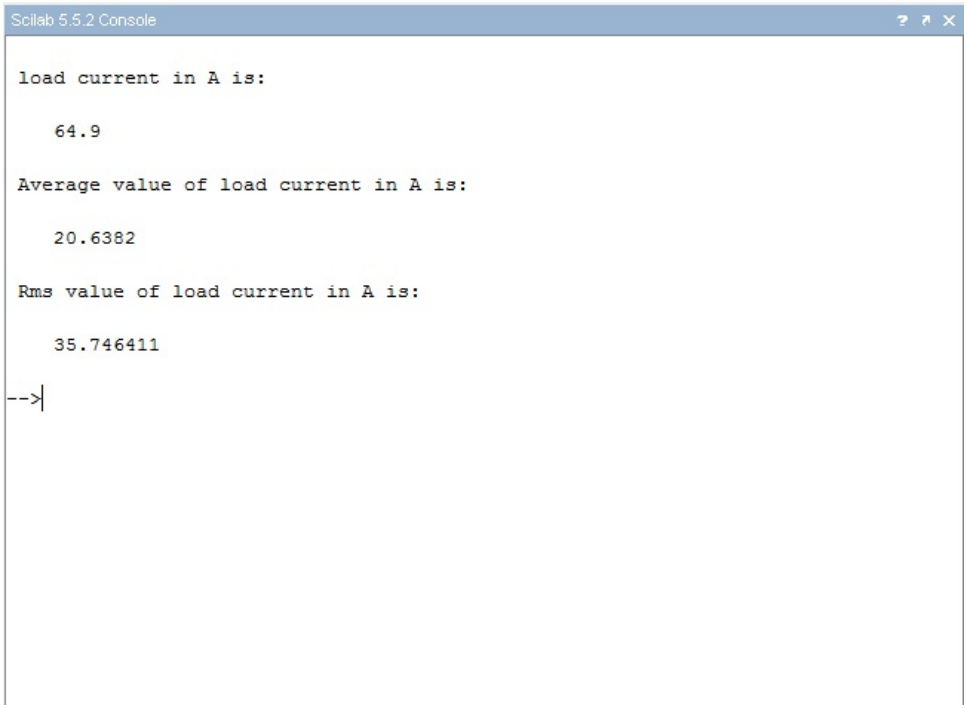

Figure 3.8: Determine the average and rms value of load current

```
14 Vdia=1.17*Vs*pf;
15 Vd=Vdia-((3*Id*Xc)/(2*%pi));
16 Vc=Vdia-Vd;
17 a=pf-((Vc*2)/Vdio);
18 b=acos(a);
19 c=(b*180)/%pi;
20 u=c-30;
21 disp(u,"the overlap angle in deg is:")
```

Scilab code Exa 3.8 Determine the average and rms value of load current

```
1 //Electric Drives:concepts and applications by V.
    subrahmanyam
2 //Publisher:Tata McGraw-Hill
3 //Edition:Second
4 //Ex3_8
5 clc;
6 clear;
7 Rd=2.5;//Resistance in ohm
8 V=250;// voltage in V
9 f=50;//Frequency in Hz
10 Vs=150;//Supply voltage in V
11 pf=-0.5;//Powerfactor
12 Eb=-250;//Back emf in V
13 Xc=0.636;//Reactance in ohm
14 Vdia=1.17*Vs*pf;
15 Id=(Vdia-Eb)/Rd;
16 disp(Id,"load current in A is:")
17 Ith=(Id*Xc)/2;
18 disp(Ith,"Average value of load current in A is:")
19 Irms=sqrt(3)*Ith;
20 disp(Irms,"Rms value of load current in A is:")
21 //Result vary due to error in calculation of current
    in the textbook
```

Scilab code Exa 3.9 Determine the overlap angle

```
1 //Electric Drives:concepts and applications by V.
    subrahmanyam
2 //Publisher:Tata McGraw-Hill
3 //Edition:Second
4 //Ex3_9
5 clc;
6 clear;
```

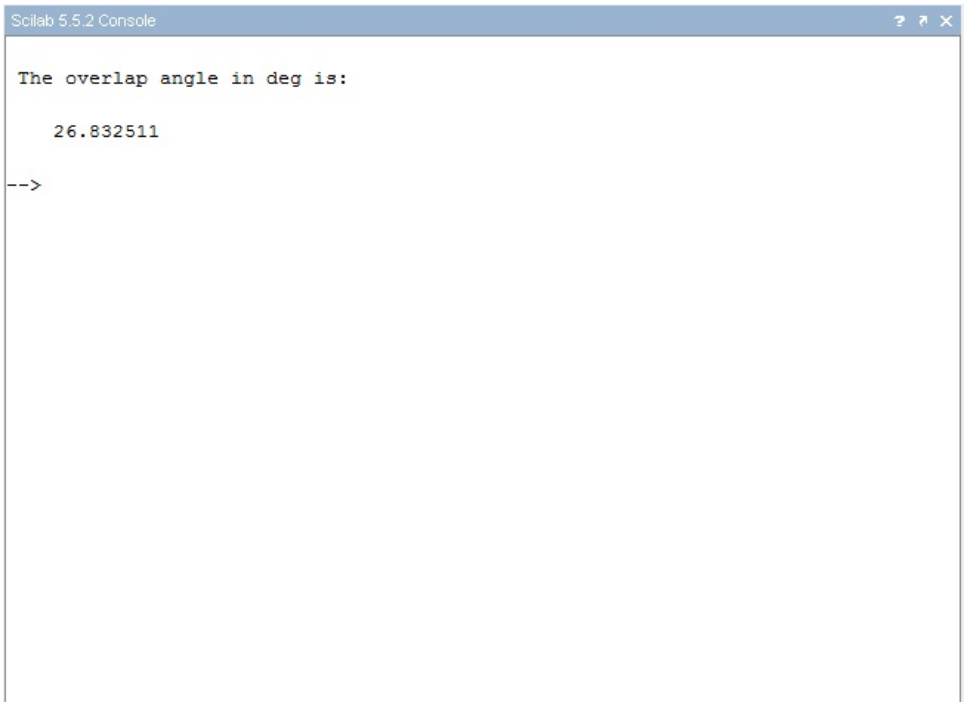

Figure 3.9: Determine the overlap angle

```
7 L=0.003;//Inductance in mH
8 Id=64.9;//Current in A
9 V=162.25;//voltage in V
10 Vs=150;//Supply voltage in V
11 f=50;//Frequency in Hz
12 Rd=2.5;//Resistance in ohm
13 Eb=-250;//Back emf in V
14 pf=-0.5;//Powerfactor
15 Xc=2*%pi*f*L;
16 Vdia=(Id*(Rd+((3*Xc)/(2*%pi))))+Eb;
17 a=Vdia/(1.17*Vs);
18 b=acos(a);
19 c=(b*180)/%pi;
20 Alpha=-0.3338;//angle in radian
21 X=(3*Id*Xc)/(%pi*Vs);
22 d=acos(Alpha-X);
23 e=(d*180)/%pi;
24 u=e-c;
25 disp(u,"The overlap angle in deg is:")
26 //Result vary due to error in calculation of overlap
    angle in the textbook
```

Scilab code Exa 3.10 Determine the average value of load voltage and current and p

```
1 //Electric Drives:concepts and applications by V.
   subrahmanyam
2 //Publisher:Tata McGraw-Hill
3 //Edition:Second
4 //Ex3_10
5 clc;
6 clear;
7 Vs=400;//Supply voltage in V
8 f=50;//Frequency in Hz
```

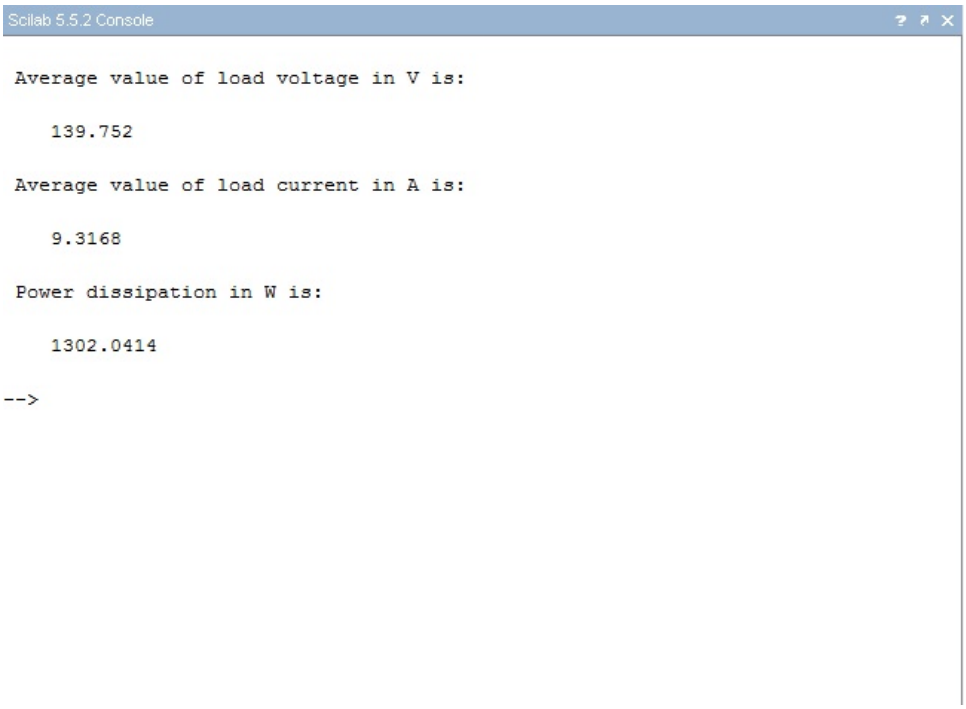

Figure 3.10: Determine the average value of load voltage and current and power dissipation

Figure 3.11: Determine the powerfactor

```
Rd=15;//Resistance in ohm
pf=0.2588;//Powerfactor
Vdia=1.35*Vs*pf;
disp(Vdia,"Average value of load voltage in V is:")
Id=Vdia/Rd;
disp(Id,"Average value of load current in A is:")
P=Vdia*Id;
disp(P,"Power dissipation in W is:")
```

Scilab code Exa 3.11 Determine the powerfactor

Figure 3.12: Determine the thyristor current

```
1  //Electric Drives:concepts and applications by V.
       subrahmanyam
2  //Publisher:Tata McGraw-Hill
3  //Edition:Second
4  //Ex3_11
5  clc;
6  clear;
7  Alpha=75;//angle in degree
8  a=cos(Alpha);
9  b=a/3.6;
10 pf=(3*b)/%pi;
11 disp(pf,"The power factor is:")
```

Scilab code Exa 3.12 Determine the thyristor current

```
1 //Electric Drives:concepts and applications by V.
    subrahmanyam
2 //Publisher:Tata McGraw-Hill
3 //Edition:Second
4 //Ex3_12
5 clc;
6 clear;
7 Vs=400;//Supply voltage in V
8 Id=9.317;//Current in A
9 pf=0.2588;//Powerfactor
10 Vth=sqrt(2)*Vs;
11 Ia=sqrt(2/3)*Id;
12 Ith=Ia/sqrt(2);
13 Imax=Ith/pf;
14 disp(Imax,"The max current in A is:")
```

Scilab code Exa 3.13 Determine the overlap angle

```
1 //Electric Drives:concepts and applications by V.
    subrahmanyam
2 //Publisher:Tata McGraw-Hill
3 //Edition:Second
4 //Ex3_14
5 clc;
6 clear;
7 t0=1.5;//Time in ms
8 t1=3;//Time in ms
9 Vs=200;//Supply voltage in V
```

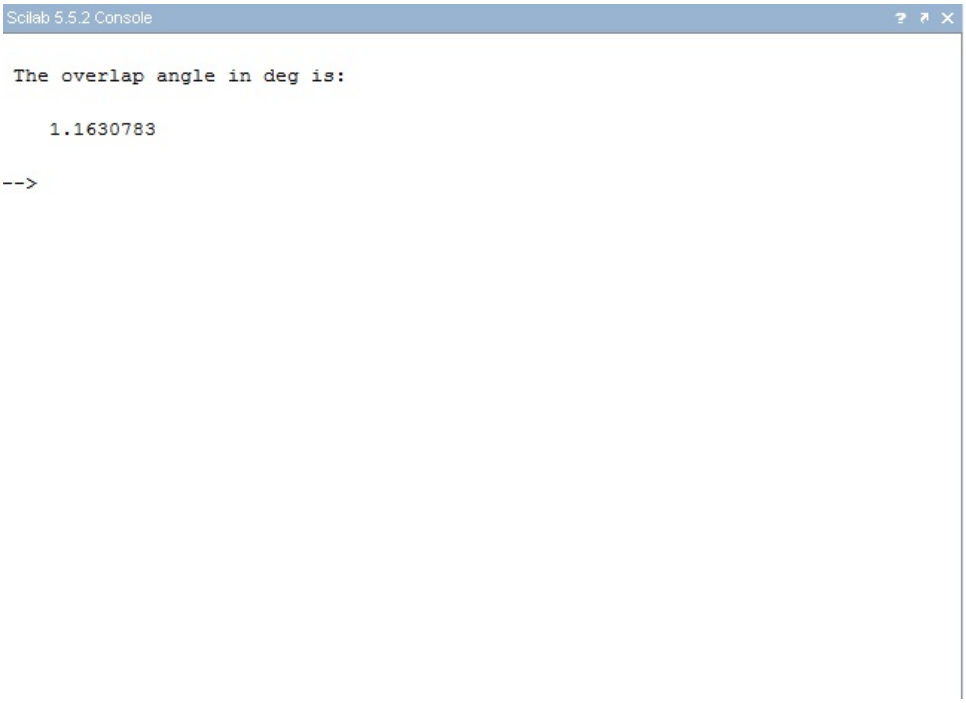

Figure 3.13: Determine the overlap angle

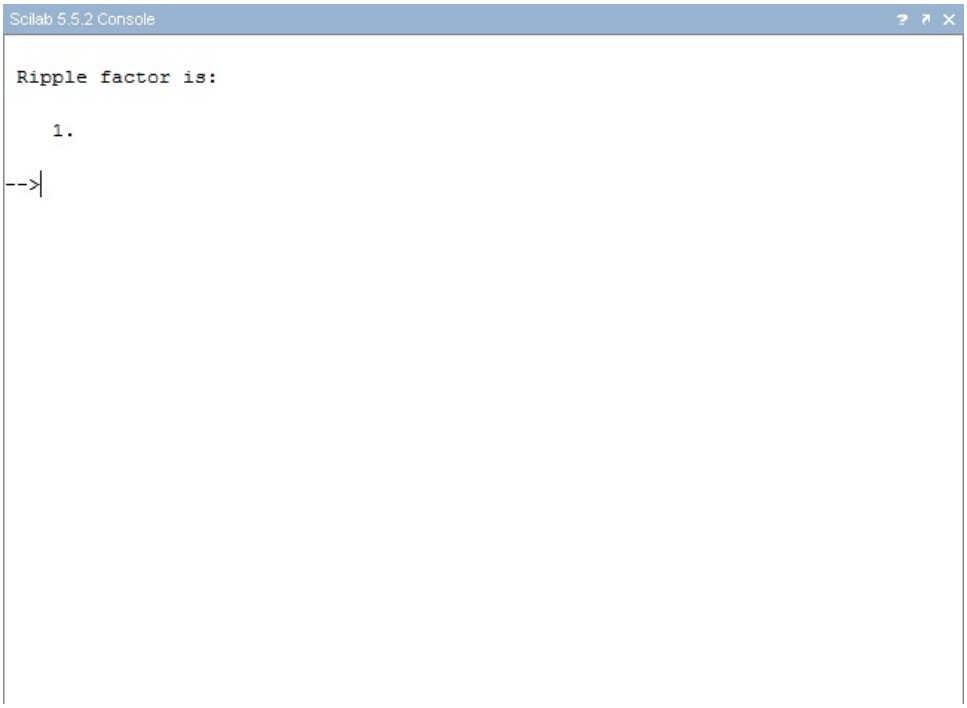

Figure 3.14: Determine the ripple factor

```
10 gama=t0/t1;
11 Vl=gama*Vs;
12 Vrms=sqrt(gama)*Vs;
13 Rf=(sqrt(1-gama))/(sqrt(gama));
14 disp(Rf,"Ripple factor is:")
```

Scilab code Exa 3.14 Determine the ripple factor

```
1 //Electric Drives:concepts and applications by V.
    subrahmanyam
2 //Publisher:Tata McGraw-Hill
3 //Edition:Second
```

Figure 3.15: Determine the maximum and minimum current

```
4  //Ex3_14
5  clc;
6  clear;
7  t0=1.5;//Time in ms
8  t1=3;//Time in ms
9  Vs=200;//Supply voltage in V
10 gama=t0/t1;
11 Vl=gama*Vs;
12 Vrms=sqrt(gama)*Vs;
13 Rf=(sqrt(1-gama))/(sqrt(gama));
14 disp(Rf,"Ripple factor is:")
```

Scilab code Exa 3.15 Determine the maximum and minimum current

```
1 //Electric Drives:concepts and applications by V.
    subrahmanyam
2 //Publisher:Tata McGraw-Hill
3 //Edition:Second
4 //Ex3_15
5 clc;
6 clear;
7 R=1.5;//Resistance in ohm
8 L=3;//Inductance in H
9 Ton=2;//Time in ms
10 T=6;//Time in ms
11 Vs=150;//Supply voltage in V
12 t=Ton/T;
13 tON=L/R;
14 Vavg=T*Vs;
15 Iavg=Vavg/R;
16 P=(Iavg)^2*R;
17 Io=23.032;
18 I=1-exp(-t);
19 I1=Io*exp(-t);
20 Imax=(Vs/R)*I+I1;
21 disp(Imax,"Maximum current in A is:")
22 Imin=Imax*exp(-2*t);
23 disp(Imin,"Minimum current in A is:")
```

Chapter 4

Control of Electric Motors

Scilab code Exa 4.1 Determine the average value of current

```
1 //Electric Drives:concepts and applications by V.
    subrahmanyam
2 //Publisher:Tata McGraw-Hill
3 //Edition:Second
4 //Ex4_1
5 clc;
6 clear;
7 Eb=50;// voltage in V
8 V=120;// voltage in V
9 f=50;//frequency in Hz
10 R=10;// Resistance in ohm
11 a=asin(Eb/(sqrt(2)*V));
12 Alpha=(a*180)/%pi;
13 pf=0.9556;
14 Iavg=(1/(2*%pi*R))*((2*sqrt(2)*V*pf)-(Eb*(%pi-(2*
    Alpha))));
15 disp(Iavg,"Current Iavg in A is:")
```

Figure 4.1: Determine the average value of current

Figure 4.2: Determine the efficiency

Scilab code Exa 4.3 Determine the efficiency

```
1 //Electric Drives:concepts and applications by V.
    subrahmanyam
2 //Publisher:Tata McGraw-Hill
3 //Edition:Second
4 //Ex4_3
5 clc;
6 clear;
7 P=10000;
8 V=240;// voltage in V
```

```
N=1000;//Speed in rpm
Eff1=0.87;//Efficiency in %
Vs=250;// voltage in V
f=50;//frequency in Hz
Alpha=0.5;//angle
R=0.40;// Resistance in ohm
Fdf=1;//fundamental displacement factor
df=0.9;//distortion factor
pf=0.9;//the power factor
Pi=P/Eff1;
I=Pi/V;
Eb=V-(I*R);
Vi=0.9*Vs;
Eb1=Vi-(I*R);
N1=(Eb1/Eb)*N;
Pi1=V*I*pf*(10)^(-3);
Pi2=(Pi1*N1)/N;
Vc=0.9*Vs*Alpha;
Eb2=Vc-(I*R);
N2=(N*Eb2)/Eb;
P0=((Pi1*N2)/N)*1000;
Pi0=Vc*I;
Eff=(P0/Pi0)*100;
disp(Eff,"Efficiency in % is:")
//Result vary due to roundoff error
```

Scilab code Exa 4.4 Determine the powerfactor

```
//Electric Drives:concepts and applications by V.
   subrahmanyam
//Publisher:Tata McGraw-Hill
//Edition:Second
//Ex4_4
```

Figure 4.3: Determine the powerfactor

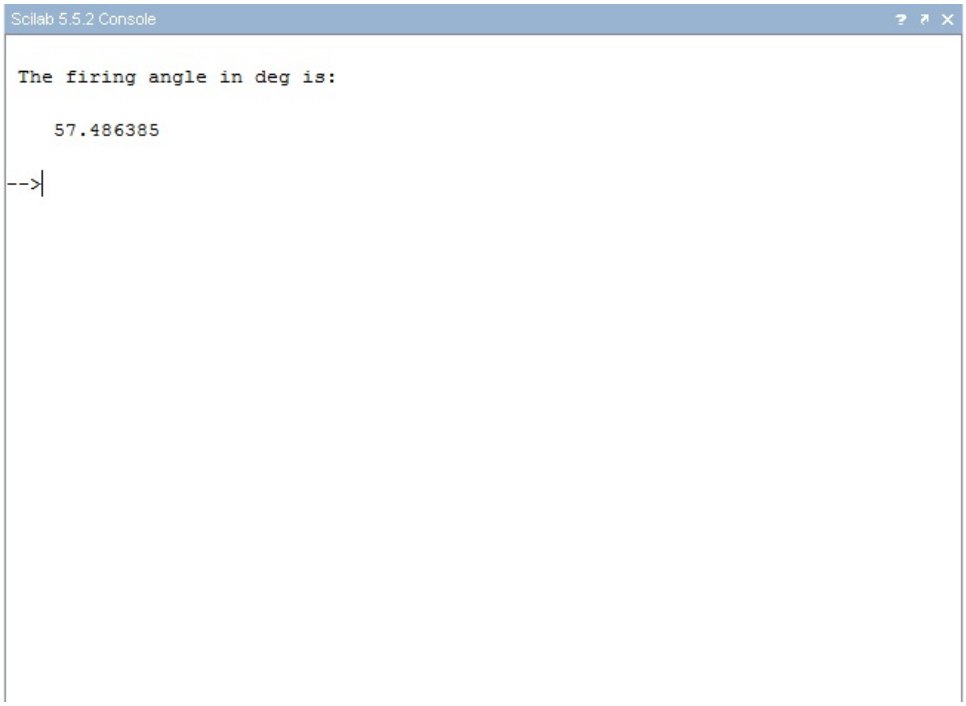

Figure 4.4: Determine the firing angle

```
clc;
clear;
V=250;// voltage in V
f=50;//frequency in Hz
R=1.5;// Resistance in ohm
L=30;//inductance in mH
Eb=100;//Back emf in V
Alpha=0.866;//angle
Vc=0.9*V*Alpha;
Id=(Vc-Eb)/R;
P=Vc*Id*10^(-3);
pf=0.9*Alpha;
disp(pf,"powerfactor is:")
```

Scilab code Exa 4.5 Determine the firing angle

```
1 //Electric Drives:concepts and applications by V.
    subrahmanyam
2 //Publisher:Tata McGraw-Hill
3 //Edition:Second
4 //Ex4_5
5 clc;
6 clear;
7 N=1800;//Speed in rpm
8 I=60;//Current in A
9 V=400;// voltage in V
10 E=185;//Back emf in V
11 N2=900;//Speed in rpm
12 R=0.5;// Resistance in ohm
13 Vs=V/2.34;
14 Vl=V/1.35;
15 Vi=V-(I*R);
16 V=E+(I*R);
17 a=acos(V/(2.34*Vs));
18 Alpha=(a*180)/%pi;
19 disp(Alpha,"The firing angle in deg is:")
```

Scilab code Exa 4.6 Determine the firing angle

```
1 //Electric Drives:concepts and applications by V.
    subrahmanyam
2 //Publisher:Tata McGraw-Hill
3 //Edition:Second
4 //Ex4_6
```

Figure 4.5: Determine the firing angle

```
clc;
clear;
V=500;// voltage in V
Vs=250;// voltage in V
I=181;//Current in A
N=1500;//Speed in rpm
R=0.1;// Resistance in ohm
f=50;//frequency in Hz
Eb=Vs-(I*R);
Eb1=Eb/3;
A1=acos(Vs/(1.35*V));
Alpha1=(A1*180)/%pi;
Ia2=I/9;
V2=Eb1+(Ia2*R);
A2=acos(V2/(1.35*V));
Alpha2=(A2*180)/%pi;
Vl=Vs/1.35;
A3=acos(V2/(1.35*Vl));
Alpha3=(A3*180)/%pi;
disp(Alpha3,"The firing angle in deg is:")
```

Scilab code Exa 4.7.a Determine the firing angle

```
//Electric Drives:concepts and applications by V.
   subrahmanyam
//Publisher:Tata McGraw-Hill
//Edition:Second
//Ex4_7a
clc;
clear;
V=300;// voltage in V
Vt=363.25;// voltage in V
f=60;//frequency in Hz
```

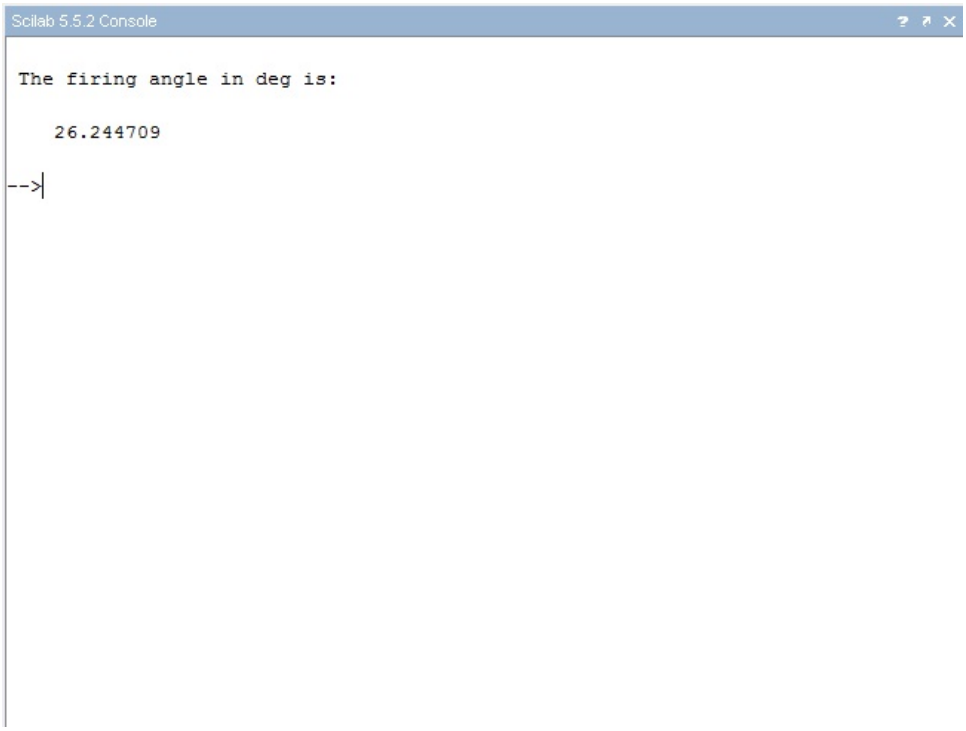

Figure 4.6: Determine the firing angle

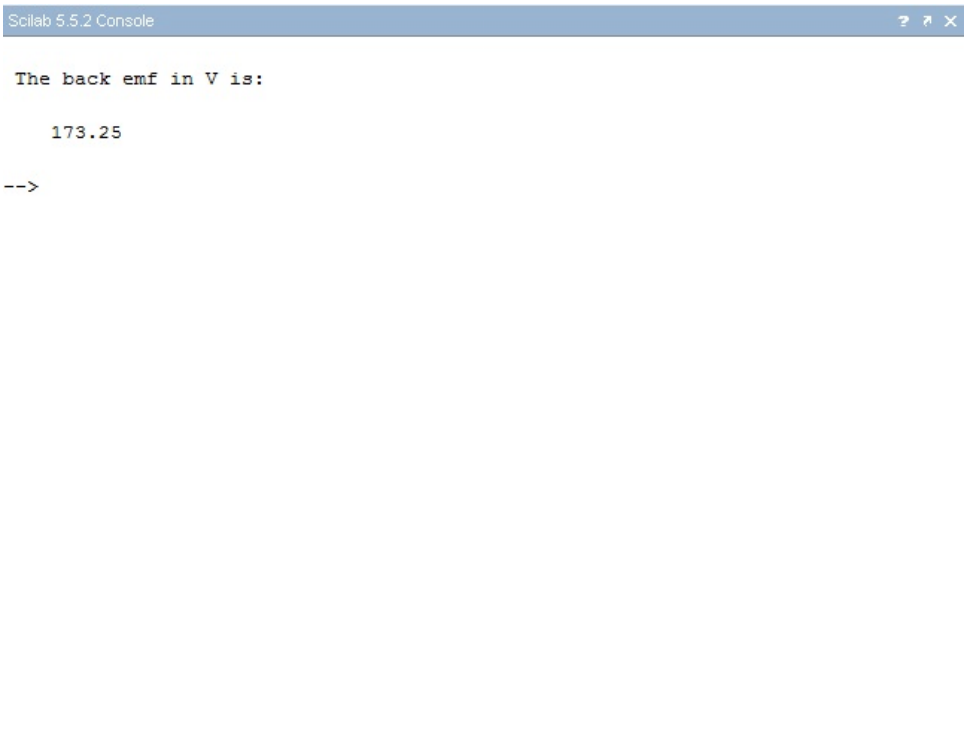

Figure 4.7: Determine the back emf voltage

```
10 Rd=0.02;// Resistance in ohm
11 La=0.002;//inductance in H
12 Id=500;//Current in A
13 N=1500;//Speed in rpm
14 Eb=Vt-(Id*Rd);
15 A=acos(Vt/(1.35*V));
16 Alpha=(A*180)/%pi;
17 disp(Alpha,"The firing angle in deg is:")
```

Scilab code Exa 4.7.b Determine the back emf voltage

```
1 //Electric Drives:concepts and applications by V.
    subrahmanyam
2 //Publisher:Tata McGraw-Hill
3 //Edition:Second
4 //Ex4_7b
5 clc;
6 clear;
7 V=300;// voltage in V
8 Vt=363.25;// voltage in V
9 f=60;//frequency in Hz
10 Rd=0.02;// Resistance in ohm
11 La=0.001;//inductance in H
12 Id=500;//Current in A
13 N=1500;//Speed in rpm
14 Xc=2*%pi*f*La;
15 Z=Rd+((3*Xc)/%pi);
16 Eb=Vt-(Id*Z);
17 disp(Eb,"The back emf in V is:")
```

Scilab code Exa 4.8 Determine the constant

```
1 //Electric Drives:concepts and applications by V.
    subrahmanyam
2 //Publisher:Tata McGraw-Hill
3 //Edition:Second
4 //Ex4_8
5 clc;
6 clear;
7 V=600;// voltage in V
8 R=0.16;// Resistance in ohm
9 Ia=210;//Current in A
10 N=600;//Speed in rpm
11 n=10;//no of unit
```

Figure 4.8: Determine the constant

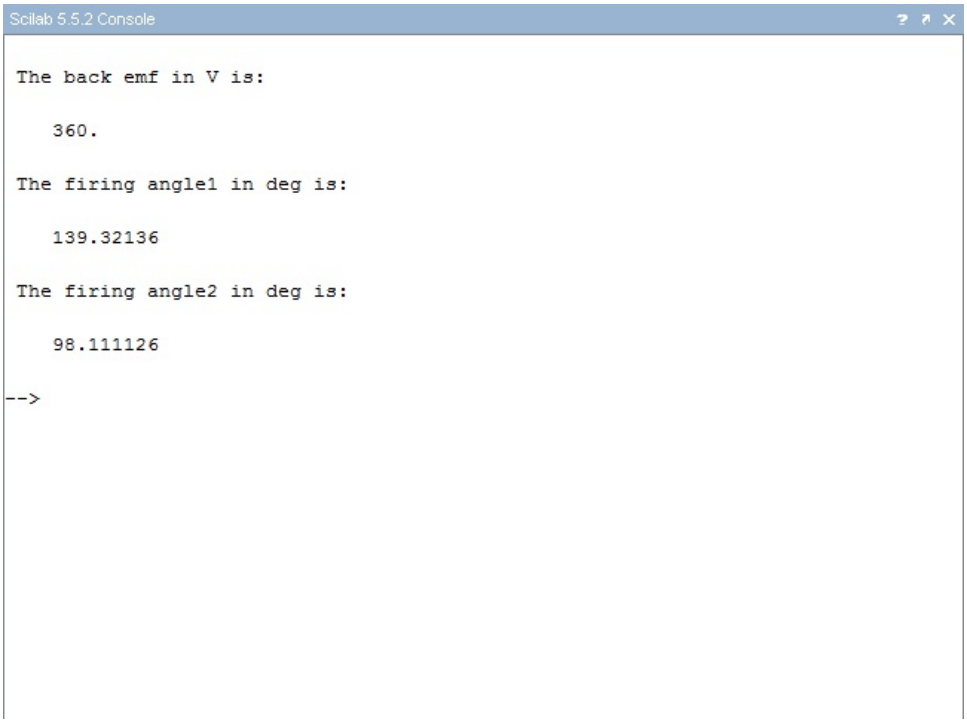

Figure 4.9: Determine the back emf and firing angle

```
12 Eb=V-(Ia*R);
13 Td=((Eb*Ia)/(2*%pi*n));
14 W=(2*%pi*N)/60;
15 A=Td/(W)^2;
16 disp(A,"The constant A is:")
```

Scilab code Exa 4.9 Determine the back emf and firing angle

```
1 //Electric Drives:concepts and applications by V.
    subrahmanyam
2 //Publisher:Tata McGraw-Hill
```

```
3 //Edition:Second
4 //Ex4_9
5 clc;
6 clear;
7 V1=500;// voltage in V
8 V2=450;// voltage in V
9 Vs=420;// voltage in V
10 V=400;// voltage in V
11 I=60;//Current in A
12 R=1.5;// Resistance in ohm
13 R1=5;// Resistance in ohm
14 Eb=20;//Back emf in V
15 f=50;//frequency in Hz
16 Vl=V2+Eb;
17 A=acos(Vl/(1.35*Vs));
18 Alpha1=(A*180)/%pi;
19 Eb1=V2-(I*R);
20 disp(Eb1,"The back emf in V is:")
21 V3=-V2-(I*R);
22 Vc=-V2+Eb;
23 A1=acos(Vc/(1.35*Vs));
24 Alpha2=(A1*180)/%pi;
25 disp(Alpha2,"The firing angle1 in deg is:")
26 Eb2=-V-(I*R);
27 Vc1=-V+Eb+(R1*I);
28 A2=acos(Vc1/(1.35*Vs));
29 Alpha3=(A2*180)/%pi;
30 disp(Alpha3,"The firing angle2 in deg is:")
```

Scilab code Exa 4.10 Determine the inductance

```
1 //Electric Drives:concepts and applications by V.
    subrahmanyam
```

Figure 4.10: Determine the inductance

```
2 //Publisher:Tata McGraw-Hill
3 //Edition:Second
4 //Ex4_10
5 clc;
6 clear;
7 V=500;// voltage in V
8 I=15;//Current in A
9 t=0.6;//time in sec
10 f=80;//frequency in Hz
11 Vav=V*t;
12 Vi=V-Vav;
13 Ton=t/f;
14 L=Vi*(Ton/I);
15 disp(L,"The inductance in Henry is:")
```

Scilab code Exa 4.12 Determine the current

```
1 //Electric Drives:concepts and applications by V.
    subrahmanyam
2 //Publisher:Tata McGraw-Hill
3 //Edition:Second
4 //Ex4_12
5 clc;
6 clear;
7 V=460;// voltage in V
8 N1=1200;//Speed in rpm
9 N2=1000;//Speed in rpm
10 r1=0.06;// Resistance in ohm
11 r2=0.32;// Resistance in ohm
12 x1=2.16;//Reactance in ohm
13 x2=0.48;//Reactance in ohm
14 x=0.6*%i;//Reactance in ohm
15 xm=8*%i;//Reactance in ohm
```

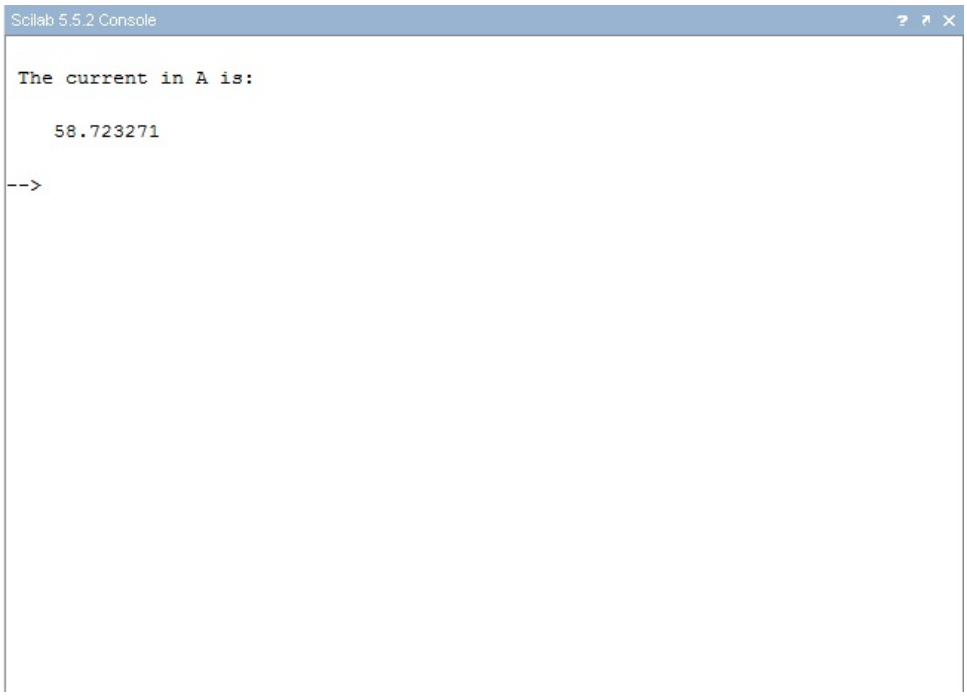

Figure 4.11: Determine the current

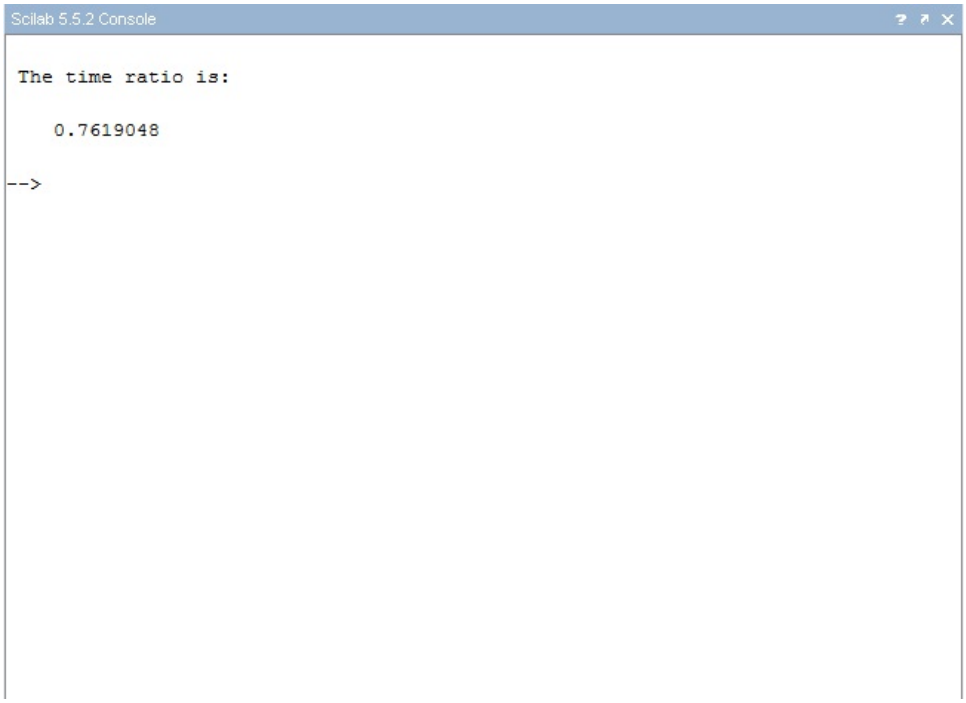

Figure 4.12: Determine the time ratio

```
16 S1=(N1-N2)/N1;
17 Z=(xm+(x1+x))/(x1+xm+x);
18 [M, P] = polar(Z);
19 M * exp(%i * P);
20 disp(Z,"z:")
```

Scilab code Exa 4.14 Determine the time ratio

```
1 //Electric Drives:concepts and applications by V.
    subrahmanyam
2 //Publisher:Tata McGraw-Hill
3 //Edition:Second
```

```
4 //Ex4_14
5 clc;
6 clear;
7 V=440;// voltage in V
8 R1=0.07;// Resistance in ohm
9 R2=0.05;// Resistance in ohm
10 X=0.2;//Reactance in ohm
11 N=1420;//Speed in rpm
12 Xm=20;//Reactance in ohm
13 S1=80;//slip in rpm
14 S2=500;//slip in rpm
15 Ra=((S2/S1)*R2)-R2;
16 R=2*Ra;
17 Ra1=4*R2;
18 T=(Ra1*2)/R;
19 disp(T,"The time ratio is:")
```

Scilab code Exa 4.15 Determine the firing angle

```
1 //Electric Drives:concepts and applications by V.
    subrahmanyam
2 //Publisher:Tata McGraw-Hill
3 //Edition:Second
4 //Ex4_15
5 clc;
6 clear;
7 P=1000;
8 N=1500;//Speed in rpm
9 R2=0.06;// Resistance in ohm
10 I2=125.6;//Current in A
11 T=1.5;//Time in sec
12 N1=1420;//Speed in rpm
13 S=(R2*P)/N;
```

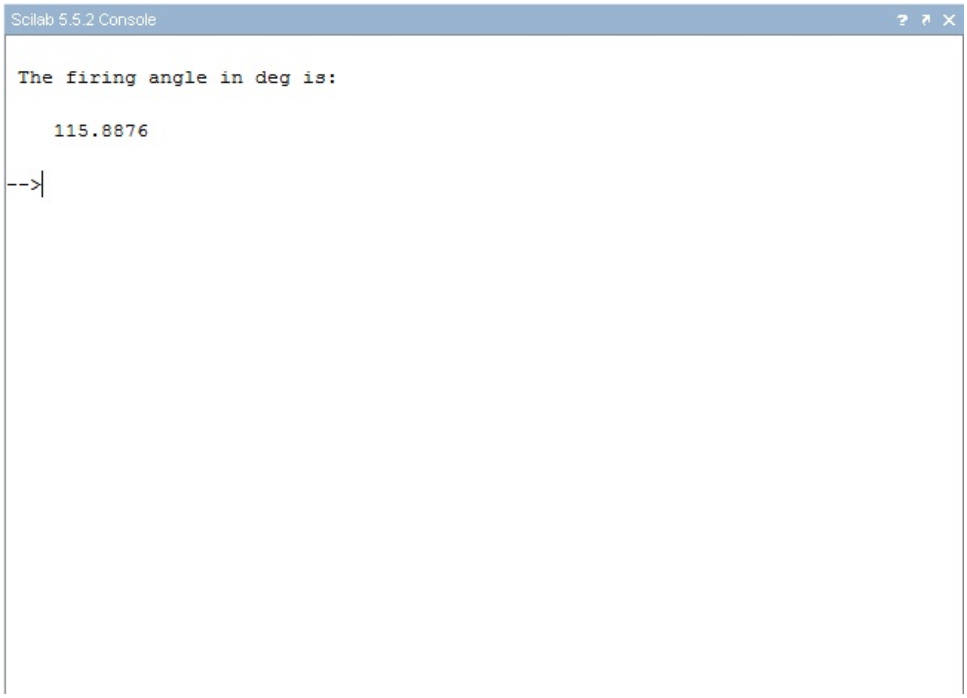

Figure 4.13: Determine the firing angle

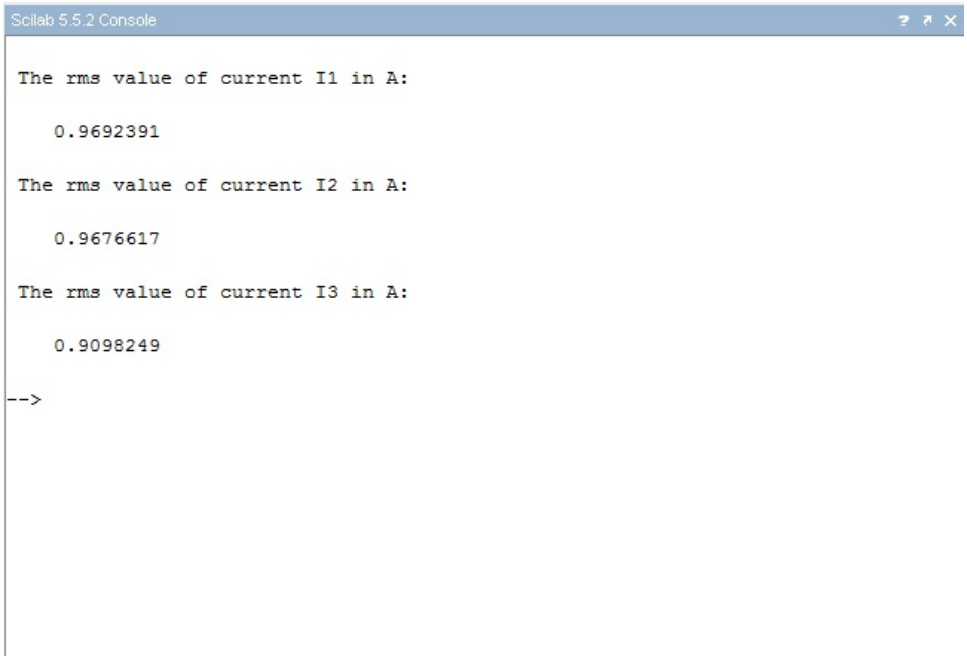

Figure 4.14: Determine the rms value of current

```
14 K=((S/(2*%pi*N))*(I2)^2*T)/(N1)^2;
15 T1=K*(N1)^2;
16 N2=750;//Speed in rpm
17 S0=0.489;//No load slip
18 S2=1.12;//load slip
19 T2=K*(N2)^2;
20 X1=(T2*S)/T1;
21 A=acos(-S0/S2);
22 Alpha=(A*180)/%pi;
23 disp(Alpha,"The firing angle in deg is:")
```

Scilab code Exa 4.19 `Determine the rms value of current`

```
1  //Electric Drives:concepts and applications by V.
      subrahmanyam
2  //Publisher:Tata McGraw-Hill
3  //Edition:Second
4  //Ex4_19
5  clc;
6  clear;
7  V=400;// voltage in V
8  R1=10;// Resistance in ohm
9  R2=5;// Resistance in ohm
10 X1=2.6*%i;//Reactance in ohm
11 X2=2.4*%i;//Reactance in ohm
12 Xm=36.4*%i;//Reactance in ohm
13 Z=0.06;//zigma value
14 C=486;//constant
15 F4=2.5;//frequency in Hz
16 F2=25;//frequency in Hz
17 Z1=(1+X1)+((Xm*(R1+X2))/(R1+X2+Xm));
18 [M, P] = polar(Z1);
19 M * exp(%i * P);
20 Ieff1=sqrt(1+(M/(Z*Xm))^2*(((R2*(%pi)^4)/C)-1));
21 disp(Ieff1,"The rms value of current I1 in A:")
22 Z2=(1+(X1/2))+(((Xm/2)*((R1/2)+(X2/2)))/((R1/2)+X2+(
      Xm/2)));
23 [M, P] = polar(Z2);
24 M * exp(%i * P);
25 Ieff2=sqrt(1+(M/(Z*(Xm/2)))^2*(((R2*(%pi)^4)/C)-1));
26 disp(Ieff2,"The rms value of current I2 in A:")
27 S=(F4/F2);
28 Z3=(1+(X1*S))+(((Xm*S)*((R1*S)+(X2*S)))/((R1*S)+(X2*
      S)+(Xm*S)));
29 [M, P] = polar(Z3);
30 M * exp(%i * P);
31 Ieff3=sqrt(1+(M/(Z*(Xm*S)))^2*(((R2*(%pi)^4)/C)-1));
32 disp(Ieff3,"The rms value of current I3 in A:")
```

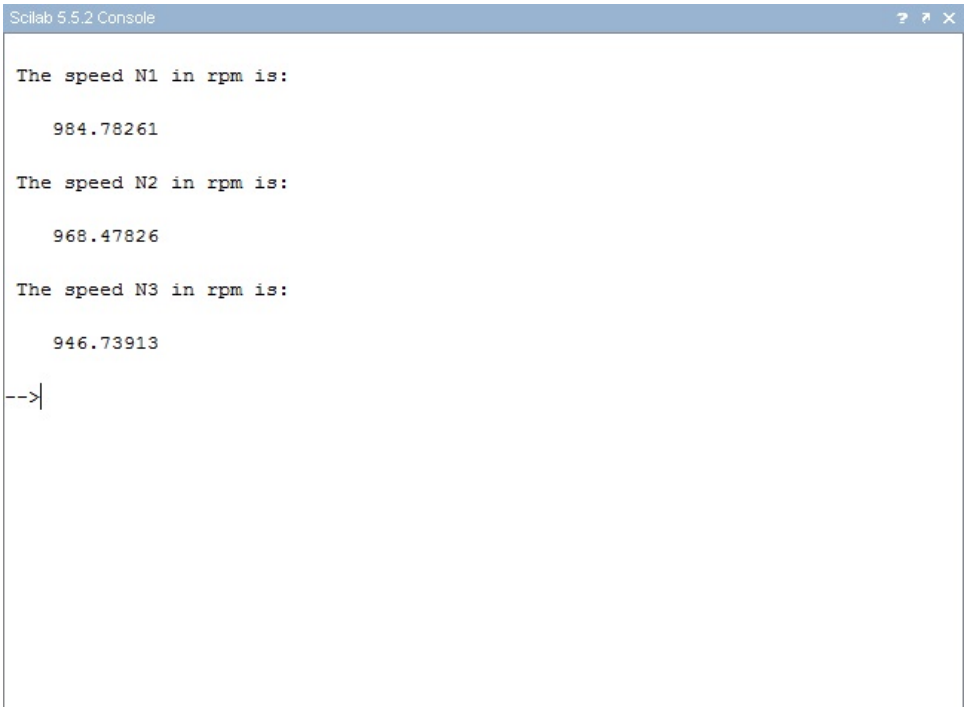

Figure 4.15: Determine the speed

Scilab code Exa 4.20 `Determine the speed`

```
1 //Electric Drives:concepts and applications by V.
    subrahmanyam
2 //Publisher:Tata McGraw-Hill
3 //Edition:Second
4 //Ex4_20
5 clc;
6 clear;
7 R=0.05;// Resistance in ohm
8 N0=1000;//Speed in rpm
```

```
Rf=46;// Resistance in ohm
I1=75;//Current in A
I2=150;//Current in A
I3=250;//Current in A
V=230;// voltage in V
Eb=230;//Back emf in V
If=V/Rf;
Ia1=I1-If;
Eb1=V-(Ia1*R);
N1=(Eb1/Eb)*N0;
disp(N1,"The speed N1 in rpm is:")
Ia2=I2-If;
Eb2=V-(Ia2*R);
N2=(Eb2/Eb)*N0;
disp(N2,"The speed N2 in rpm is:")
Ia3=I3-If;
Eb3=V-(Ia3*R);
N3=(Eb3/Eb)*N0;
disp(N3,"The speed N3 in rpm is:")
```

Chapter 5

Rating and Heating of Motors

Scilab code Exa 5.1 Determine the temperature

```
1 //Electric Drives:concepts and applications by V.
    subrahmanyam
2 //Example:5.1
3 clc;
4 clear;
5 theta1=60;//Temperature rise of motor in degree
6 theta2=40;//Temperature rise of motor in degree
7 e=0.5;//exponential value
8 I1=110;//current in A
9 I2=125;//current in A
10 t1=4;//Time in hour
11 t2=8;//Time in hour
12 theta=theta1/theta2;
13 tough=-(1/log(0.5));
14 thetam1=theta2/e;
15 thetam2=thetam1*(I2/I1)^2;
16 x=t1/(theta1*tough);
17 a=exp(-x);
18 y=t2/(theta1*tough);
```

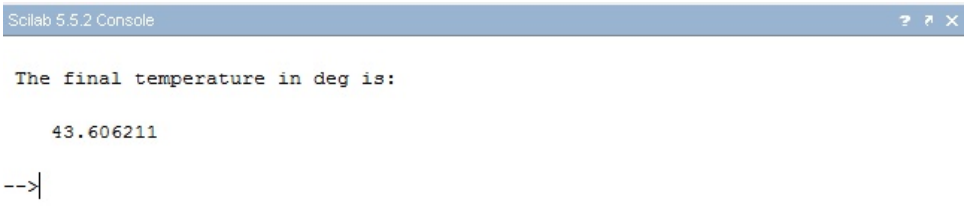

Figure 5.1: Determine the temperature

Figure 5.2: Determine the overloading

```
19 b=exp(-y);
20 thetam=I2*((1-a)/(1-(a*b)));
21 disp(thetam,"The final temperature in deg is:")
```

Scilab code Exa 5.2 Determine the overloading

```
1 //Electric Drives:concepts and applications by V.
    subrahmanyam
2 //Publisher:Tata McGraw-Hill
3 //Edition:Second
4 //Ex5_2
5 clc;
```

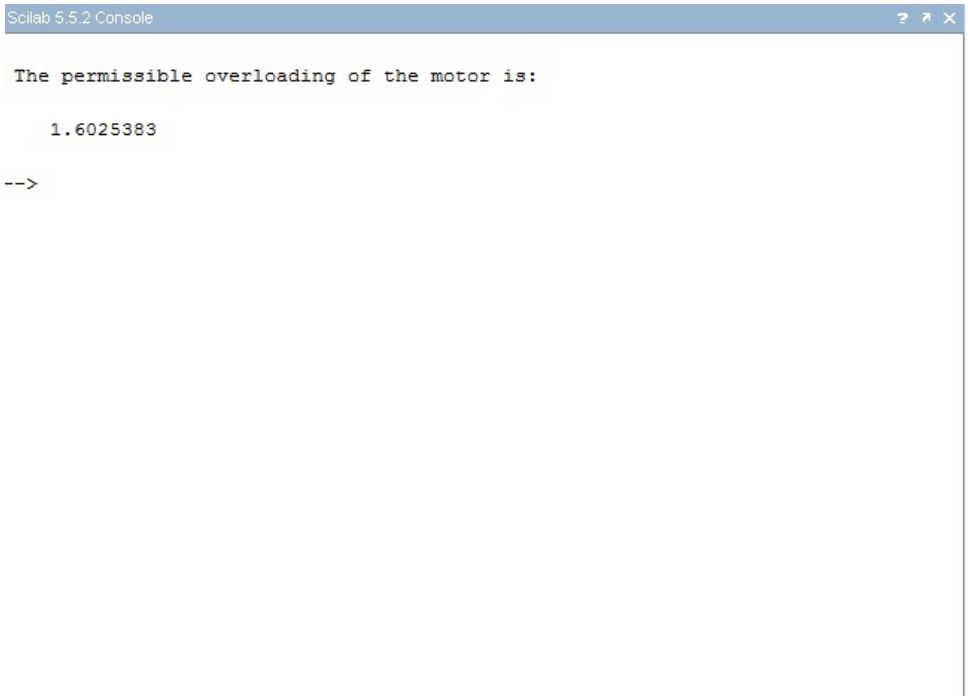

Figure 5.3: Determine the overloading

```
6  clear;
7  T=100;//Temperature rise of motor in degree
8  t1=2;//Time in hour
9  t2=1.5;//Time in hour
10 Alpha=0.5;//Angle in rad
11 e=exp(-t1/t2);
12 thetam=100/(1-e);
13 t=thetam/T;
14 x=sqrt((t*(Alpha+1))-Alpha);
15 disp(x,"The permissible overloading is:")
```

Scilab code Exa 5.3 `Determine the overloading`

```
1  //Electric Drives:concepts and applications by V.
     subrahmanyam
2  //Publisher:Tata McGraw-Hill
3  //Edition:Second
4  //Ex5_3
5  clc;
6  clear;
7  Alpha=0.4;//Angle in rad
8  T1=100;//Temperature rise of motor in degree
9  T2=150;//Temperature rise of motor in degree
10 P=125;//Power in KW
11 t1=15;//Time in hour
12 t2=30;//Time in hour
13 x=-t1/T1;
14 a=exp(x);
15 y=-t2/T2;
16 b=exp(y);
17 p=sqrt(((Alpha+1)*(1-(a*b)))/(1-a)-Alpha);
18 disp(p,"The permissible overloading of the motor is:
     ")
```