Circuit analysis using “Symbolic math” in Matlab

* Linear equation

Last week, I introduced symbolic math to solve symbolic parameter equations. Let’s remind us.

Given

Then

syms x y a

f = a\*x + 2\*y;

g =2\*x +y;

eqn =[f == 5, g == 4];

S =solve(eqn,x,y);

S.x

S.y

subs(S.x,a,2)

Matlab gives answer as

If , S.x = 3/2.

But if the equations are linear(in this case is linear), it is good to use following commands as

syms x y a

A =[a 2; 2 1];

B = [ 5;4];

X =A\B

X(1)

X(2)

subs(X(1),a,2)

which gives the same answers. The operator **“ \ “** may be remembered as

More importantly, , if does not exist, then the best linear estimator for

Is .

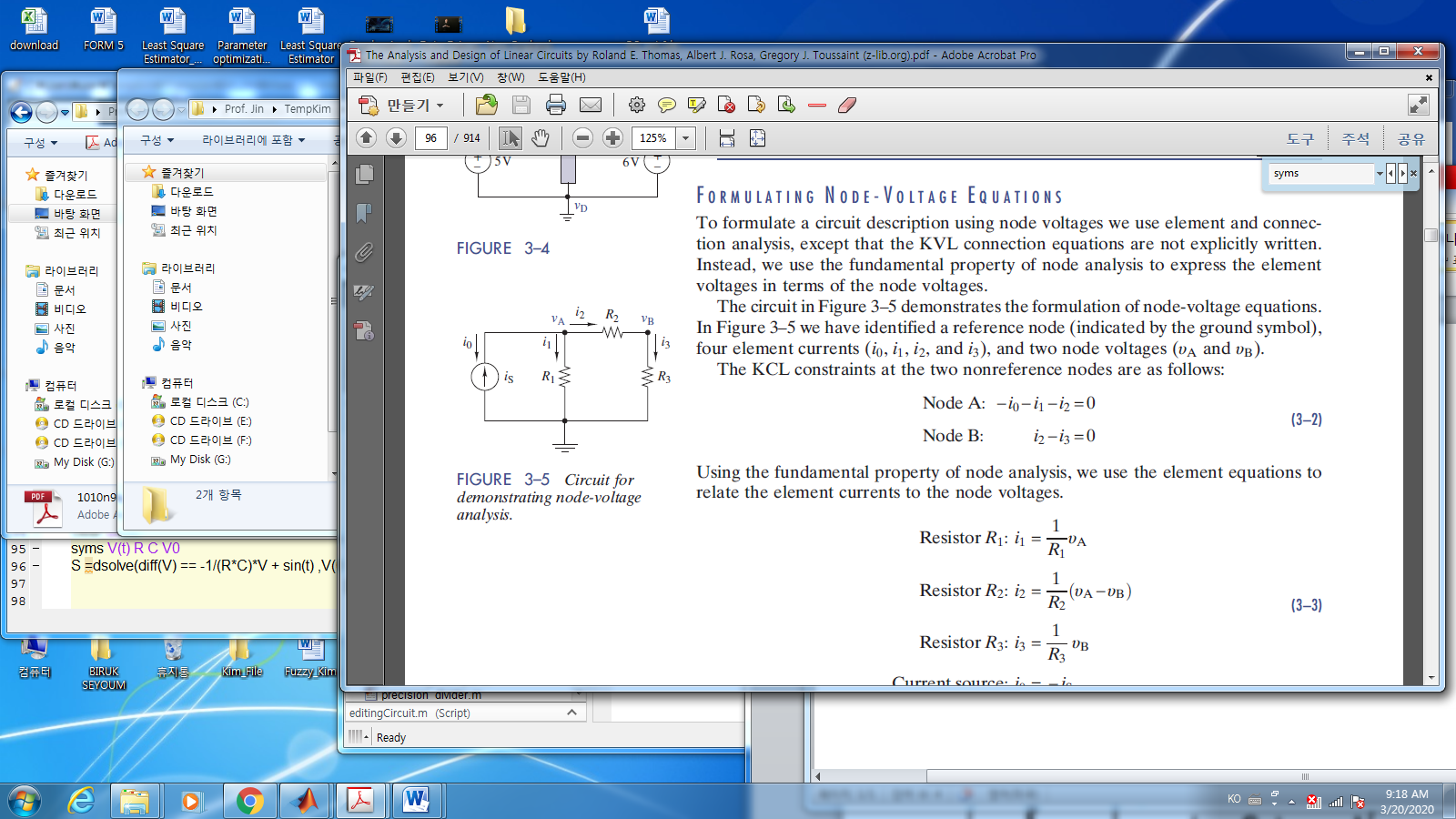
In Matlab, the “\” will do the job as

* Analyze circuit diagram

As You know KCL, KVL. Let us use “symbolic mathematic in Matlab”

* Case\_1 – node equations

1. First find nodes , and independent voltage and current sources
2. Assign voltages and currents as notations
3. Using KCL and KVL set the equations

Node A:

Node B:

1. Define state space model
2. Now You may solve above one in Matlab

%% Case-1 ,..resistors..

clear all; clc

syms R1 R2 R3 is

A =[(1/R1 + 1/R2) -1/R2; -1/R2 (1/R2 + 1/R3)];

B=[is; 0]

x = A\ B;

vA = x(1)

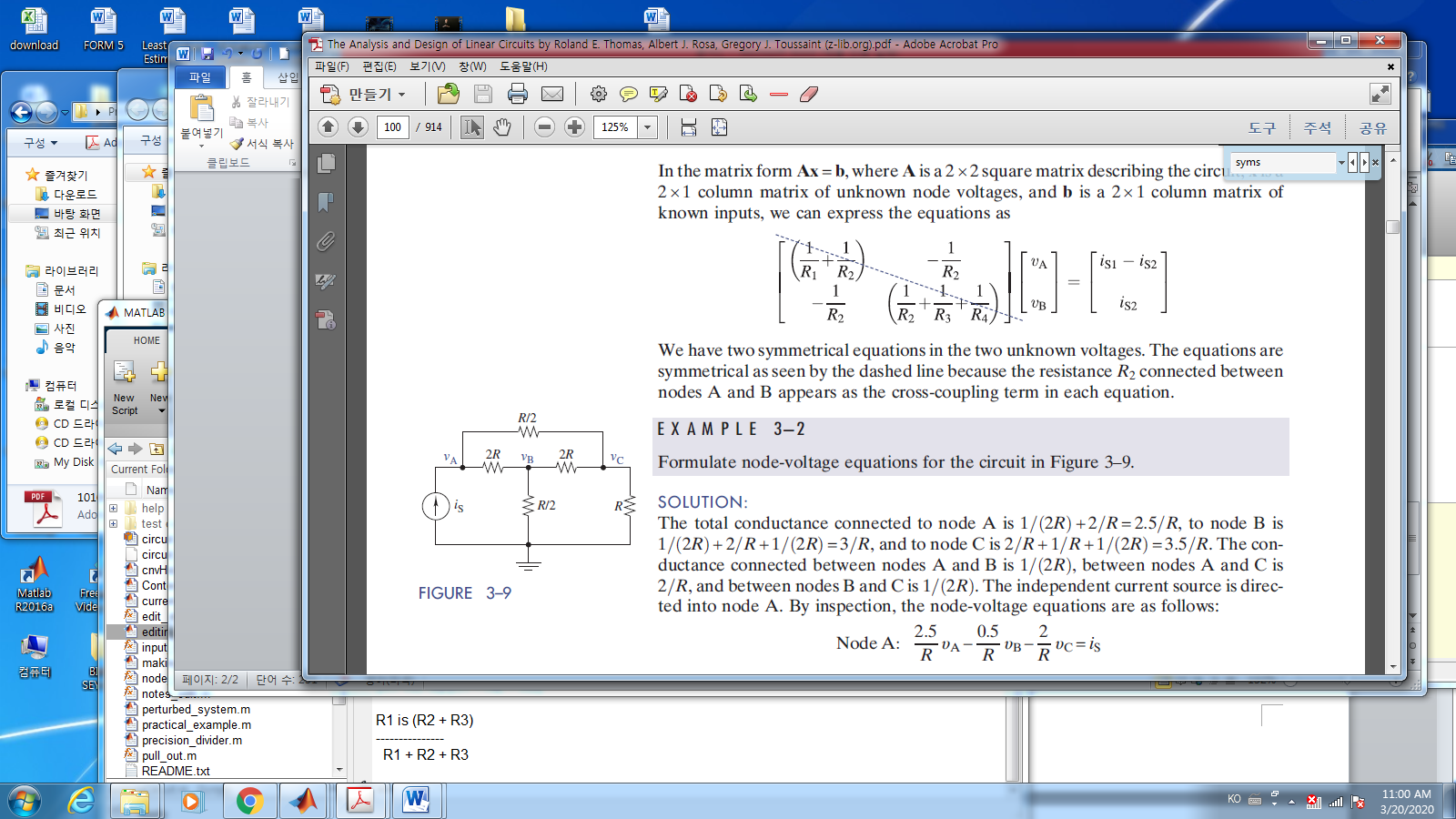
vB = x(2)

pretty(vA)

1. The solution is

* Case -2. The following circuit is

1. Set the equations.

 Node A:

Node B:

Node C:

1. Define state space model
2. You may solve above one in Matlab

%% Case-2 ,... resistors

clear all; clc

syms R is

A =[2.5/R -0.5/R -2/R; -0.5/R 3/R -0.5/R ; -2/R -0.5/R 3.5/R];

B=[is; 0; 0]

x = A\ B;

vA = x(1)

vB = x(2)

vC = x(3)

pretty(vA)

1. You may get the solution as ..

* Case-3 inductance

The voltage between a inductor, “L” with the current

1. In Matlab command , if

syms t iL vL

iL = 10\*exp(-500\*t) \* sin(2000\*t);

L = 0.0025;

vL = L\*diff(iL, 't')

tt = 0:0.00001:0.004;

iLtt = subs(iL,t,tt);

vLtt = subs(vL,t,tt);

subplot(2,1,1)

plot(tt,iLtt, 'b','LineWidth',2) ; grid on

title('current')

subplot(2,1,2)

plot(tt,vLtt, 'b','LineWidth',2); grid on

title('voltage')



* Case-4 the capacitance

The current through a conductor, “C” with the voltage

1. In Matlab command , if

syms t iC vC

vC = 10\*exp(-500\*t) \* sin(2000\*t);

C = 0.0025;

iC = C\*diff(vC, 't')

tt = 0:0.00001:0.004;

vCtt = subs(vC,t,tt);

iCtt = subs(iC,t,tt);

subplot(2,1,1)

plot(tt,vCtt, 'b','LineWidth',2) ; grid on

title(' the capacitance voltage')

subplot(2,1,2)

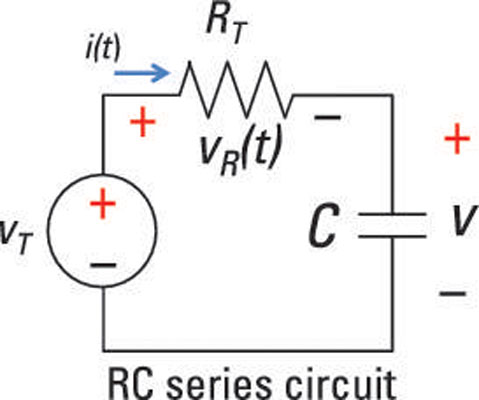
plot(tt,iCtt, 'b','LineWidth',2); grid on

title('the capacitance current')

* Case-5 capacitor and resistor

1. Set the equation

The input(the voltage source) . .Find the capacitor voltage



Since the loop current and by KVL

With respect to

1. Solve in Matlab

clear all;clc

syms Vc(t) Vs

R = 100;

C = 0.1;

T = R\*C; % time constant

Vs = sin(2\*5\*pi\*t);

Vc = dsolve( diff(Vc(t)) == -T\*Vc(t)+ Vs, Vc(0) ==0);

% for comparison

tt = 0:0.001:1;

Vstt = subs(Vs,t,tt);

Vctt = subs(Vc,t,tt);

subplot(2,1,1)

plot(tt,Vstt, 'b','LineWidth',2) ; grid on

title(' the source voltage')

subplot(2,1,2)

plot(tt,Vctt, 'b','LineWidth',2); grid on

title('the capacitance voltage')



**Week\_2 home assignments**

1. **due to next Friday .**

Problem:

For at least 4 any circuits, you select and analyze the circuit using symbolic math in Matlab.

1. Submit by e-mail or upload github…

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