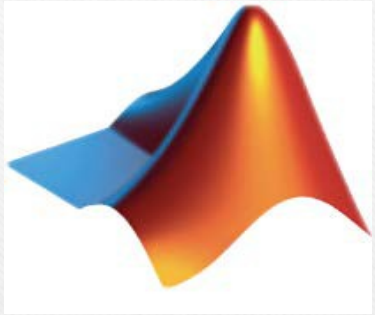
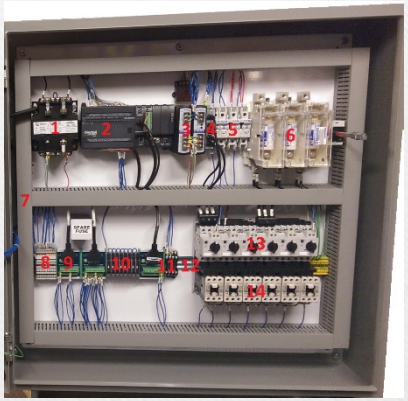
EEC380: Industrial Training (1)

Summer 2020





MATLAB **Industrial Control**

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Dr. Mohamed Selmy

Elements of Simulink

Objectives

- Understand modeling and simulation of problems
- Use Simulink for understanding problems
- Use Simulink for solving problems
- Being able to use Simulink in Research and Work

What is Simulink?

- Ordinary Differential Equations Solver (ODE)
- Block based Model description
- Non-Linear Models
- Real-time Code Generation

Starting Simulink

From MATLAB command line

simulink

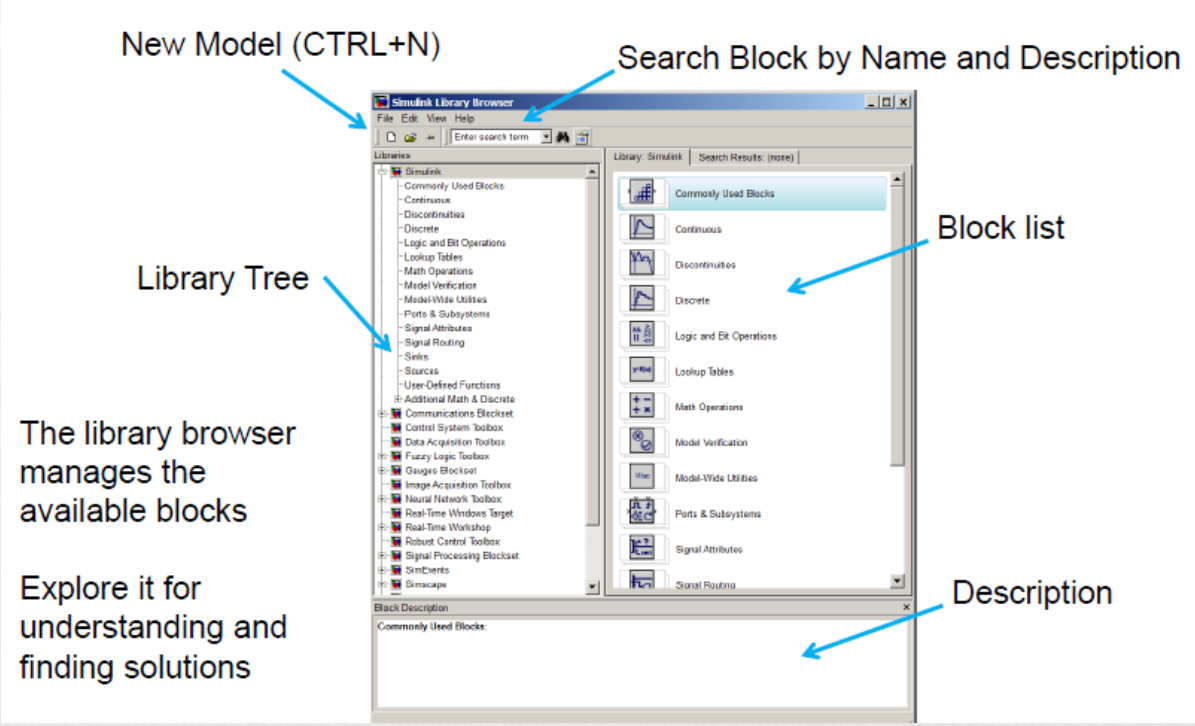
From Toolbar

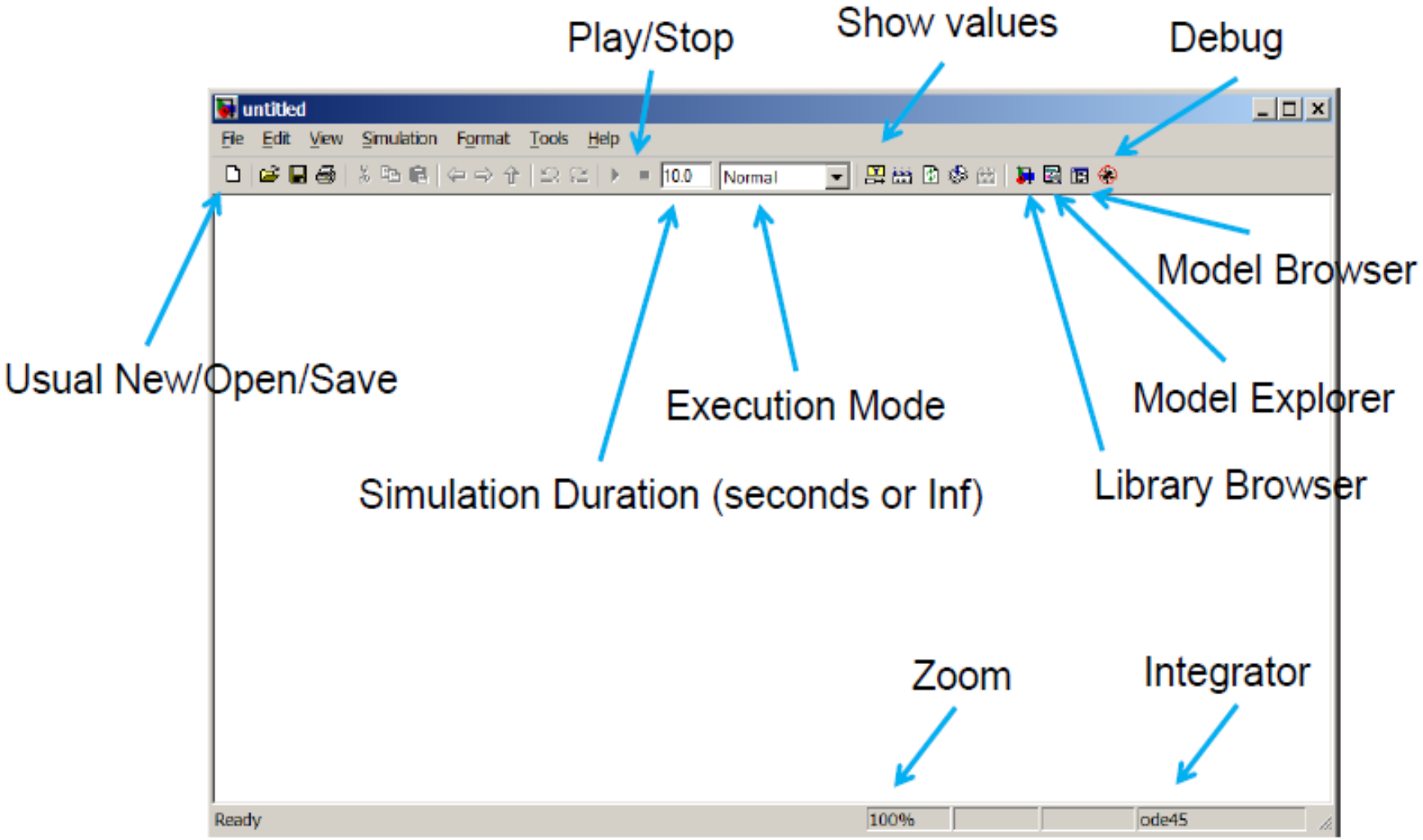
From Simulink MDL file

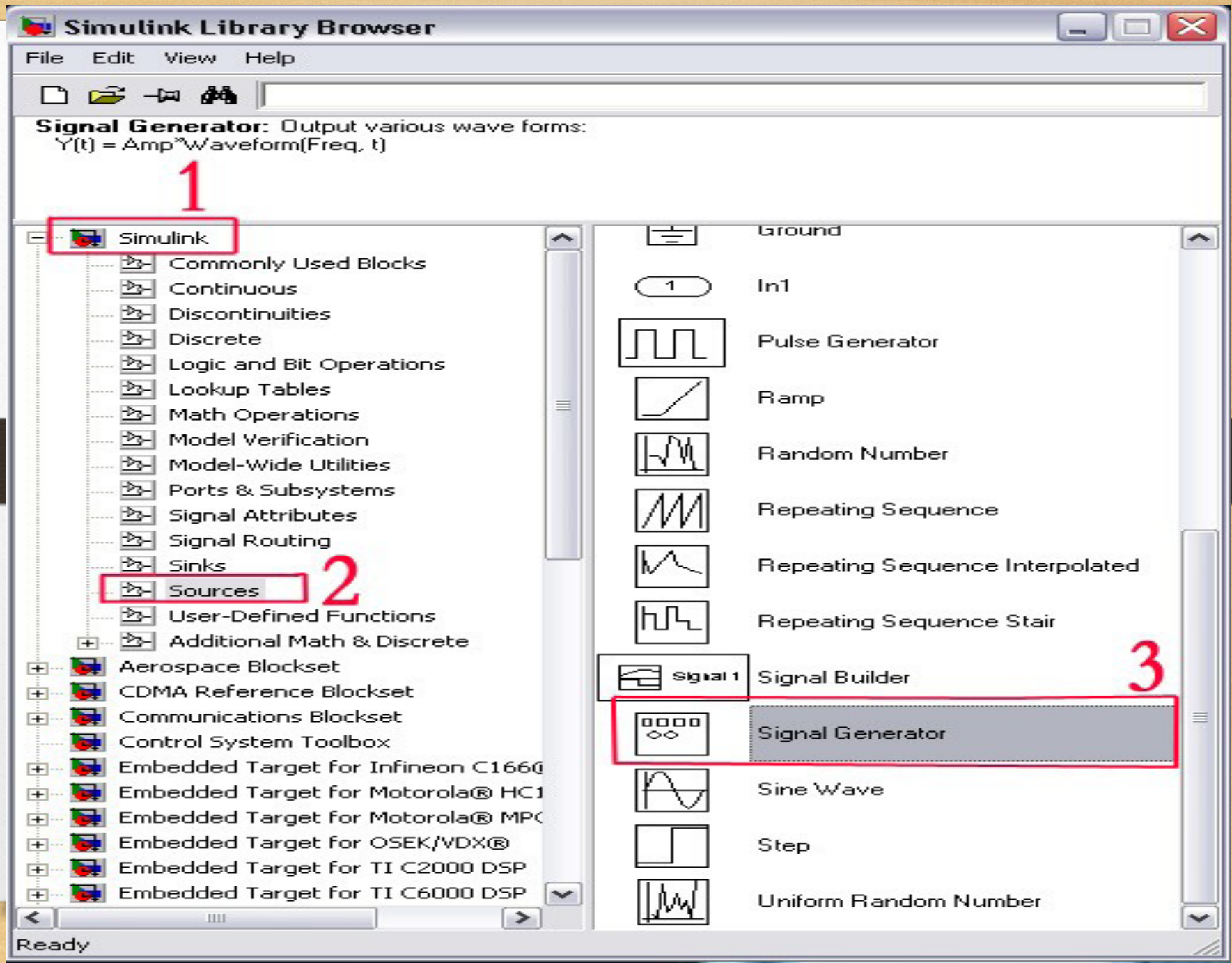
Direct open of MDL file

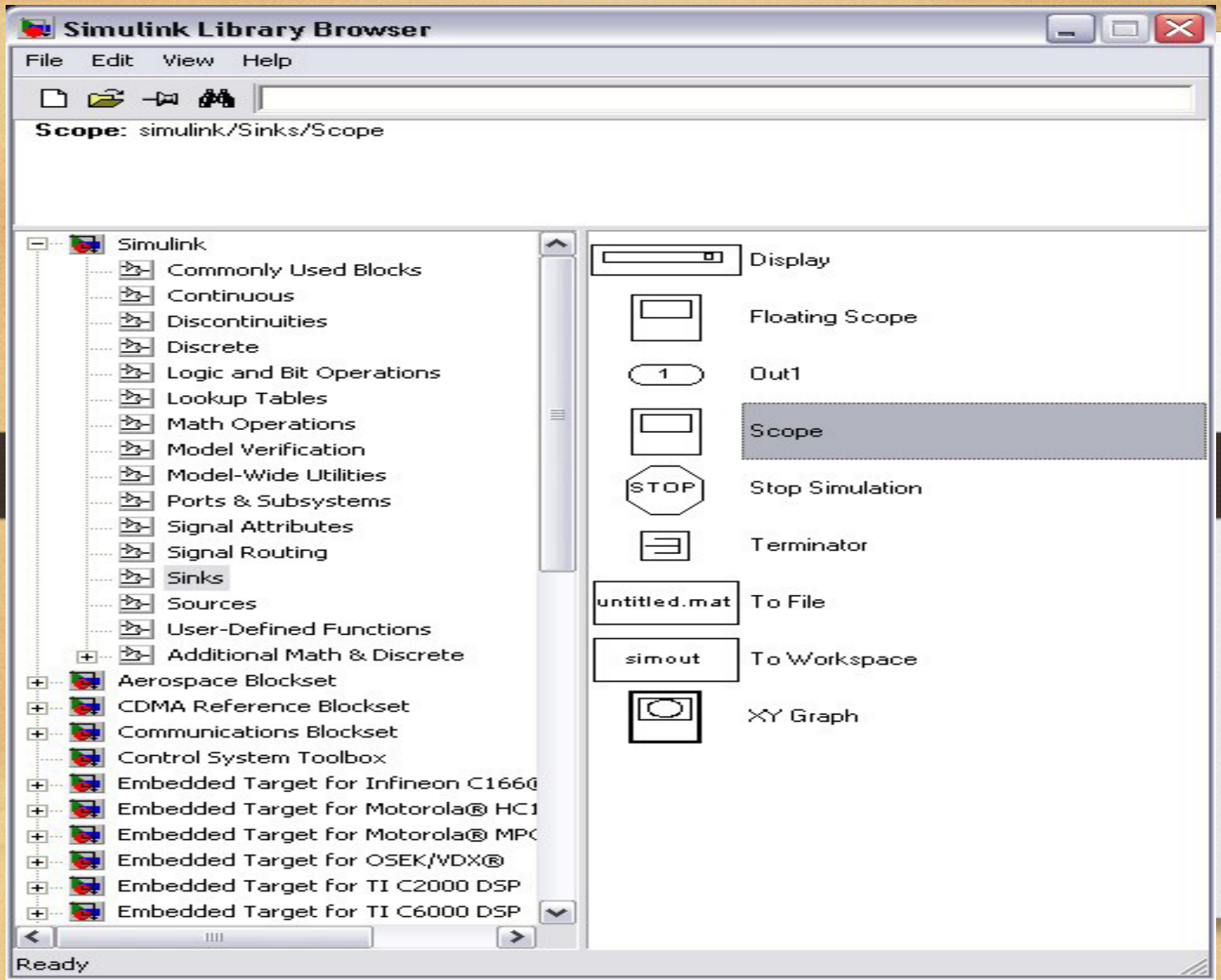
(sim,simset/simget,open_system/load_system)

Simulink Library Browser




Play/Stop
Show values
Debug
untitled
File Edit View Simulation Format Tools Help
10.0
Normal
Model Browser
Usual New/Open/Save
Execution Mode
Model Explorer
Simulation Duration (seconds or Inf)
Library Browser
Zoom
Integrator
Ready
100%
ode45


Simulink Library Browser
File Edit View Help
Signal Generator: Output various wave forms:
Y(t) = Amp*Waveform(Freq, t)
1
Simulink
Commonly Used Blocks
Continuous
Discontinuities
Discrete
Logic and Bit Operations
Lookup Tables
Math Operations
Model Verification
Model-Wide Utilities
Ports & Subsystems
Signal Attributes
Signal Routing
Sinks
Sources
2
User-Defined Functions
Additional Math & Discrete
Aerospace Blockset
CDMA Reference Blockset
Communications Blockset
Control System Toolbox
Embedded Target for Infineon C166(
Embedded Target for Motorola® HC1
Embedded Target for Motorola® MPC
Embedded Target for OSEK/VDX®
Embedded Target for TI C2000 DSP
Embedded Target for TI C6000 DSP
Ground
In1
Pulse Generator
Ramp
Random Number
Repeating Sequence
Repeating Sequence Interpolated
Repeating Sequence Stair
Signal 1
Signal Builder
3
Signal Generator
Sine Wave
Step
Uniform Random Number
Ready


Simulink Library Browser
File Edit View Help
Scope: simulink/Sinks/Scope
Simulink
Commonly Used Blocks
Continuous
Discontinuities
Discrete
Logic and Bit Operations
Lookup Tables
Math Operations
Model Verification
Model-Wide Utilities
Ports & Subsystems
Signal Attributes
Signal Routing
Sinks
Sources
User-Defined Functions
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Aerospace Blockset
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Embedded Target for Infineon C166(
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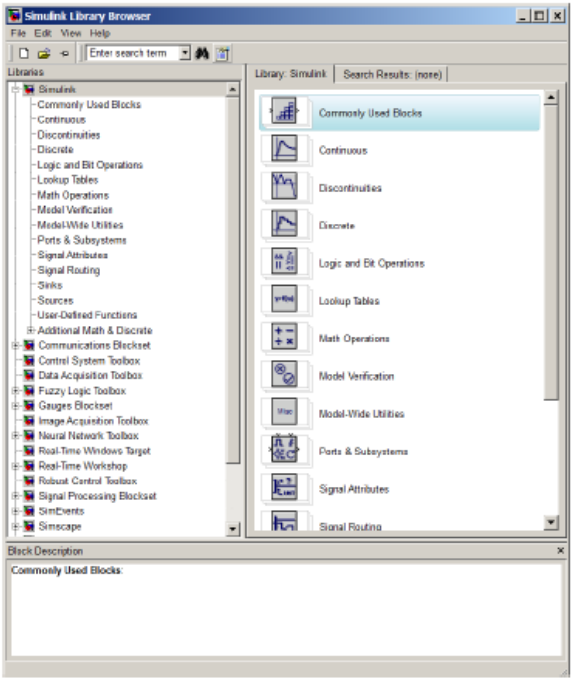
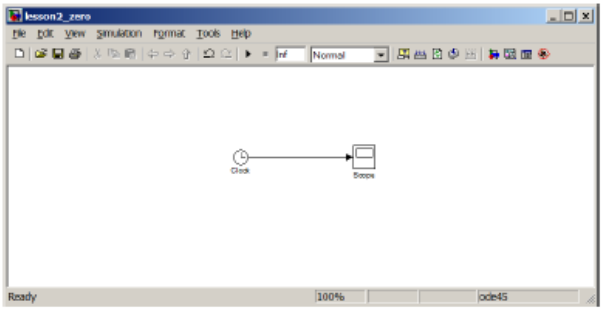
Embedded Target for Motorola® MP(
Embedded Target for OSEK/VDX®
Embedded Target for TI C2000 DSP
Embedded Target for TI C6000 DSP
Display
Floating Scope
1
Out1
Scope
STOP
Stop Simulation
Terminator
untitled.mat
To File
simout
To Workspace
XY Graph
Ready

Building a Model



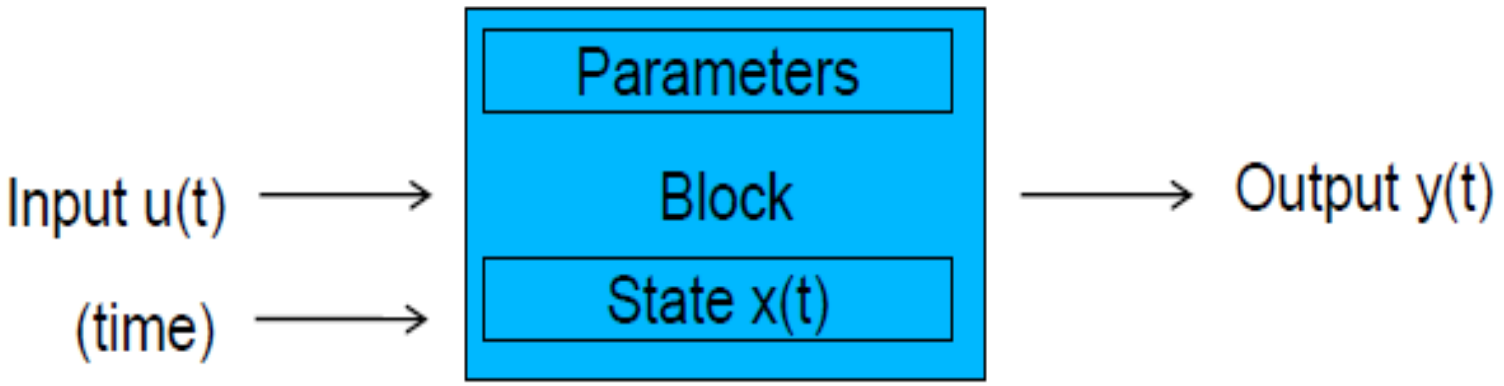
Drag and Drop blocks from Library Browser

or activate context menu of block and select “Add to …”



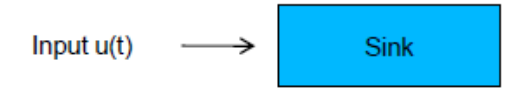
Simulink Model based Design

Simulink Block

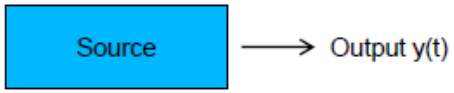


Block Types

- Source – generate data
- Sink – receives data
- Virtual Block – perform cleanup
- Subsystem – aggregation of blocks (graphical or logical)
- Custom Blocks (S-Functions) – C or M-code based



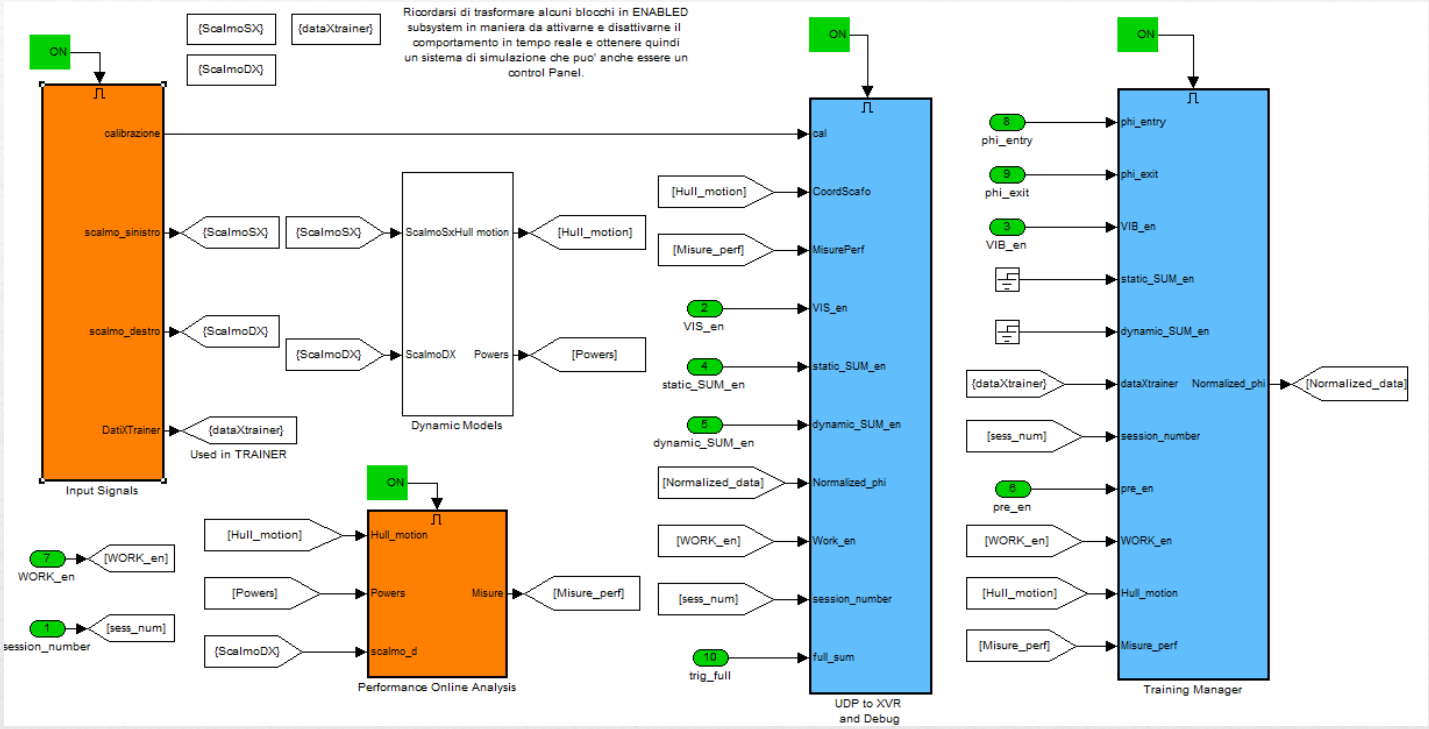
Plot, Store, Send to Network …, Goto



Load from File, Workspace, Curve Constant, …, Label, From Network …

All the others

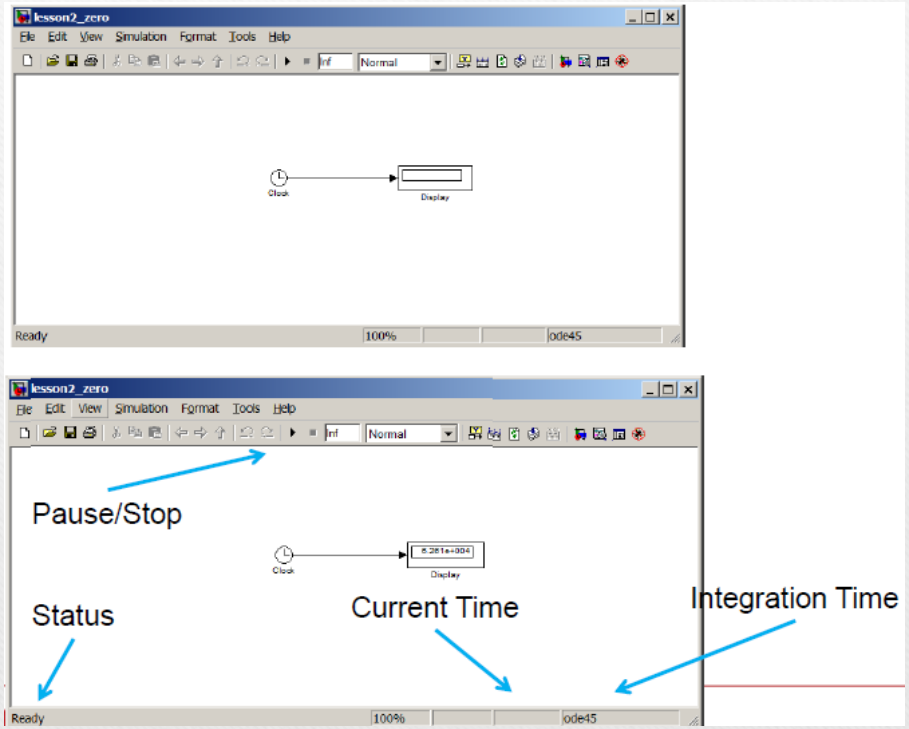
Example


{ScalmoSX}
{dataXtrainer}
{ScalmoDX}
Ricordarsi di trasformare alcuni blocchi in ENABLED subsystem in maniera da attivarne e disattivarne il comportamento in tempo reale e ottenere quindi un sistema di simulazione che puo' anche essere un control Panel.
ON
calibrazione
scalmo_sinistro
scalmo_destro
DatiXTrainer
Input Signals
{ScalmoSX}
{ScalmoDX}
{dataXtrainer}
Used in TRAINER
ScalmoSx
Hull motion
ScalmoDX
Powers
Dynamic Models
[Hull_motion]
[Powers]
7
WORK_en
[WORK_en]
1
session_number
[sess_num]
Hull_motion
Powers
scalmo_d
Misure
[Misure_perf]
Performance Online Analysis
cal
CoordScafo
MisurePerf
VIS_en
static_SUM_en
dynamic_SUM_en
Normalized_phi
Work_en
session_number
full_sum
[Normalized_data]
[Misure_perf]
2
VIS_en
4
static_SUM_en
5
dynamic_SUM_en
10
trig_full
UDP to XVR and Debug
8
phi_entry
9
phi_exit
3
VIB_en
dataXtrainer
Normalized_phi
pre_en
Hull_motion
Misure_perf
Training Manager

Manipulating Blocks

- Selection
  - Multiple Selection with Shift
  - Multiple Selection with Box Selection
- copy
  - Drag with CTRL
- Move Blocks
  - Drag
  - Rotate (CTRL+R)
- Connect Blocks
  - Select first and select second using CTRL
  - Branch line by holding CTRL from an existing line
  - Disconnect block by drag a block holding SHIFT

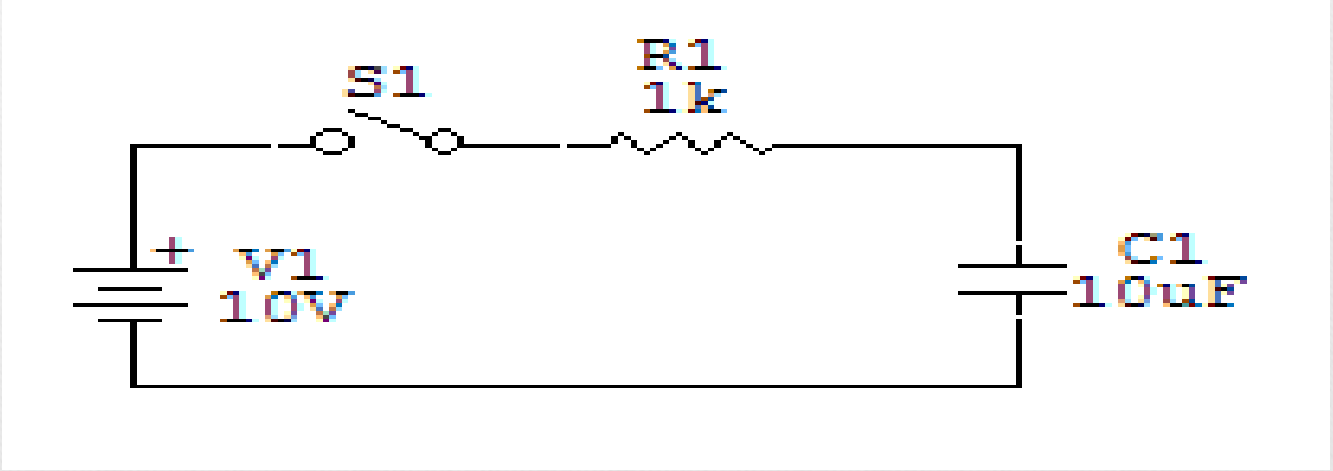
Running a Model



Ex(1)

- Write the governing differential equation (DE) for the RC circuit shown in fig(3) when switch S_1 is closed. Write a MATLAB script to analytically solve for the capacitor voltage and plot it against time. Compare the results with that obtained using Simulink(by two methods)

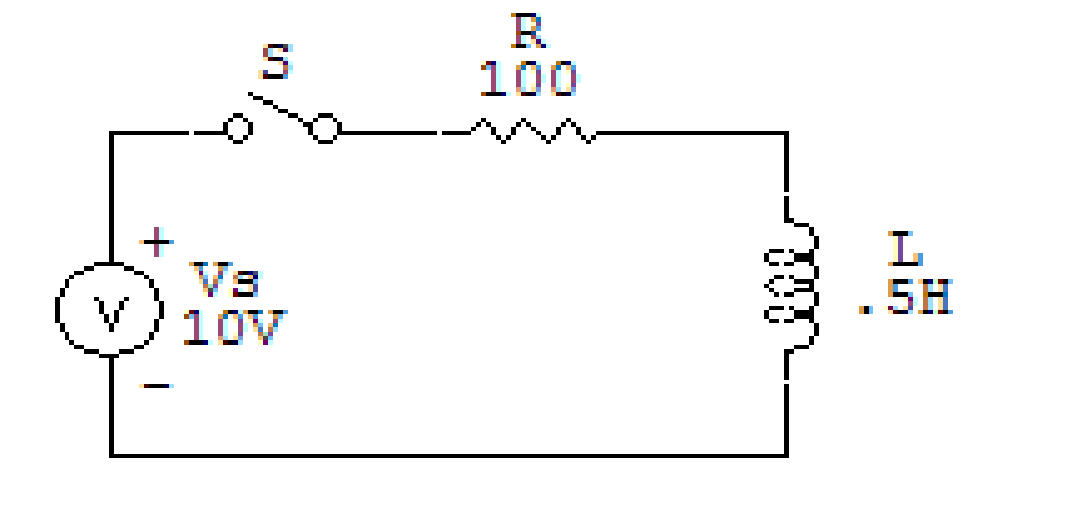
- Hint (use MATLAB simulink sim-power system & MATLAB continuous blocks



Ex 2

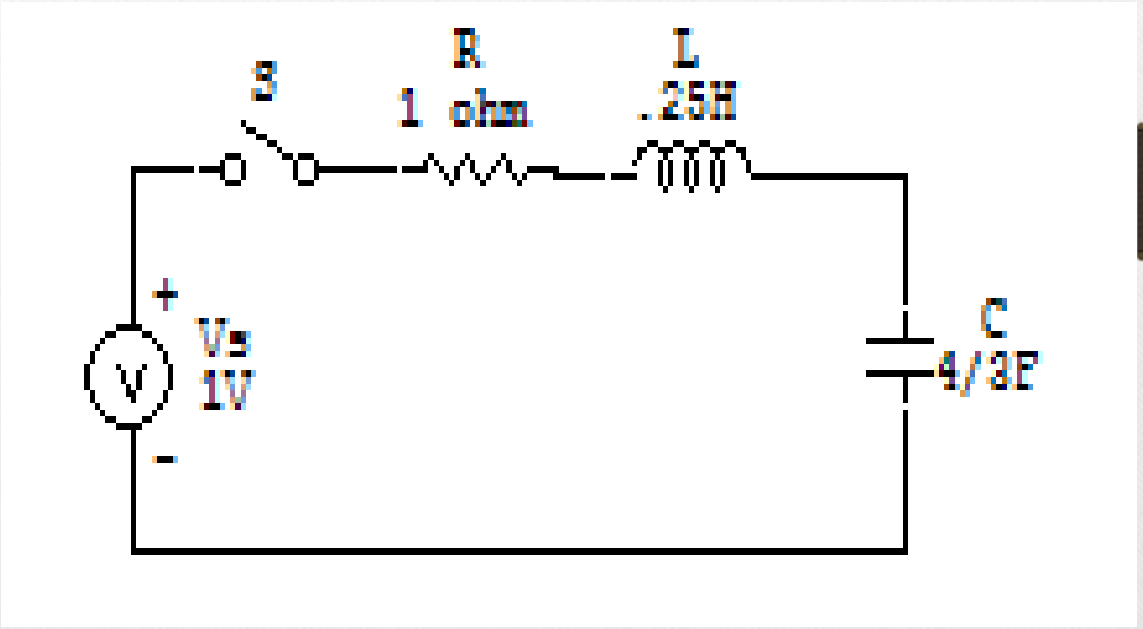
- Write the governing differential equation (DE) for the RL circuit shown in fig(4) when switch S_1 is closed. Write a MATLAB script to analytically solve for the capacitor voltage and plot it against time. Compare the results with that obtained using Simulink(by two methods)

- Hint (use MATLAB simulink sim-power system & MATLAB continuous blocks



Ex 3

- Repeat ex 3 in series RLC circuit fig(5)
- Using Simulink, find the current in the circuit and voltage across each element. Use the initial conditions $i_L(0)=0$ and $v_c(0)=0.5$ V



EX 4

- Consider the following SISO system described by the differential equation. Use simulink to plot the output y(t) where u(t) is unit step function.

$$\frac{d^4y(t)}{dt^4}+3\frac{d^3y(t)}{dt^3}+4\frac{d^2y(t)}{dt^2}+8\frac{dy(t)}{dt}+2y(t)=6u(t)$$

Ex(5)

- For circuits shown in figures, use simulink sim-power system to find voltages at each node and the current through each resistor. All voltage and current sources are DC.

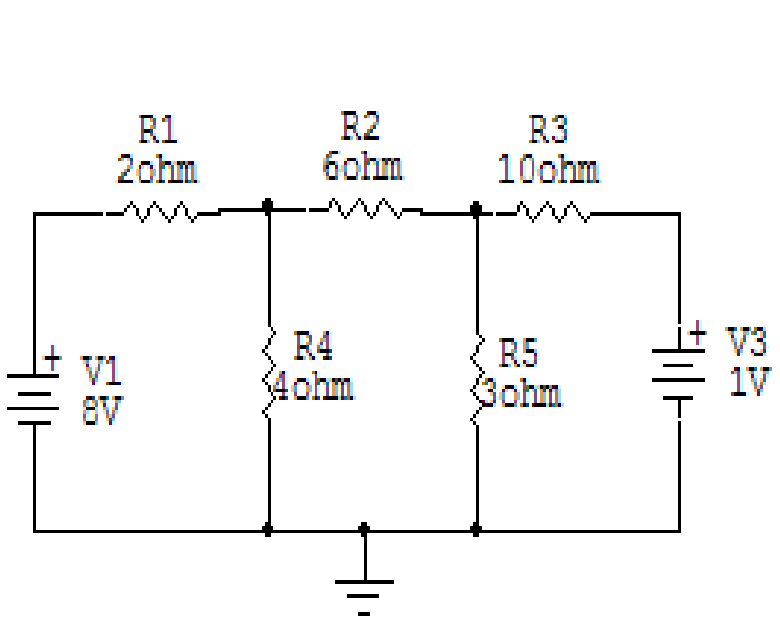
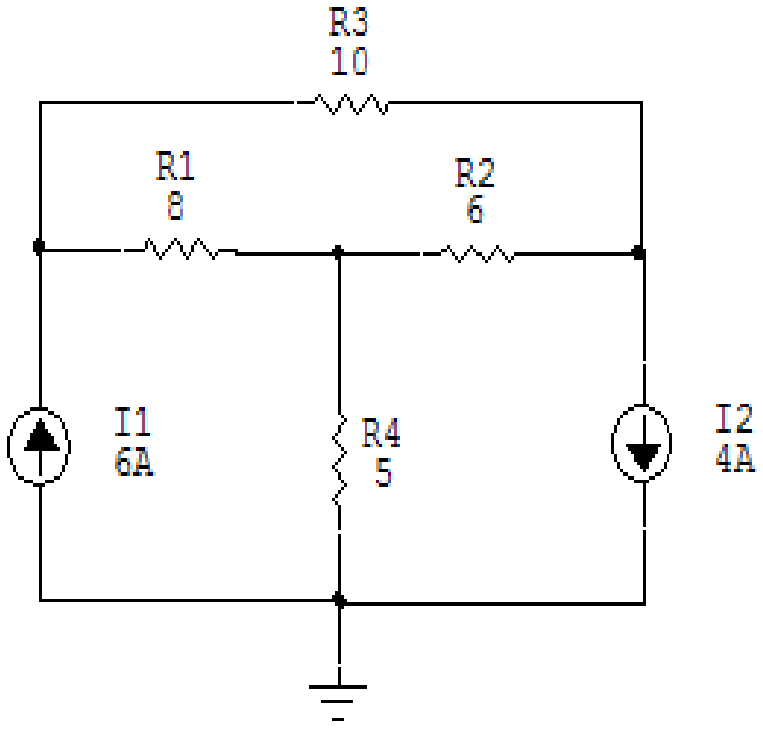
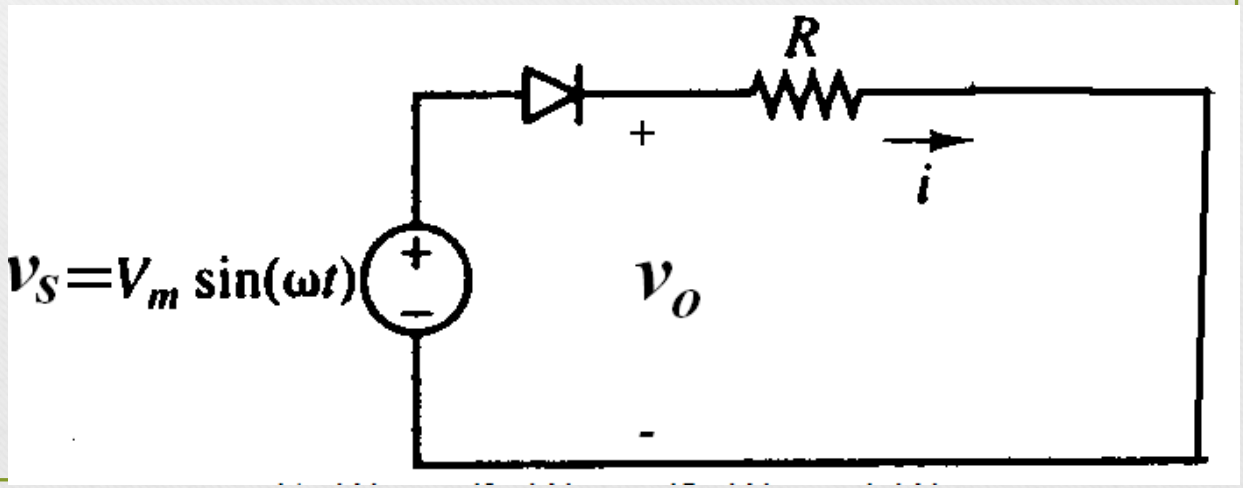


Fig 1



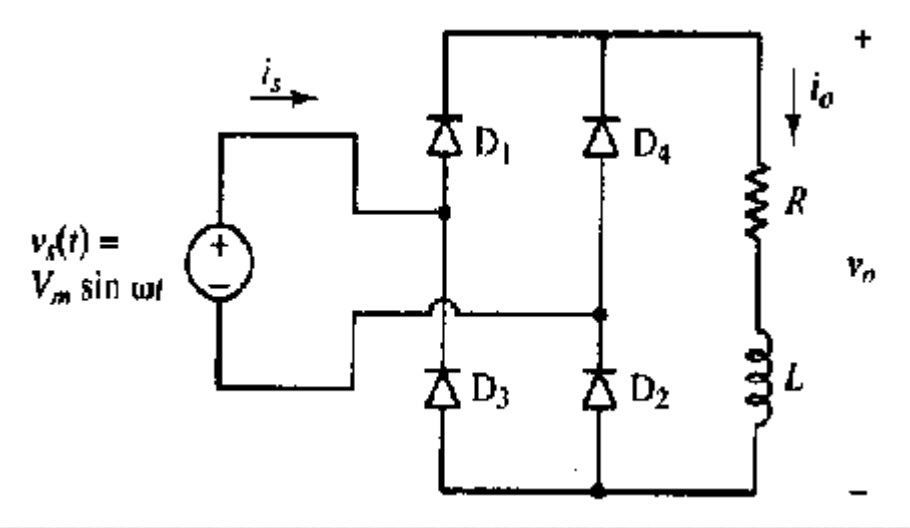
EX 6

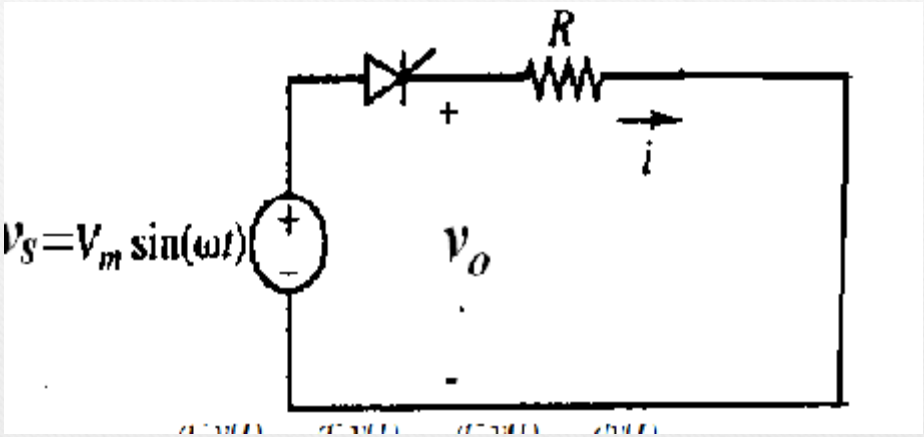
Plot the time variation of the load voltage, load current, and the voltage drop across the diode. If v_s=120 V rms at 60 Hz and R= 10Ω .use simulink



Ex7

repeat problem 6 for the circuit shown L=0 mH



Ex8

- repeat problem 6 for the circuit shown