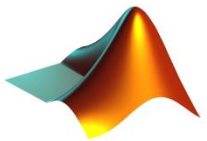
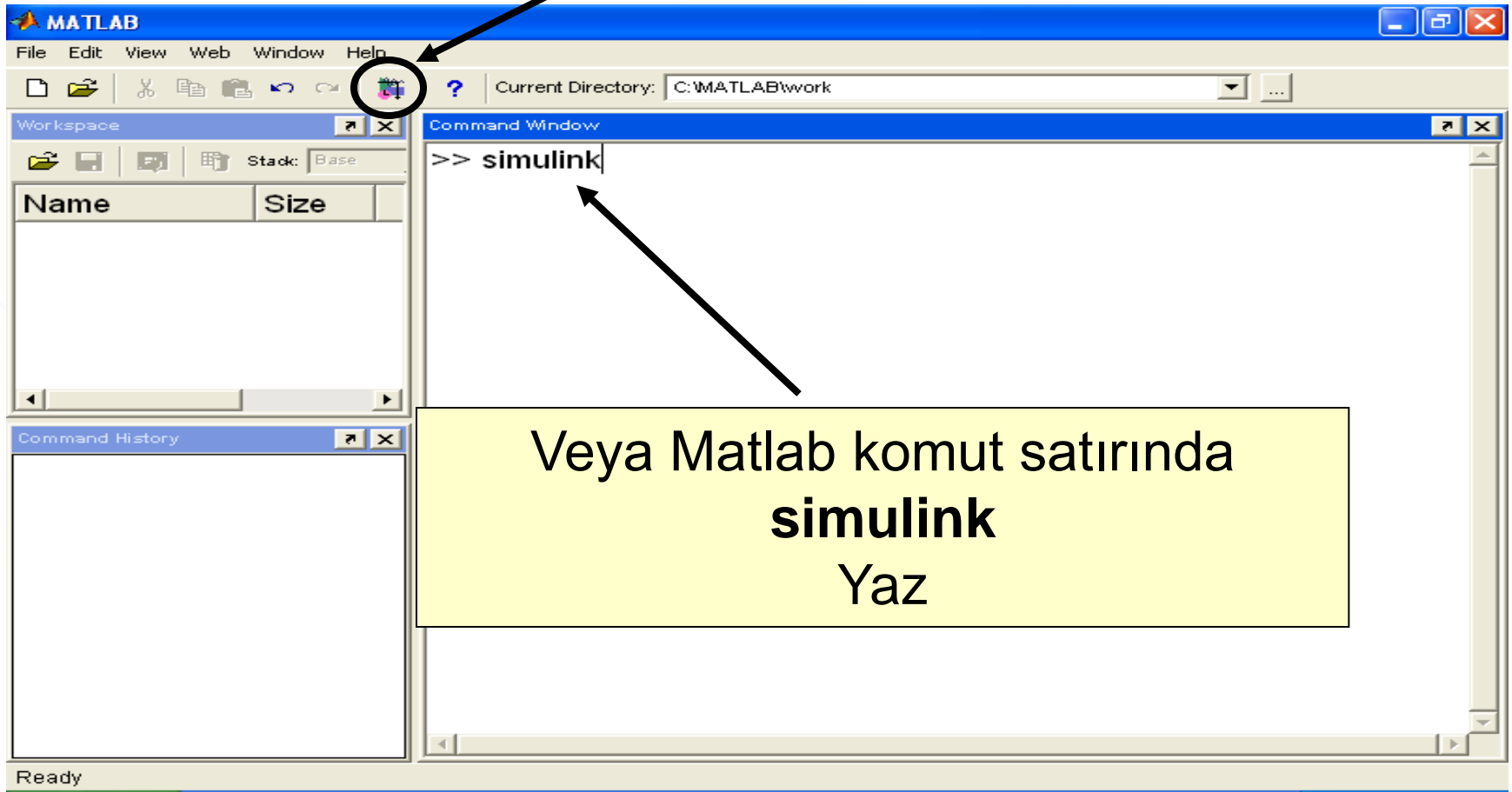


# **MATLAB** **SIMULINK**



# Simulink Oturumunu Başlatma

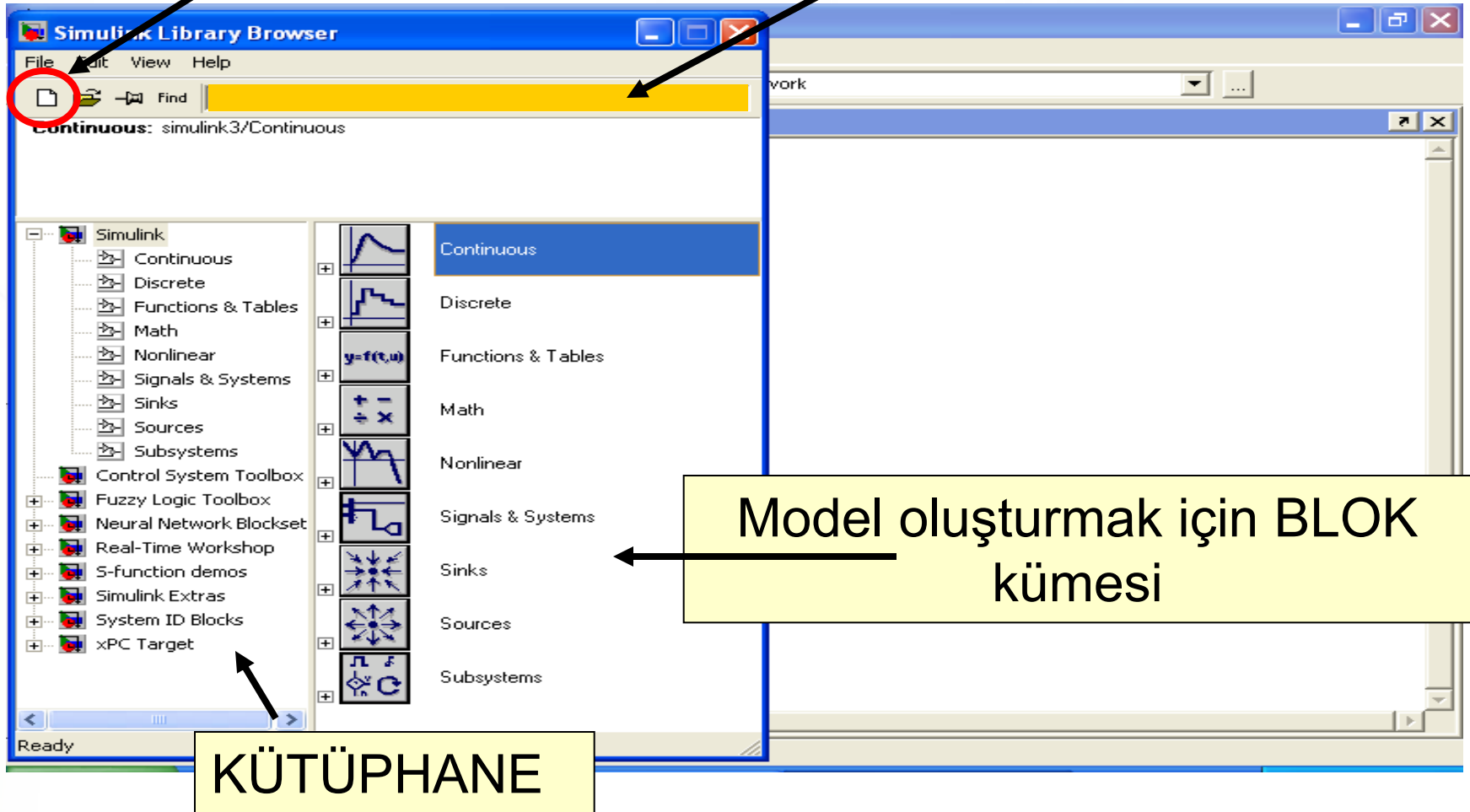
**SIMULINK icon üzerine tıkla**



# Simulink Kütüphanesi

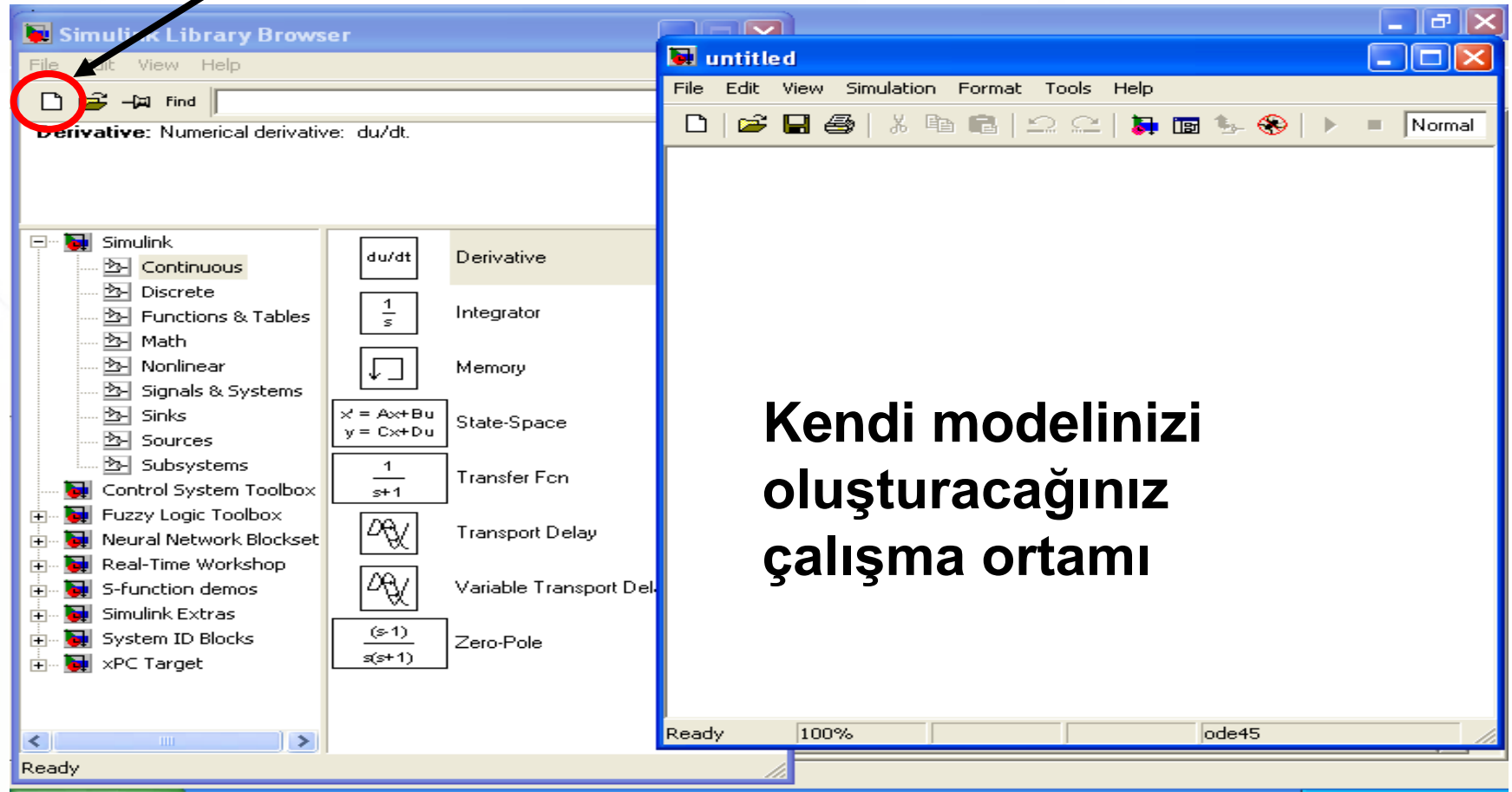
Yeni model iconu oluşturma

Arama penceresi



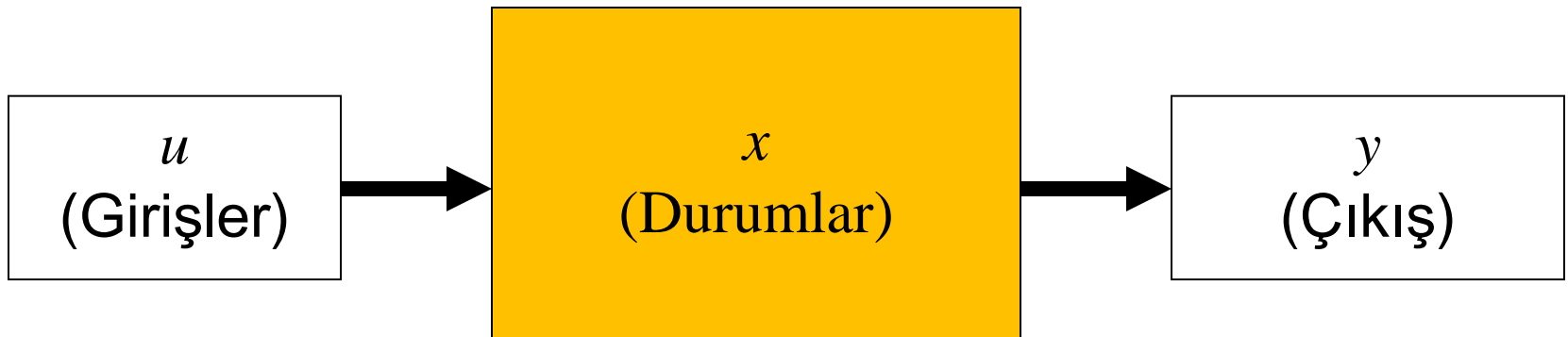
# Yeni model oluřturma

## Yeni model iconu oluřturma



# Model Oluşturma

- Simulink blok diyagramı – dinamik sistemin resimsel modeli
- Her blok ya sürekli yada ayrık çıkış üreten temel bir dinamik sistem gösterir.
- Doğrular blok çıkışlarına blok girişlerini bağlayan bağlantıları gösterir.



# Model Oluşturma (2)

- Aşağıdaki adımlar bir sistem/model kurmak için size kılavuzluk edecektir:
- ADIM 1: Blokları oluşturma
- ADIM 2: Bağlantıları yapma
- ADIM 3: Parametreleri kurma
- ADIM 4: Simülasyonu çalıştırma

# Adım 1: Blokları oluşturma

**Bu modeli sakla**

**Sinüs dalga bloğu, kaynaklar kütüphanesindedir..**

**Kaynaklar kütüphanesi**

**Sinüs dalga bloğunu simulink çalışma ortamına sürükleyin**

**Simulink Library Browser**

File Edit View Help

Find

**Sine Wave:** Output a sine wave where the sine type determines the computational technique used. The parameters in the two types are related through:

Samples per period =  $2\pi / (\text{Frequency} * \text{Sample time})$

Simulink

- Continuous
- Discrete
- Functions & Tables
- Math
- Nonlinear
- Signals & Systems
- Sinks
- Sources**
- Subsystems

Control System Toolbox

- Fuzzy Logic Toolbox
- Neural Network Blockset
- Real-Time Workshop
- S-function demos
- Simulink Extras
- System ID Blocks
- xPC Target

1 In1

Pulse Generator

Ramp

Random Number

Repeating Sequence

Signal Generator

**Sine Wave**

Step

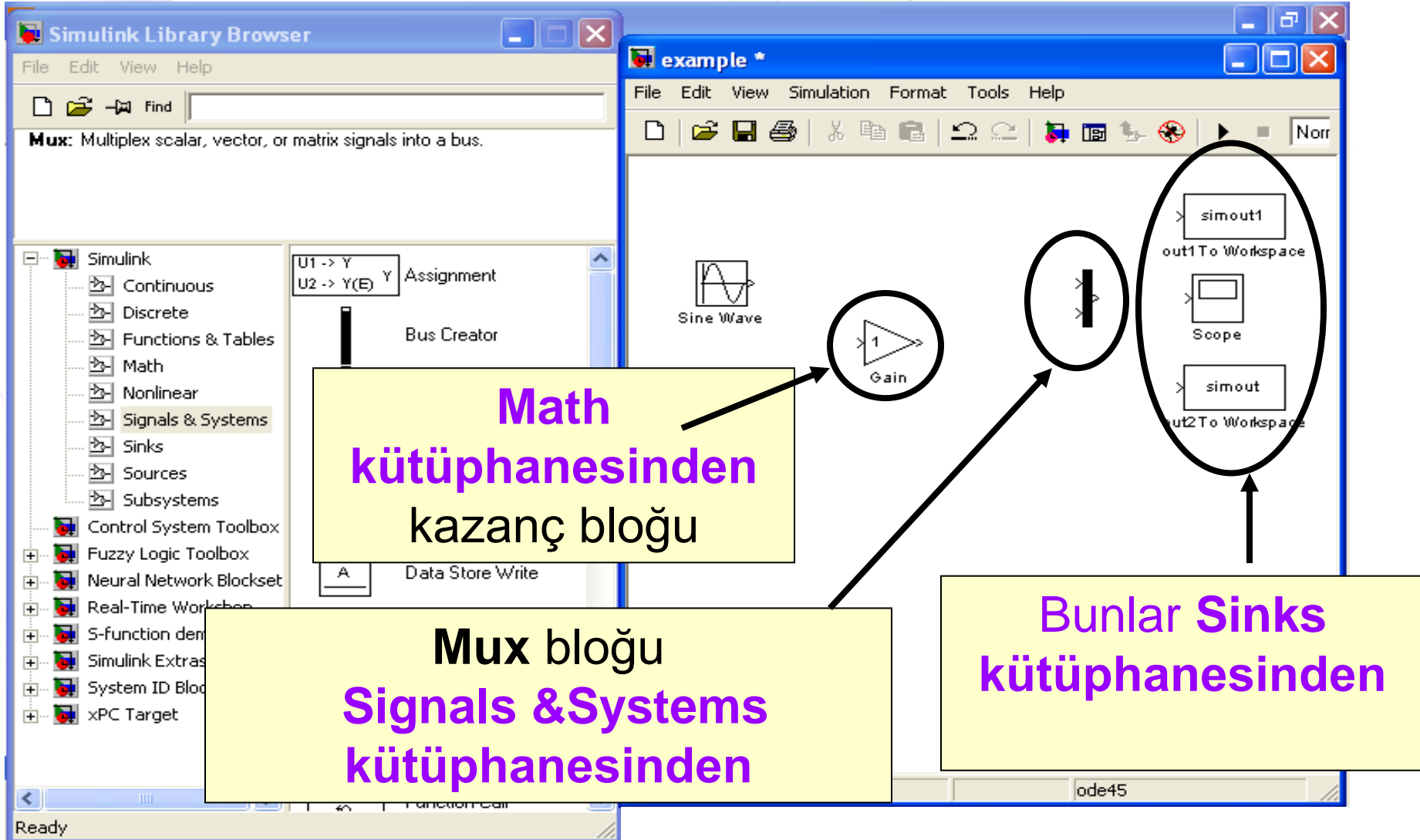
Uniform Random Number

**untitled \***

File Edit View Simulation Format Tools Help

Sine Wave

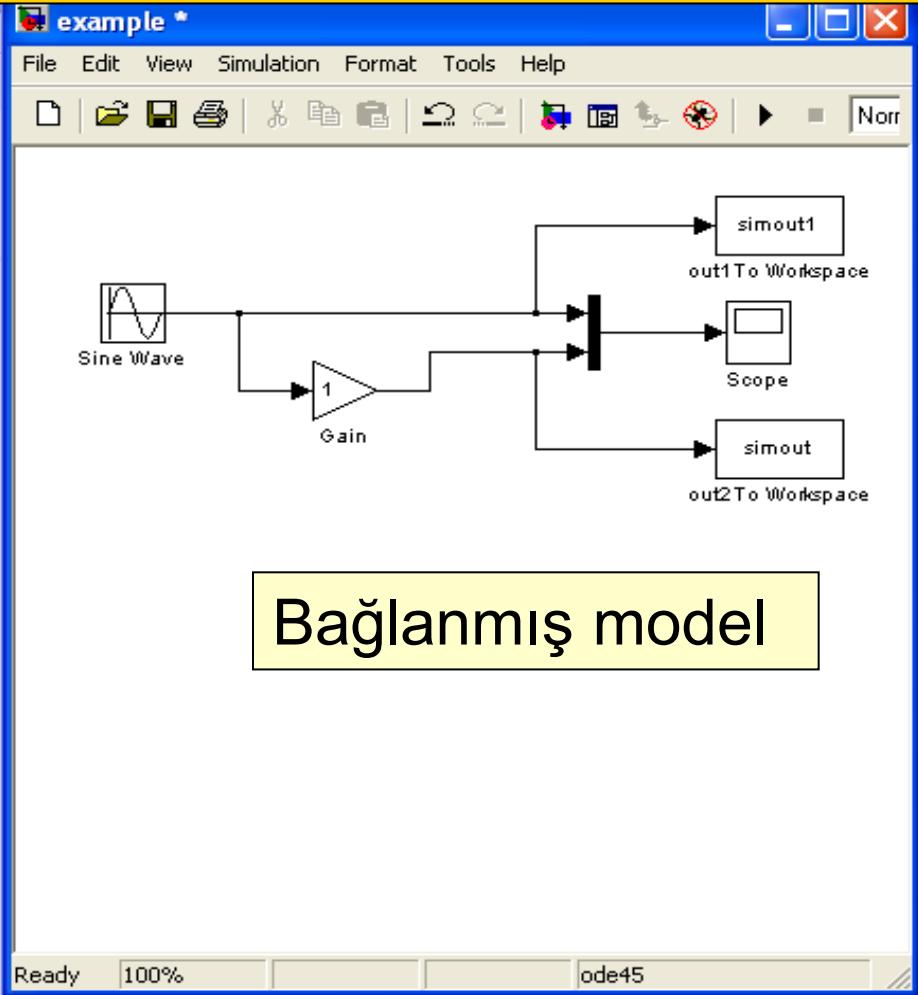
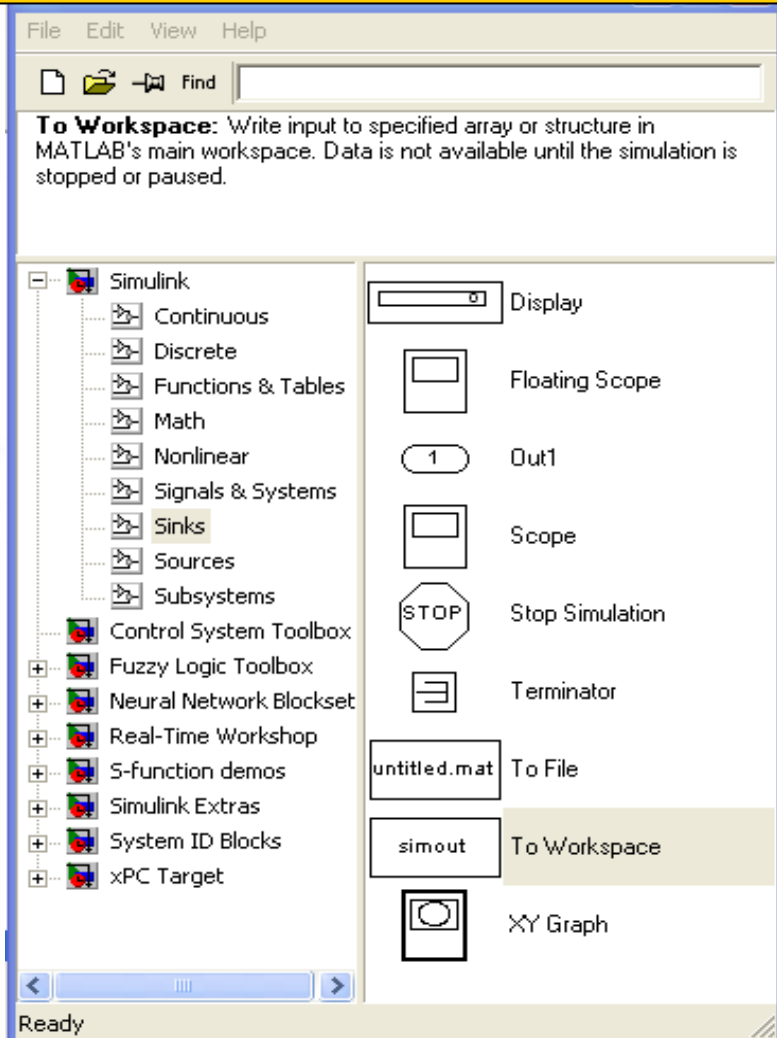
# Adım 1: Blokları oluşturma





# Adım 2: Bağlantılar yapma

Bağlantı yapmak için: kaynak porttan gidilecek porta sürüklenir.



Bağlanmış model

# Adım 3: Parametre Kurma

**Gain bloğunu çift tıklayarak parametreyi ayarlayınız.**

The screenshot shows a Simulink model with a Sine Wave block connected to a Gain block. The Gain block is circled in orange. Two dialog boxes are open:

- Block Parameters: Gain**: The Gain value is set to 5. The Multiplication is set to Element-wise( $K \cdot u$ ). The Saturate on integer overflow checkbox is checked.
- Block Parameters: out1 To Workspace**: The Variable name is set to out1. The Limit data points to last is set to inf. The Decimation is set to 1. The Sample time is set to -1. The Save format is set to Structure.

Arrows point from the text in the yellow box to the Gain block and the 'out1 To Workspace' dialog box.

# Adım 4: Simülasyonu Çalıştırma

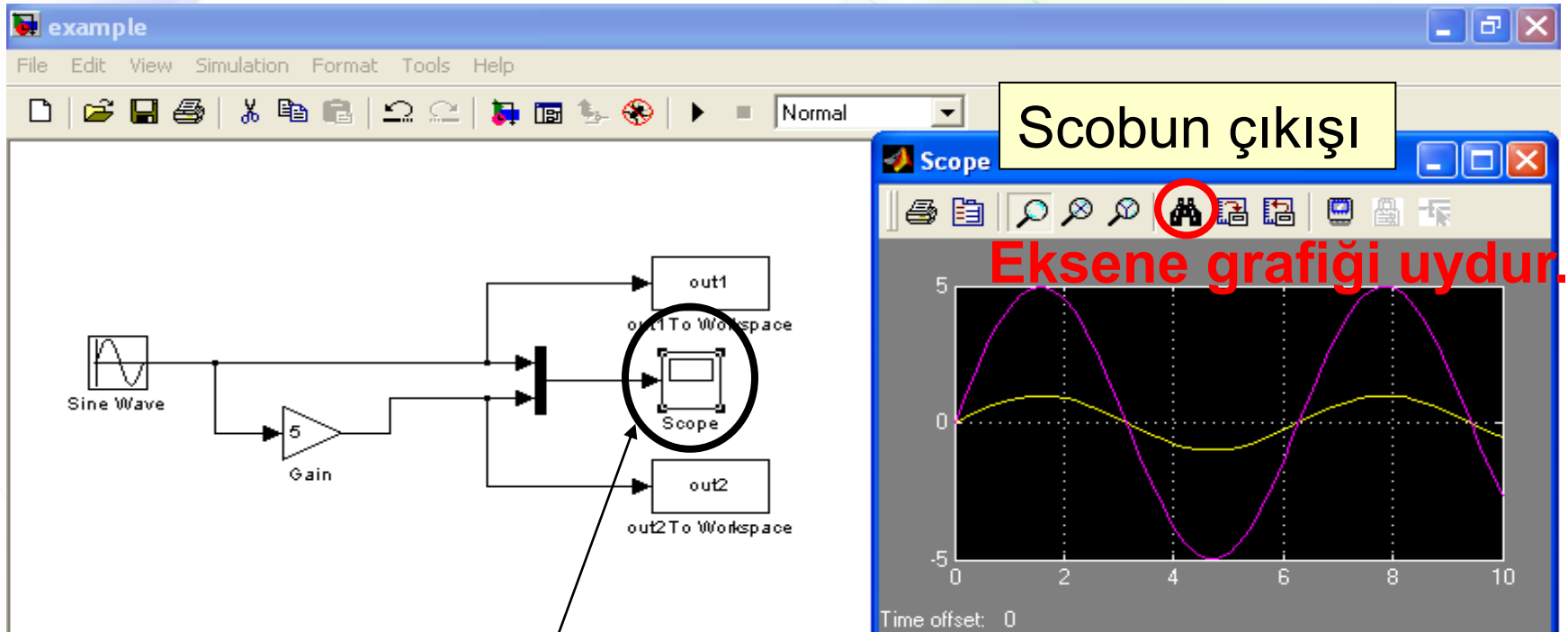
Simülasyonu çalıştırmak için run

The screenshot shows the MATLAB/Simulink environment. The main window, titled 'example', contains a block diagram with a 'Sine Wave' block, a 'Gain' block (value 5), and a 'Scope' block. The 'Simulation' menu is open, showing options: 'Start' (Ctrl+T), 'Stop', 'Simulation parameters...' (Ctrl+E), 'Normal' (checked), and 'External'. A red circle highlights the 'Run' button (a play icon) in the toolbar. A red arrow points from the 'Simulation parameters...' menu item to the 'Simulation Parameters: example' dialog box. The dialog box has tabs for 'Solver', 'Workspace I/O', 'Diagnostics', 'Advanced', and 'Real-Time Workshop'. The 'Solver' tab is active, showing 'Simulation time' with 'Start time: 0.0' and 'Stop time: 10.0'. 'Solver options' include 'Type: Variable-step' and 'ode45 (Dormand-Prince)'. 'Max step size', 'Min step size', and 'Initial step size' are all set to 'auto'. 'Relative tolerance' is '1e-3' and 'Absolute tolerance' is 'auto'. 'Output options' include 'Refine output' and 'Refine factor: 1'. The 'OK', 'Cancel', 'Help', and 'Apply' buttons are at the bottom. A yellow box at the bottom left contains the text: "simülasyon parametereleri" istenilen değerlere kurulur. A yellow box at the bottom right contains the text: Stop time değerini değiştirebilirsiniz. A status bar at the bottom shows 'Show the simulation parameters dialog', '100%', and 'ode45'.

“simülasyon parametereleri” istenilen değerlere kurulur.

Stop time değerini değiştirebilirsiniz.

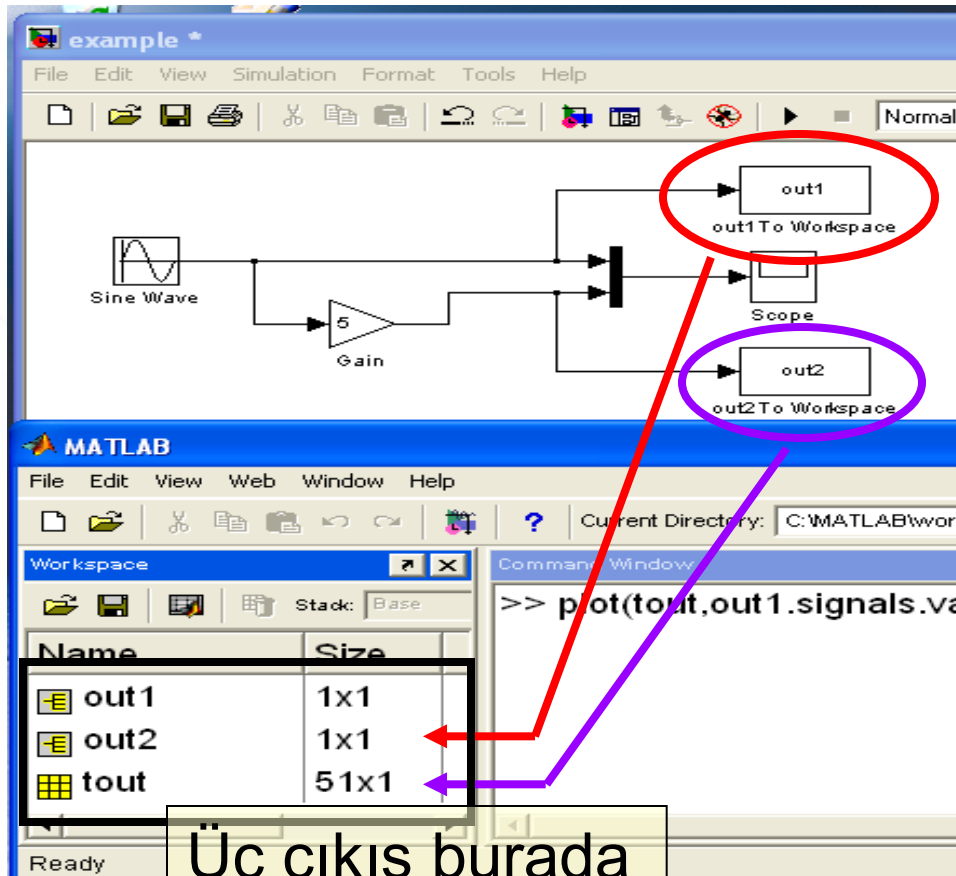
# Scope bloğu yoluyla çıkışa bakmak.



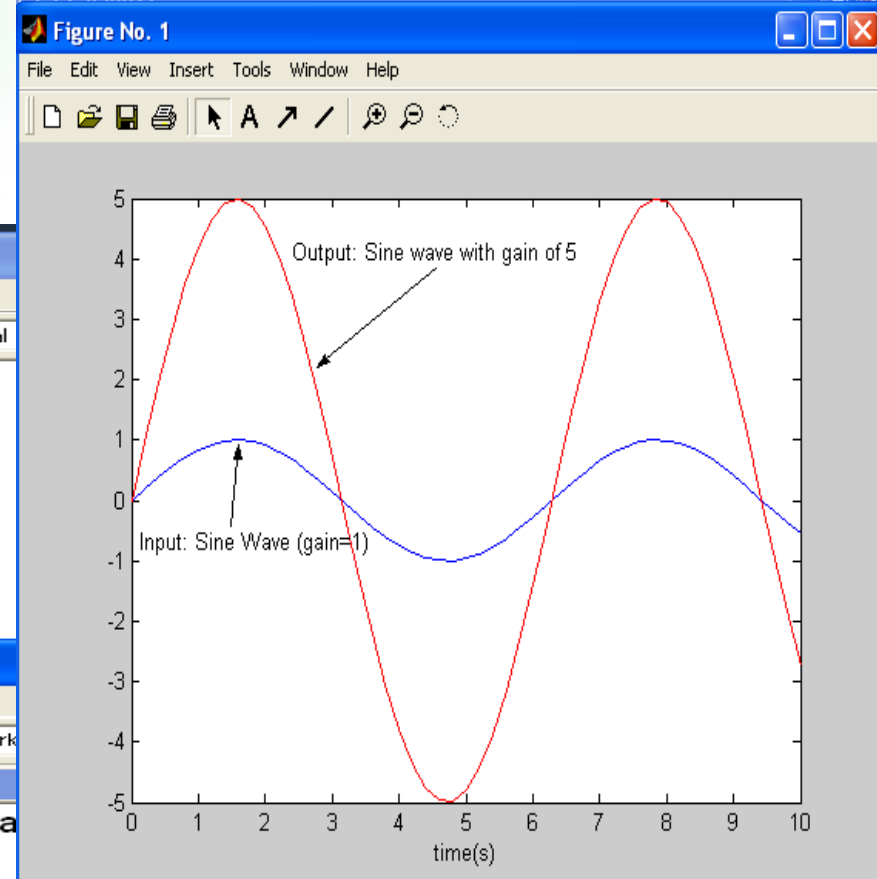
Sarı: Giriş sinüs dalga  
Mor: Çıkış (5 kazançlı sinüs dalga)

Double click on **Scope** bloğu üzerine tıklayarak sonuca bak.  
Osiloskopa benziyor.

# Çıkışa bak (workspace)



Üç çıkış burada



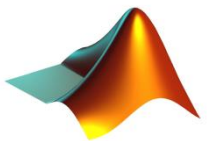
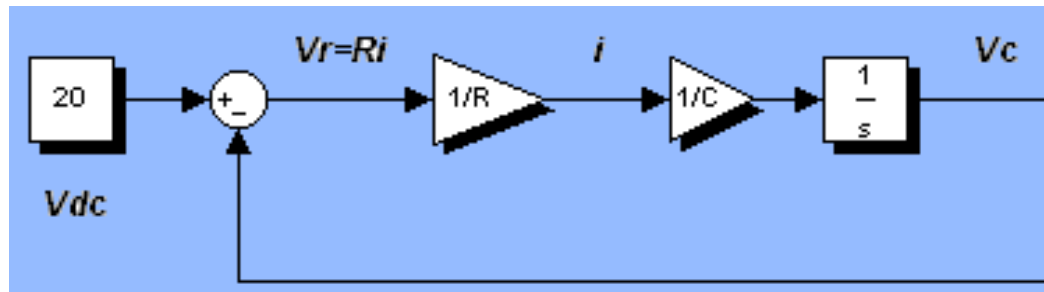
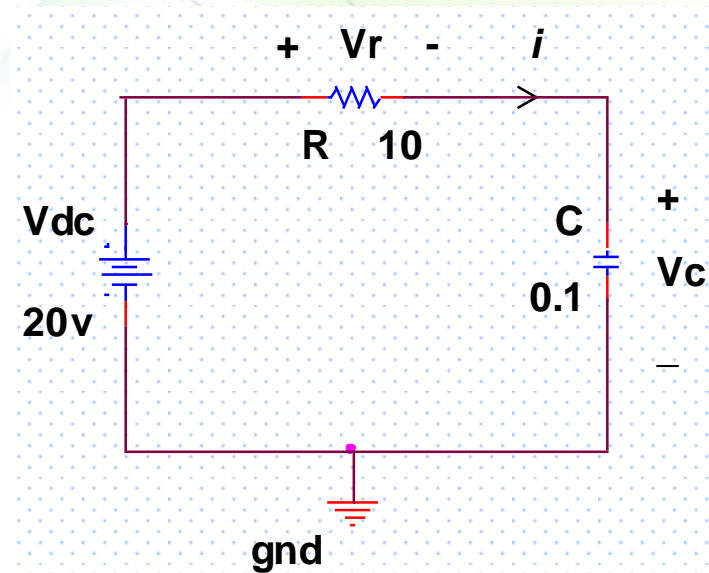
## ➤ RC DEVRESİ

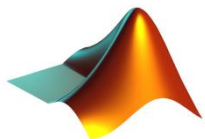
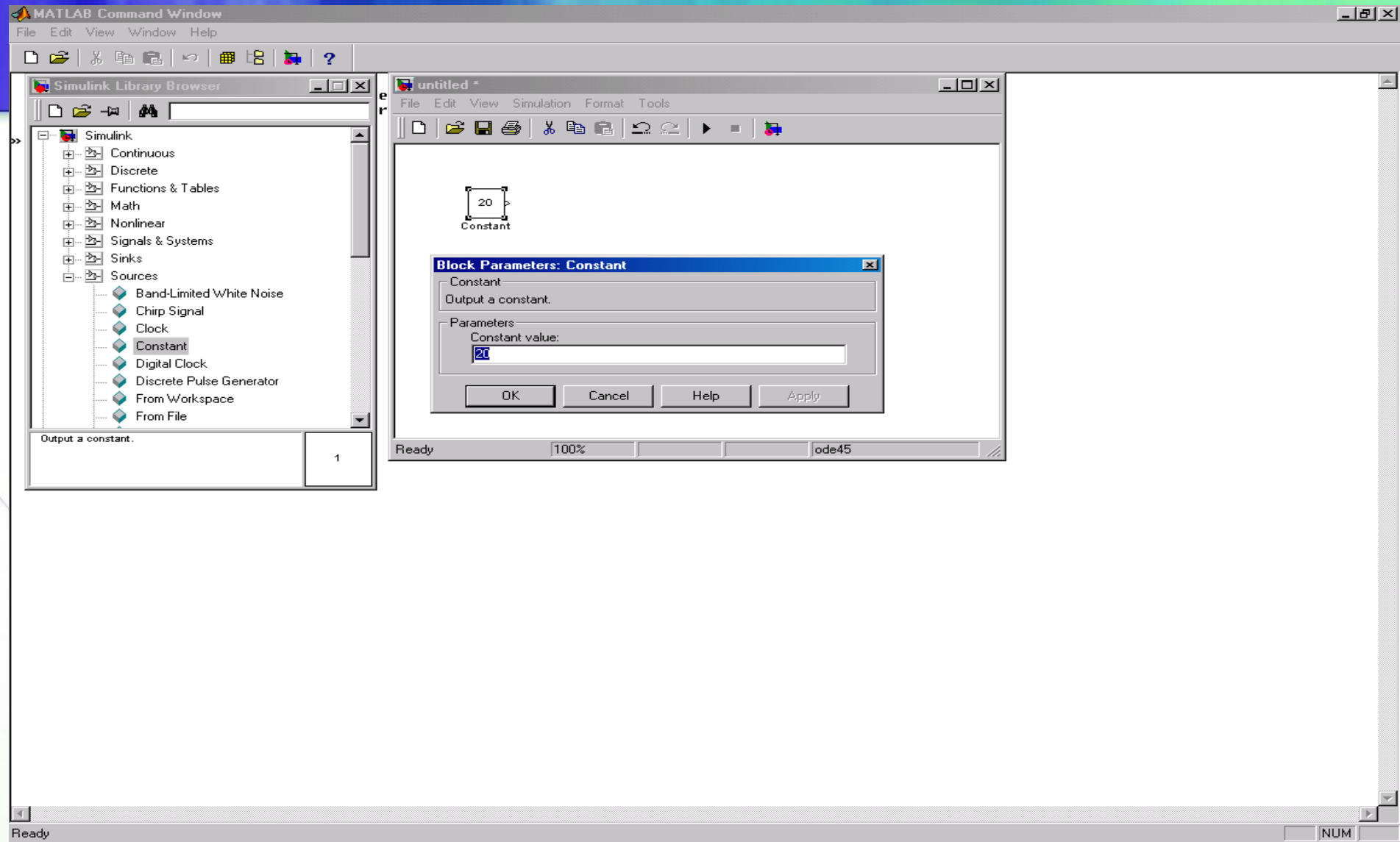
$$V_{dc} = V_r + V_c \Rightarrow V_{dc} = Ri + V_c$$

$$\Rightarrow V_{dc} - V_c = Ri = V_r$$

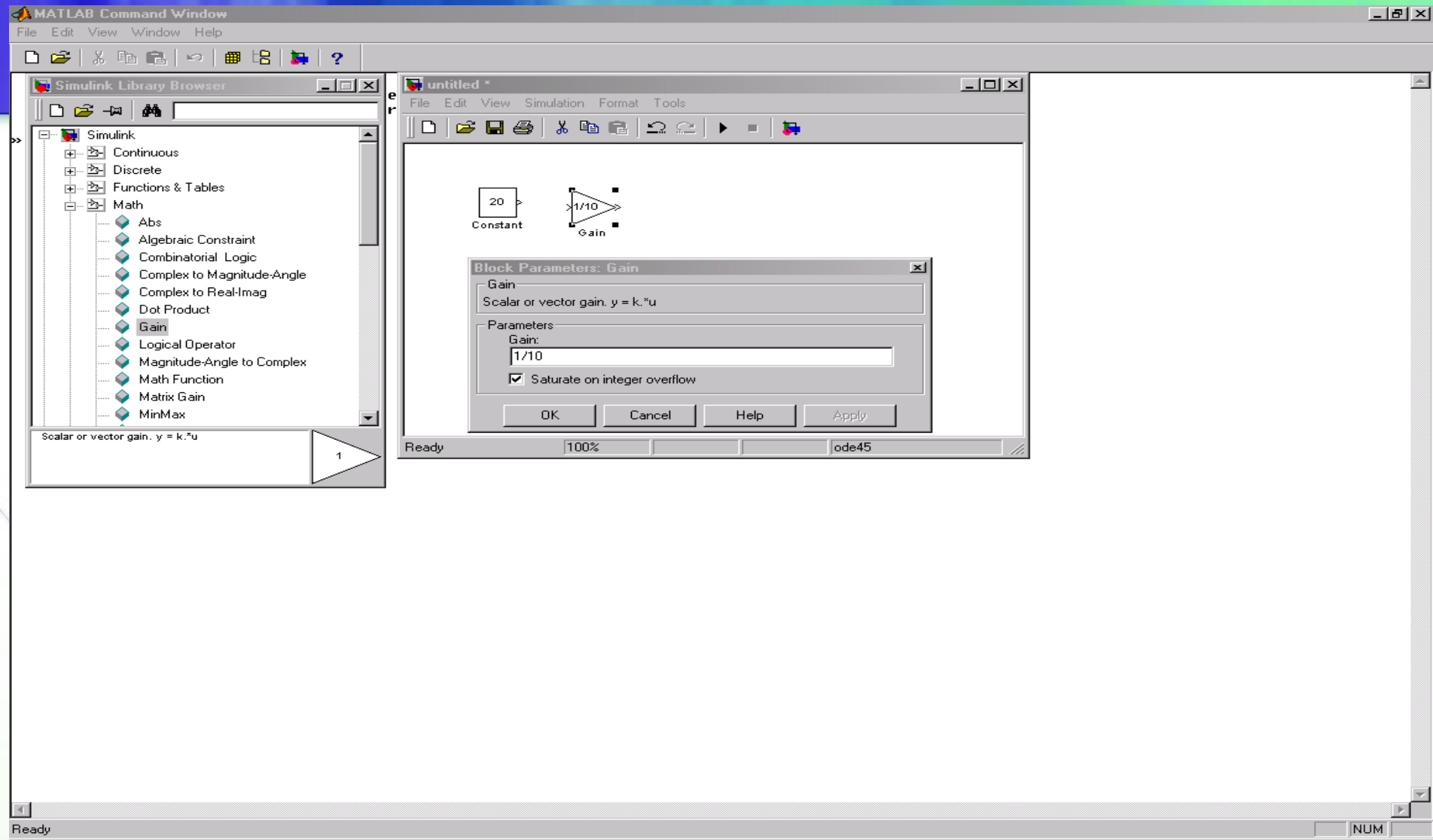
$$\Rightarrow i = \frac{V_{dc} - V_c}{R}$$

$$V_c = \frac{1}{C} \int i(dt)$$

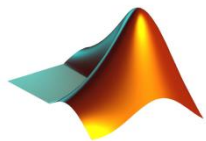




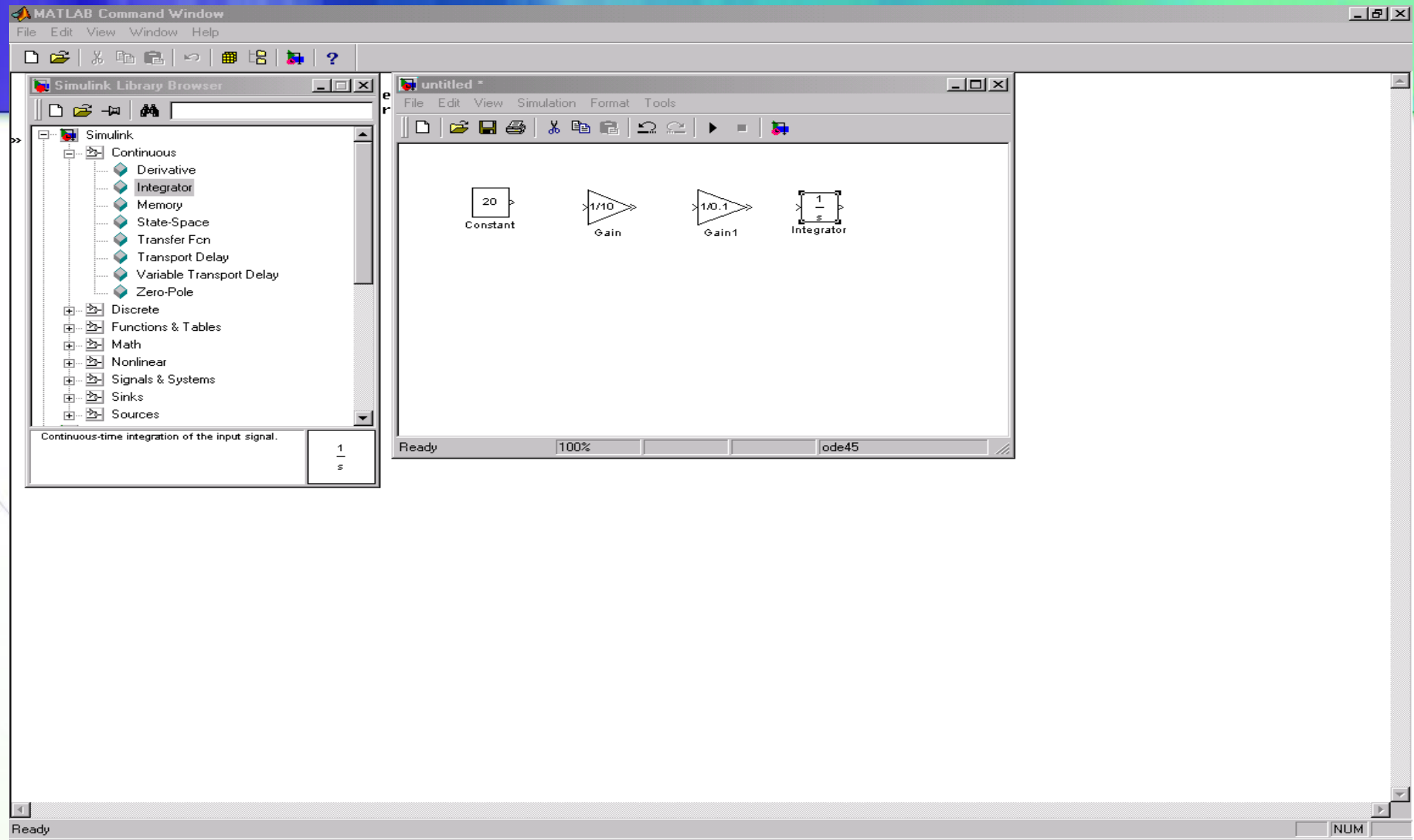
## **CONSTANT BLOĞA DEĞER ATANMASI**



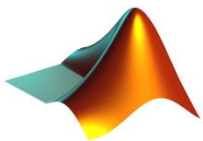
## KAZANCIN (GAIN) AYARLANMASI

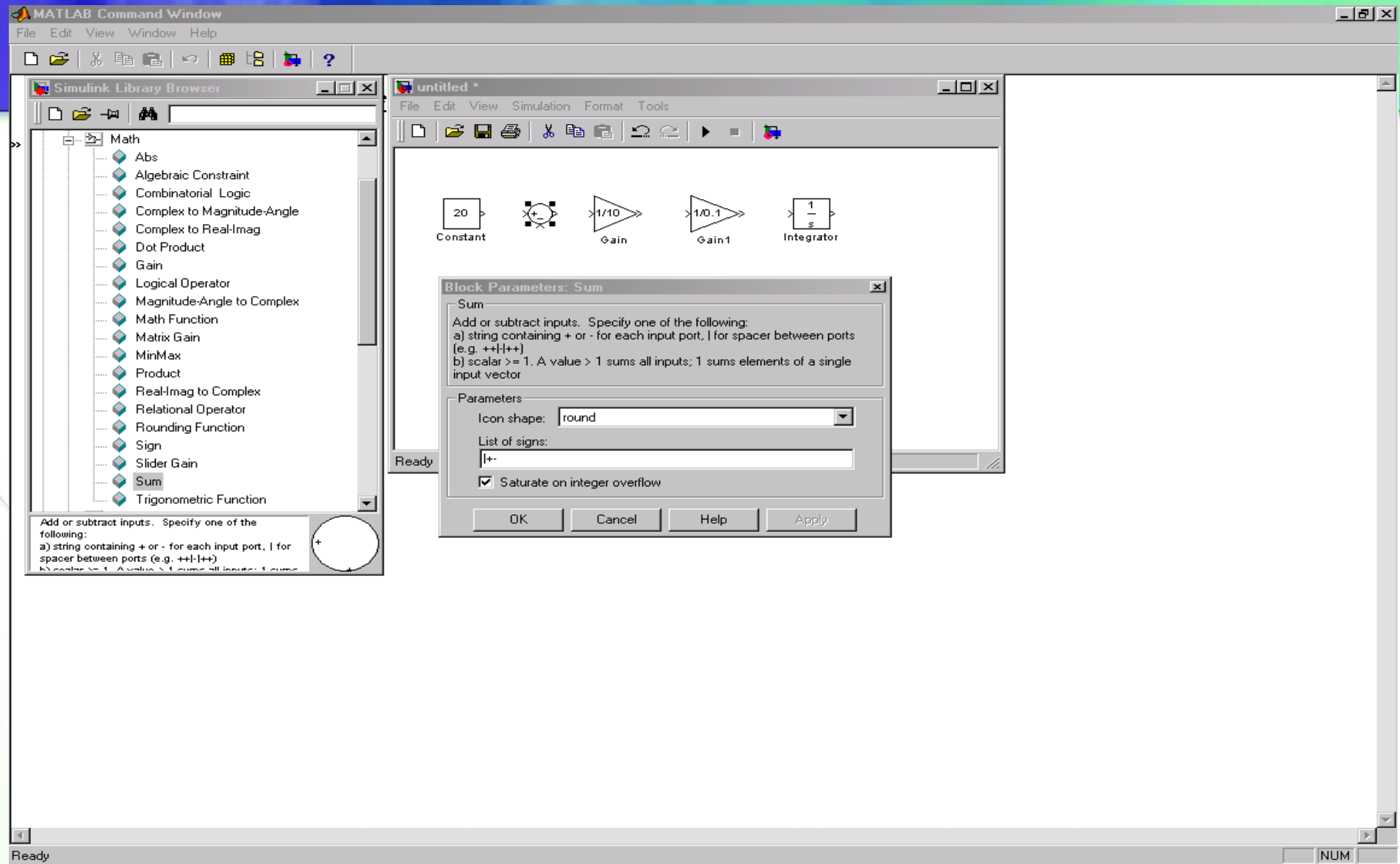




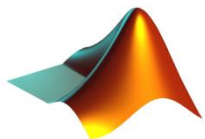


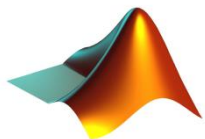
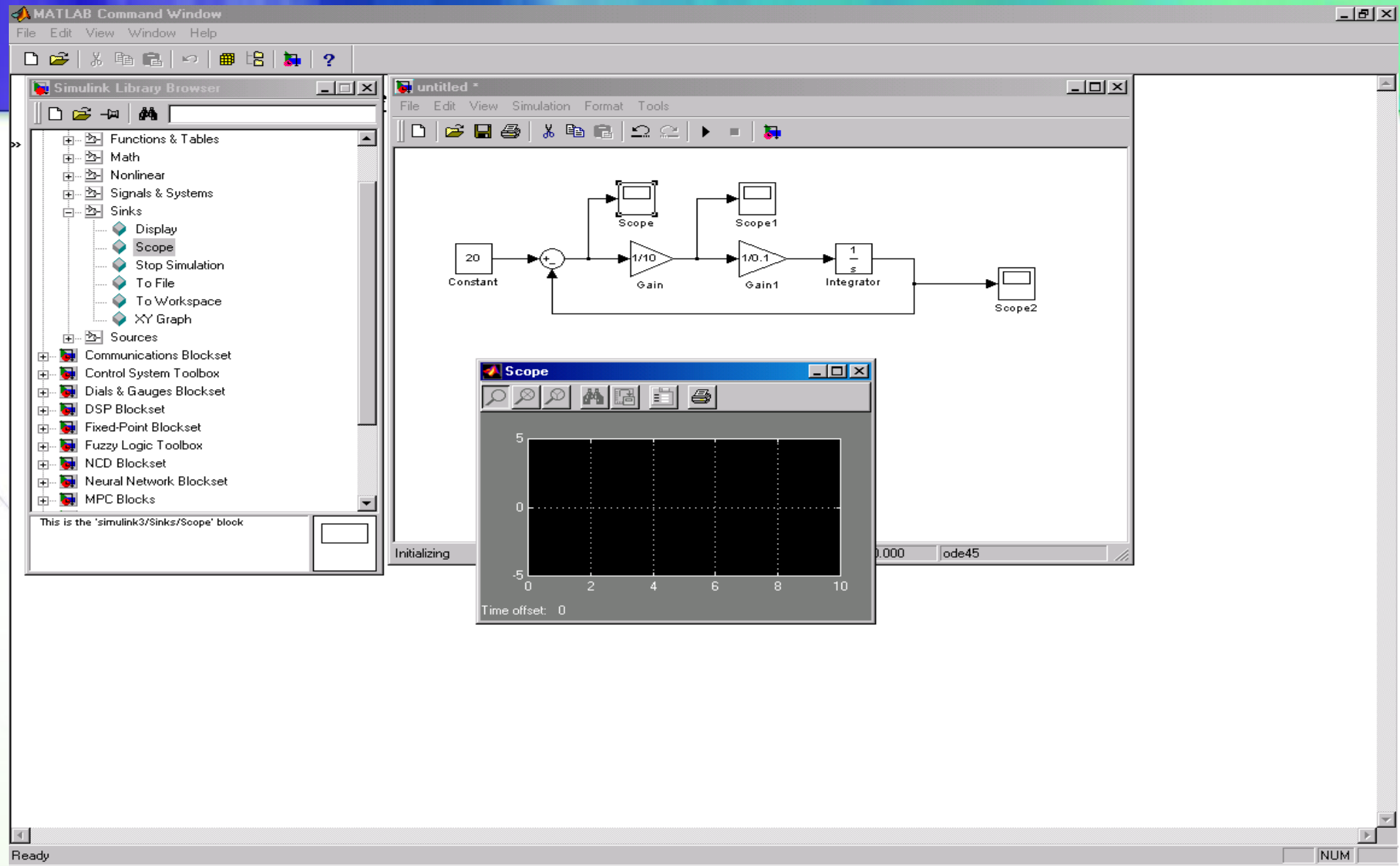
## ❖ İNTEGRATÖR YERLEŞTİRİLMESİ





## TOPLAYICININ (SUM) AYARLANMASI





## **SCOPELARIN BAĞLANMASI VE SCOPE EKRANI**

MATLAB Command Window

File Edit View Window Help

Simulink Library Browser

- Functions & Tables
- Math
- Nonlinear
- Signals & Systems
- Sinks
  - Display
  - Scope
  - Stop Simulation
  - To File
  - To Workspace
  - XY Graph
- Sources

Communications Blockset

Control System Toolbox

Dials & Gauges Blockset

DSP Blockset

Fixed-Point Blockset

Fuzzy Logic Toolbox

NCD Blockset

Neural Network Blockset

MPC Blocks

This is the 'simulink3/Sinks/Scope' block

untitled \*

File Edit View Simulation Format Tools

Start Ctrl+T

Stop

Parameters... Ctrl+E

Normal

External

Scope

Scope1

Scope2

Constant

Gain

Gain1

Integrator

Show the simulation parameters dialog 100% T=0.000 ode45

Simulation Parameters: untitled

Solver Workspace I/O Diagnostics Real-Time Workshop

Simulation time

Start time: 0.0 Stop time: 10.0

Solver options

Type: Variable-step ode45 (Dormand-Prince)

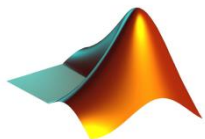
Max step size: auto Relative tolerance: 1e-3

Initial step size: auto Absolute tolerance: auto

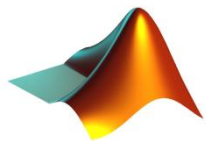
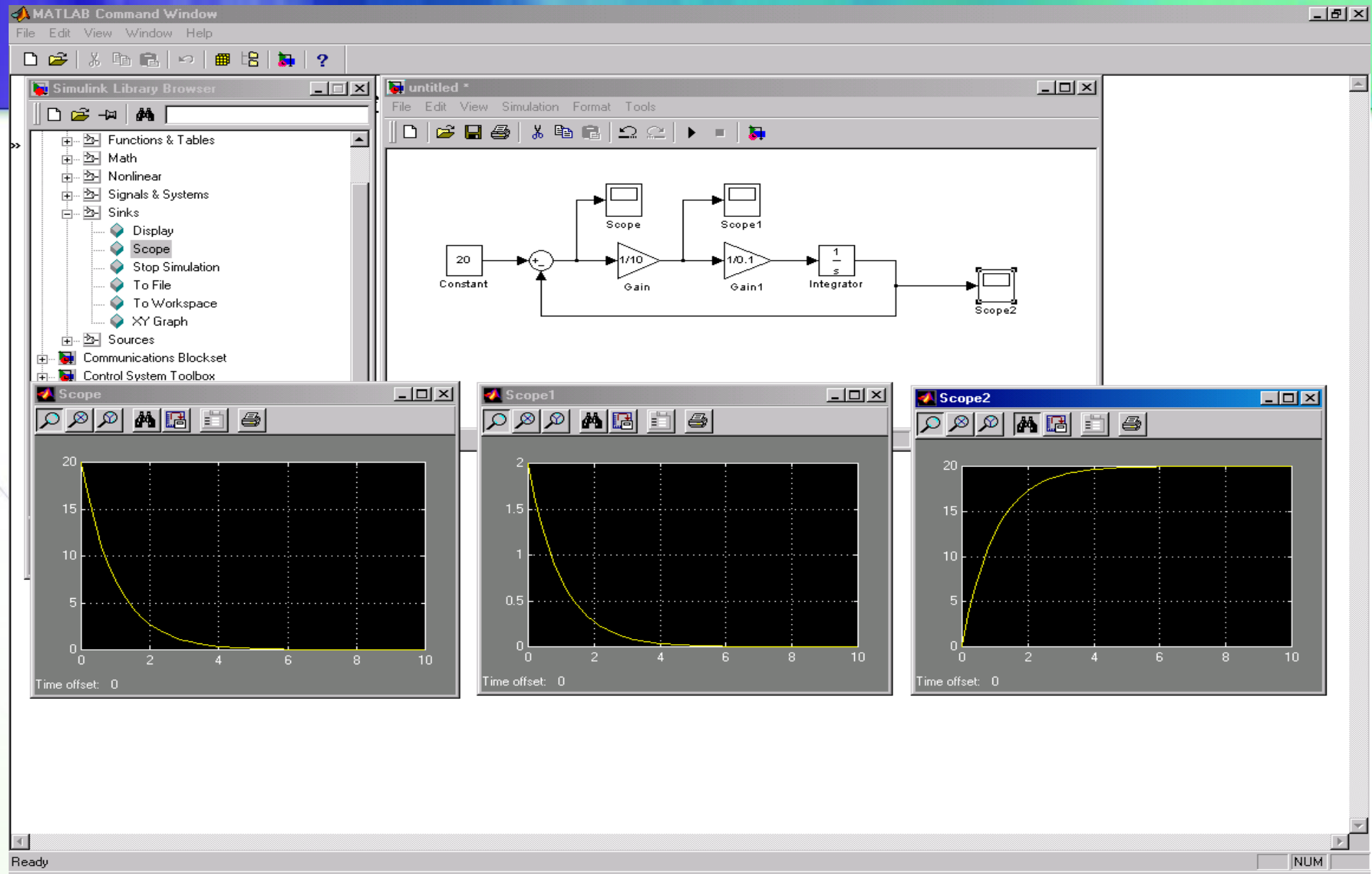
Output options

Refine output Refine factor: 1

OK Cancel Help Apply



## **SİMULASYON PARAMETRELERİNİN AYARLANMASI**



## **SİMÜLASYON SONUÇLARI (DİRENÇ GERİLİMİ, AKIM VE KAPASİTE GERİLİMİ)**

## ➤ RC DEVRESİ

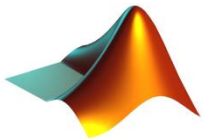
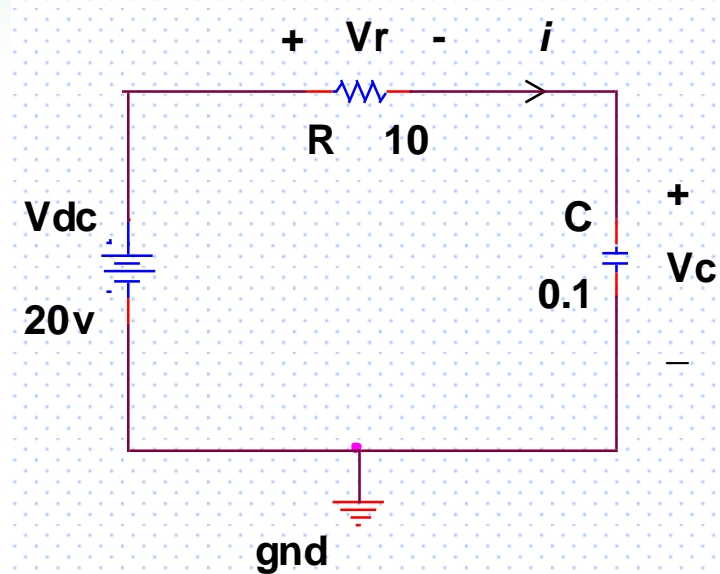
$$V_{dc} = V_r + V_c \dots (1) \quad i = C \frac{dV_c}{dt} \dots (2)$$

$$V_{dc} = Ri + V_c$$

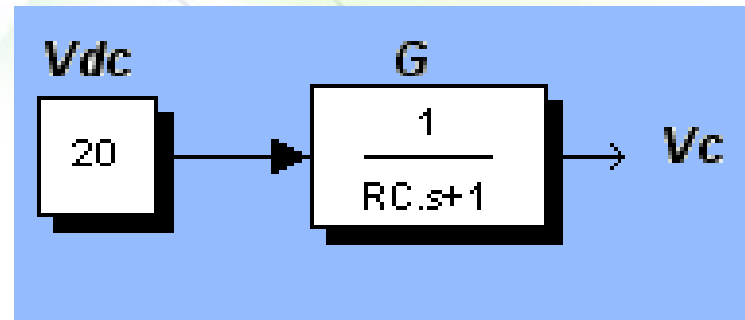
$$\Rightarrow V_{dc} = RC \frac{dV_c}{dt} + V_c$$

$$V_{dc}(s) = sRCV_c(s) + V_c(s) \Rightarrow V_c(s) = \frac{V_{dc}(s)}{1 + sRC}$$

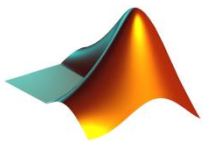
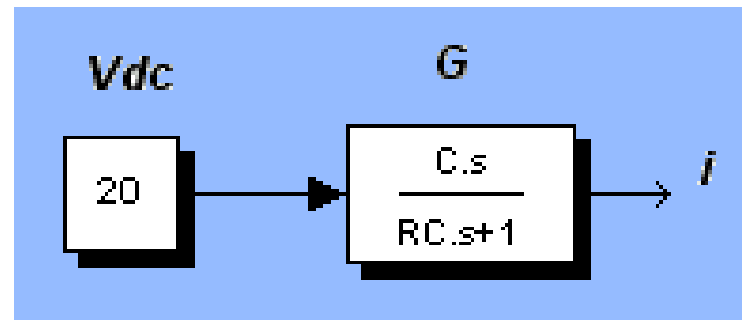
$$i(s) = \frac{sC}{1 + sRC} V_{dc}(s)$$



$$V_c(s) = \frac{1}{1+sRC} V_{dc}(s)$$



$$i(s) = \frac{sC}{1+sRC} V_{dc}(s)$$



MATLAB Command Window

File Edit View Window Help

Simulink Library Browser

Simulink

- Continuous
  - Derivative
  - Integrator
  - Memory
  - State-Space
  - Transfer Fcn
  - Transport Delay
  - Variable Transport Delay
  - Zero-Pole
- Discrete
- Functions & Tables
- Math
- Nonlinear
- Signals & Systems
- Sinks
- Sources
- Communications Blockset
- Control System Toolbox
- Dials & Gauges Blockset
- DSP Blockset
- Fixed-Point Blockset
- Fuzzy Logic Toolbox
- NCD Blockset

Matrix expression for numerator, vector expression for denominator. Output width equals the number of rows in the numerator. Coefficients are for descending powers of s.

$\frac{1}{s+1}$

sunumrcm11

File Edit View Simulation Format Tools

Ready 100% ode45

Block Parameters: Transfer Fcn1

Transfer Fcn

Matrix expression for numerator, vector expression for denominator. Output width equals the number of rows in the numerator. Coefficients are for descending powers of s.

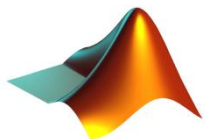
Parameters

Numerator:  
[0.1 0]

Denominator:  
[1 1]

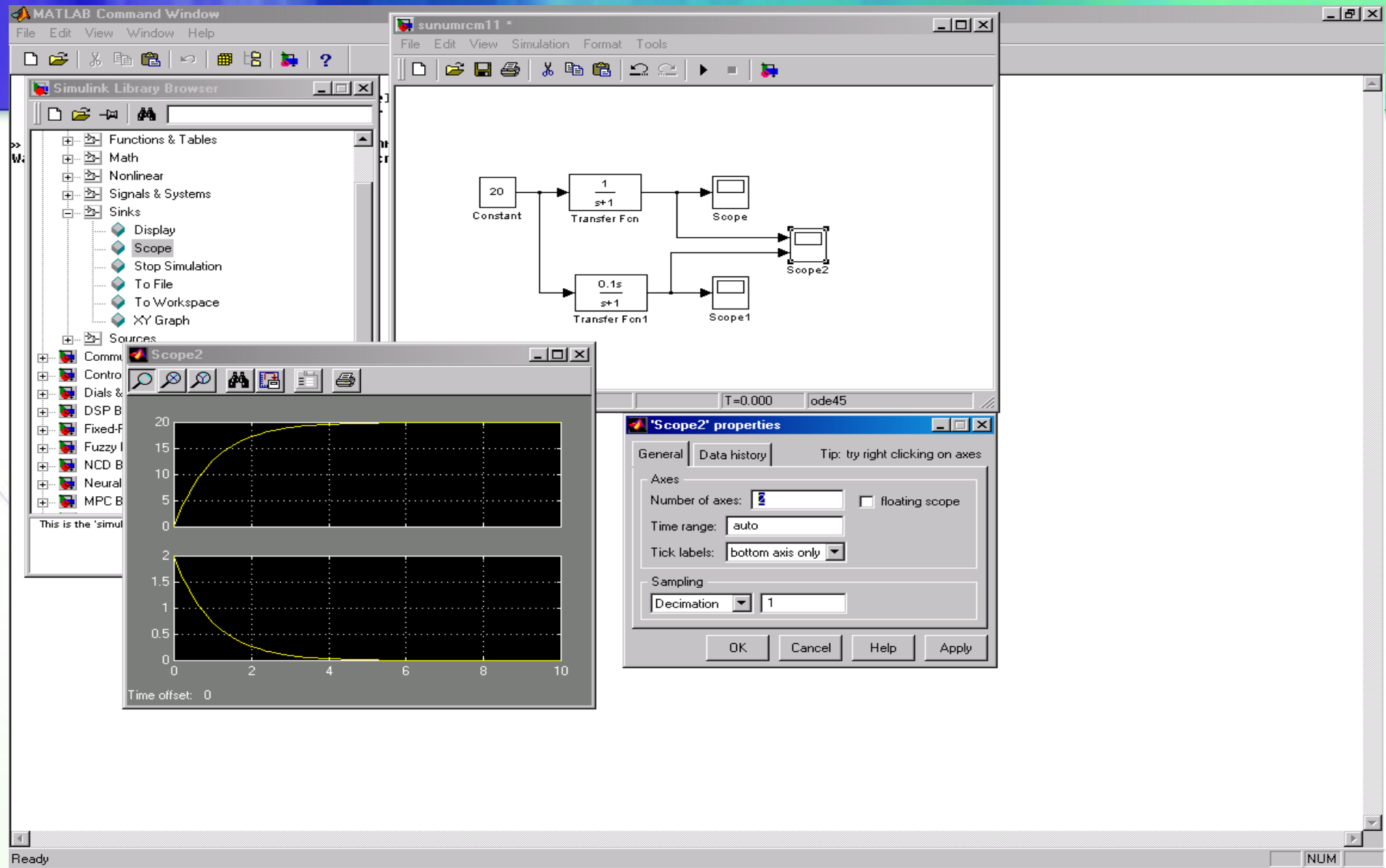
OK Cancel Help Apply

Ready NUM

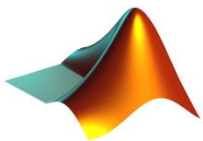


## **TRANSFER FUNCTION PARAMETRELERİNİN GİRİLMESİ**

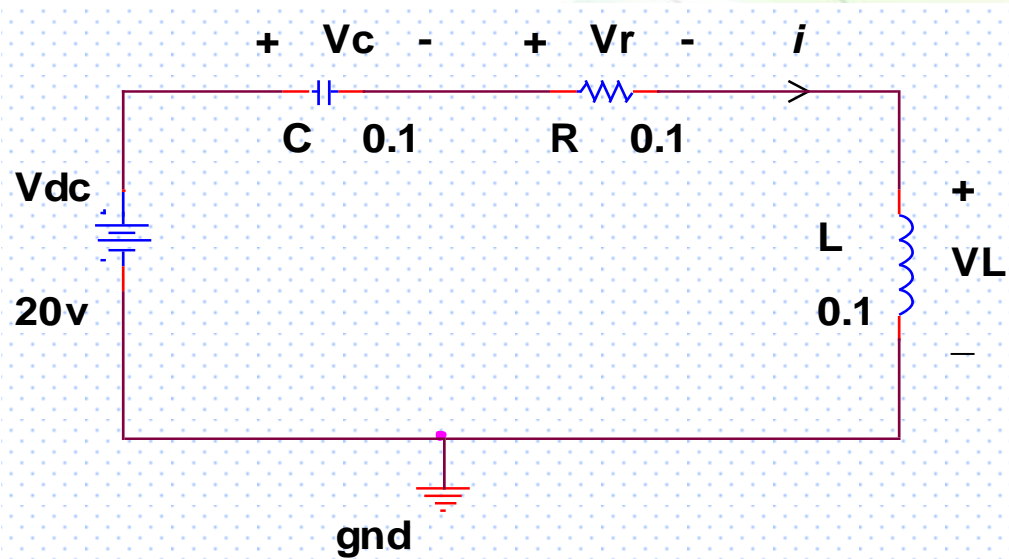




## **SCOPE EKSEN SAYISININ ARTTIRILMASI**



## ➤ RLC DEVRESİ

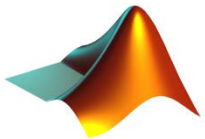


$$V_{dc} = V_r + V_c + V_L$$

$$i = C \frac{dV_c}{dt}$$

$$V_L = L \frac{di}{dt}$$

$$V_{dc} = Ri + L \frac{di}{dt} + V_c$$



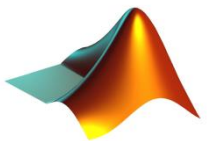
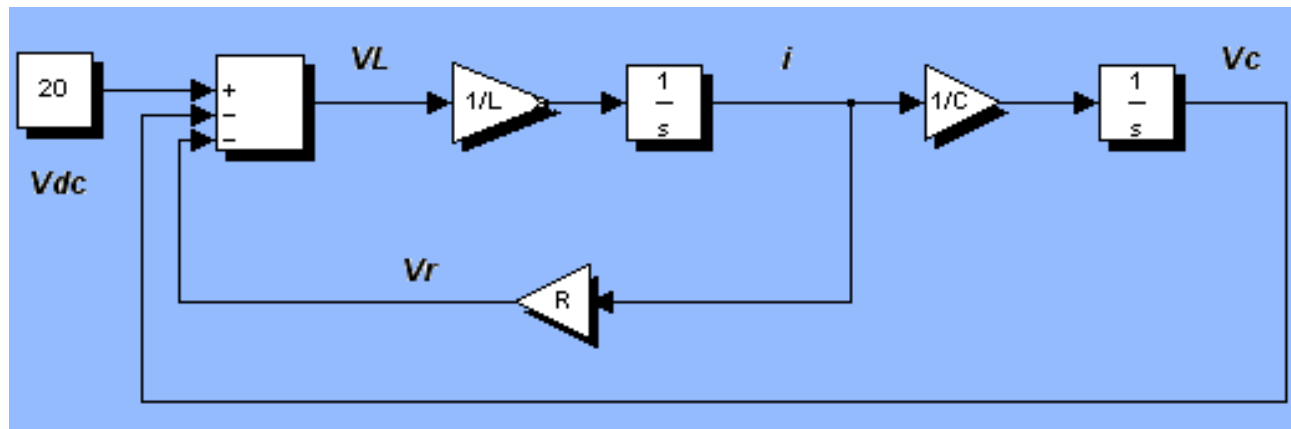
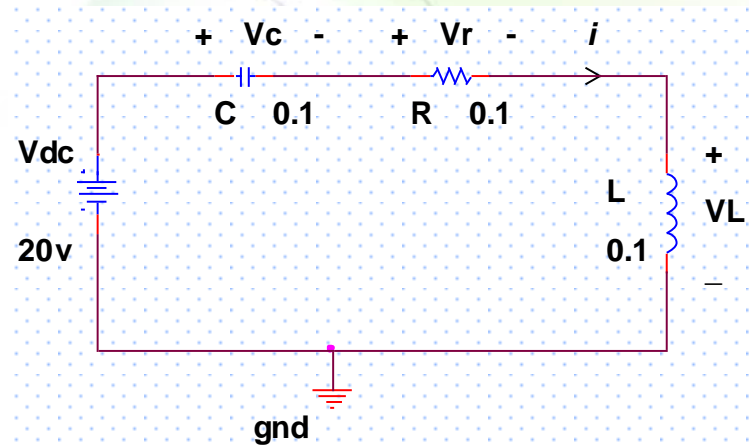
## ➤ RLC DEVRESİ

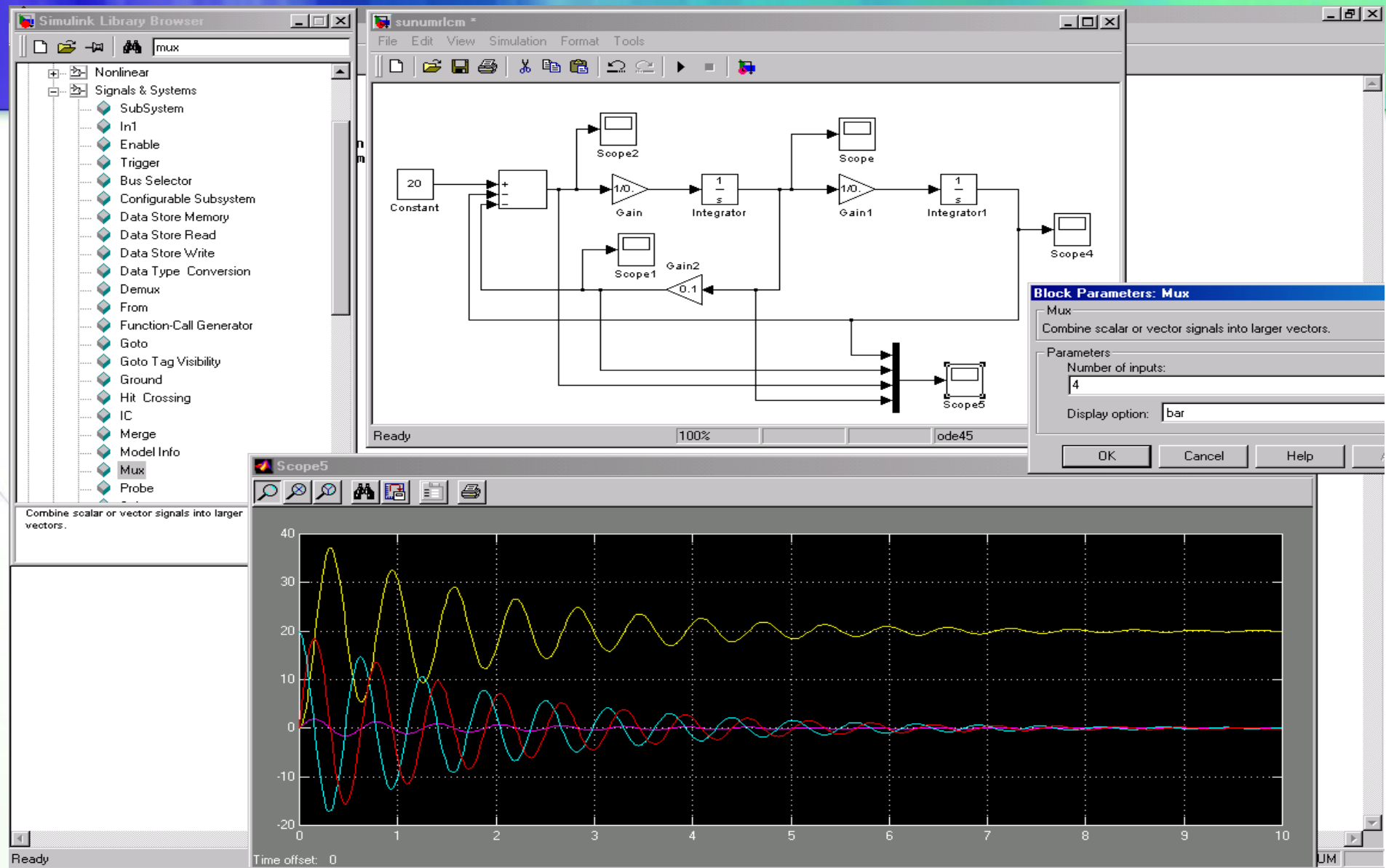
$$V_{dc} - V_r - V_c = V_L$$

$$V_{dc} - Ri - V_c = L \frac{di}{dt}$$

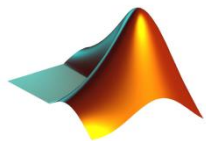
$$i = C \frac{dV_c}{dt} \quad V_L = L \frac{di}{dt}$$

$$V_r = Ri$$



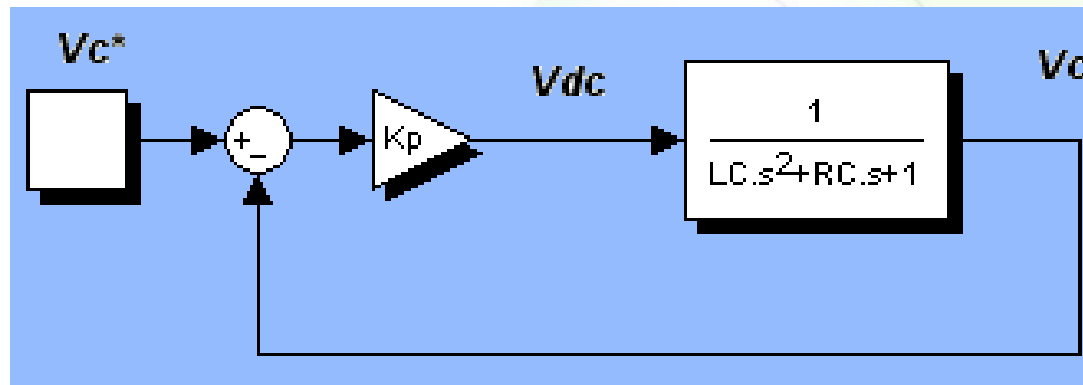


## ❖ RLC DEVRESİNDE MUX KULLANILARAK SİMÜLASYON SONUÇLARININ ELDE EDİLMESİ



## ➤ RLC DEVRESİ

(kapasite gerilimi kontrolü)

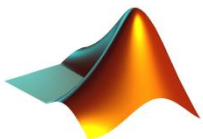


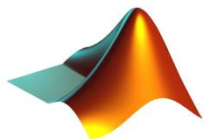
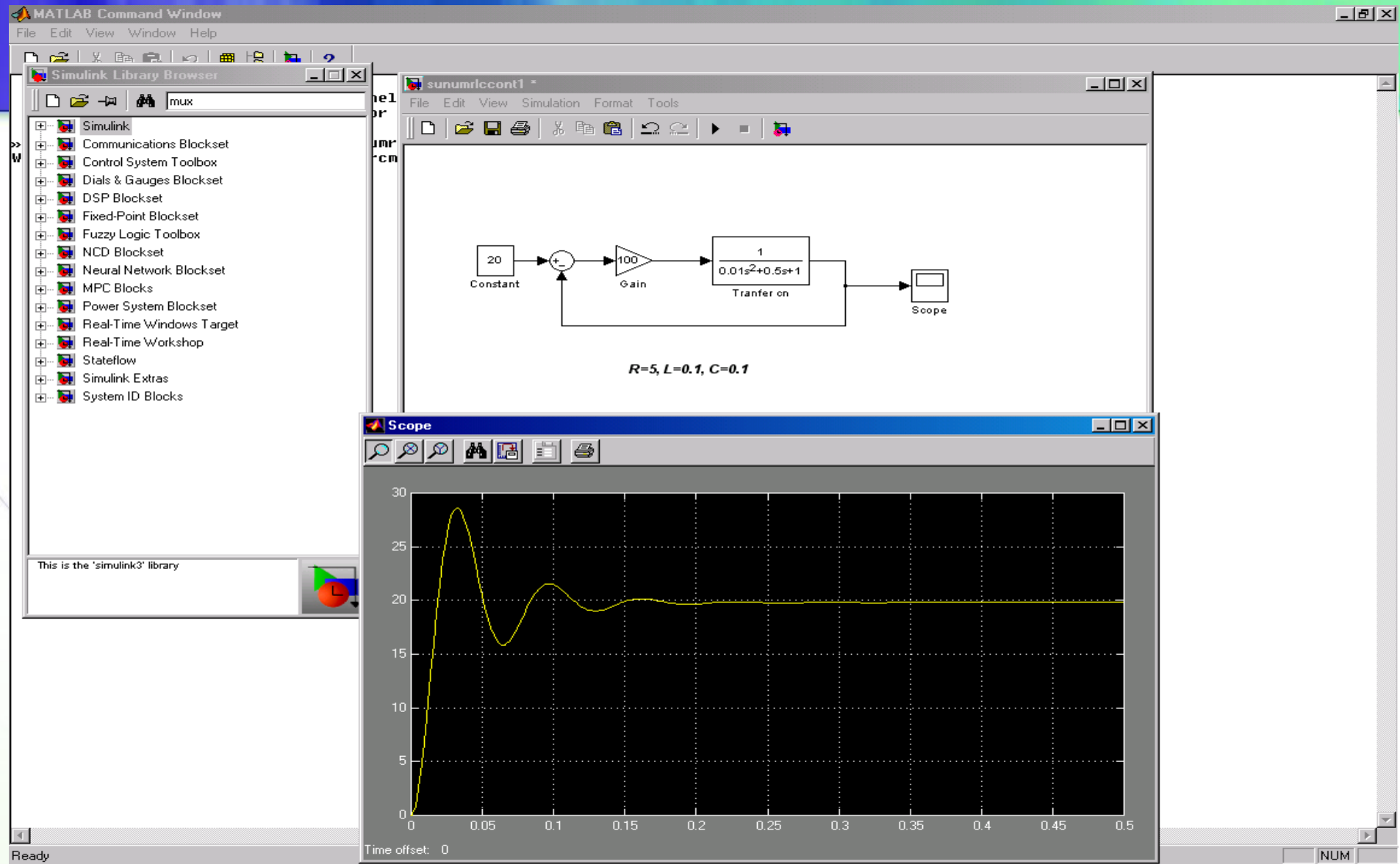
$$V_{dc} = V_r + V_c + V_L$$

$$V_{dc} = RC \frac{dV_c}{dt} + LC \frac{d^2 V_c}{dt^2} + V_c$$

$$V_{dc}(s) = sRCV_c(s) + s^2LCV_c(s) + V_c(s)$$

$$V_c(s) = \frac{1}{s^2LC + sRC + 1} V_{dc}(s)$$



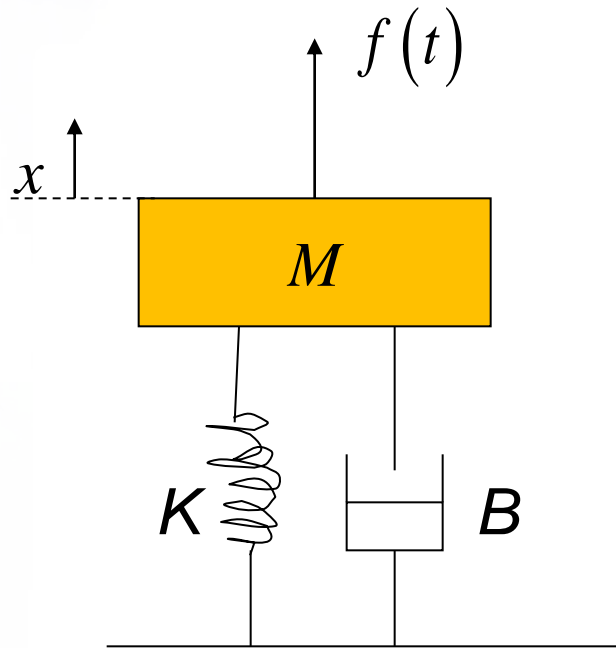


## **KAPASİTE GERİLİMİ KONTROLLÜ RLC DEVRESİ SİMÜLASYONU**

# Alt blok oluşturma

- **Subsystem – similar to “Subroutine”**
- **Advantage of Subsystems:**
  - **Reduce the number of blocks display on the main window (i.e. simplify the model)**
  - **Group related blocks together (i.e. More organized)**
  - **Can create a hierarchical block diagram (i.e. you can create subsystems within a subsystem )**
  - **Easy to check for mistakes and to explore different parameters**

## Bir dinamik sistemin örneği: kütle-yay –sönüm sistemi



Sistemin matematiksel modeli:

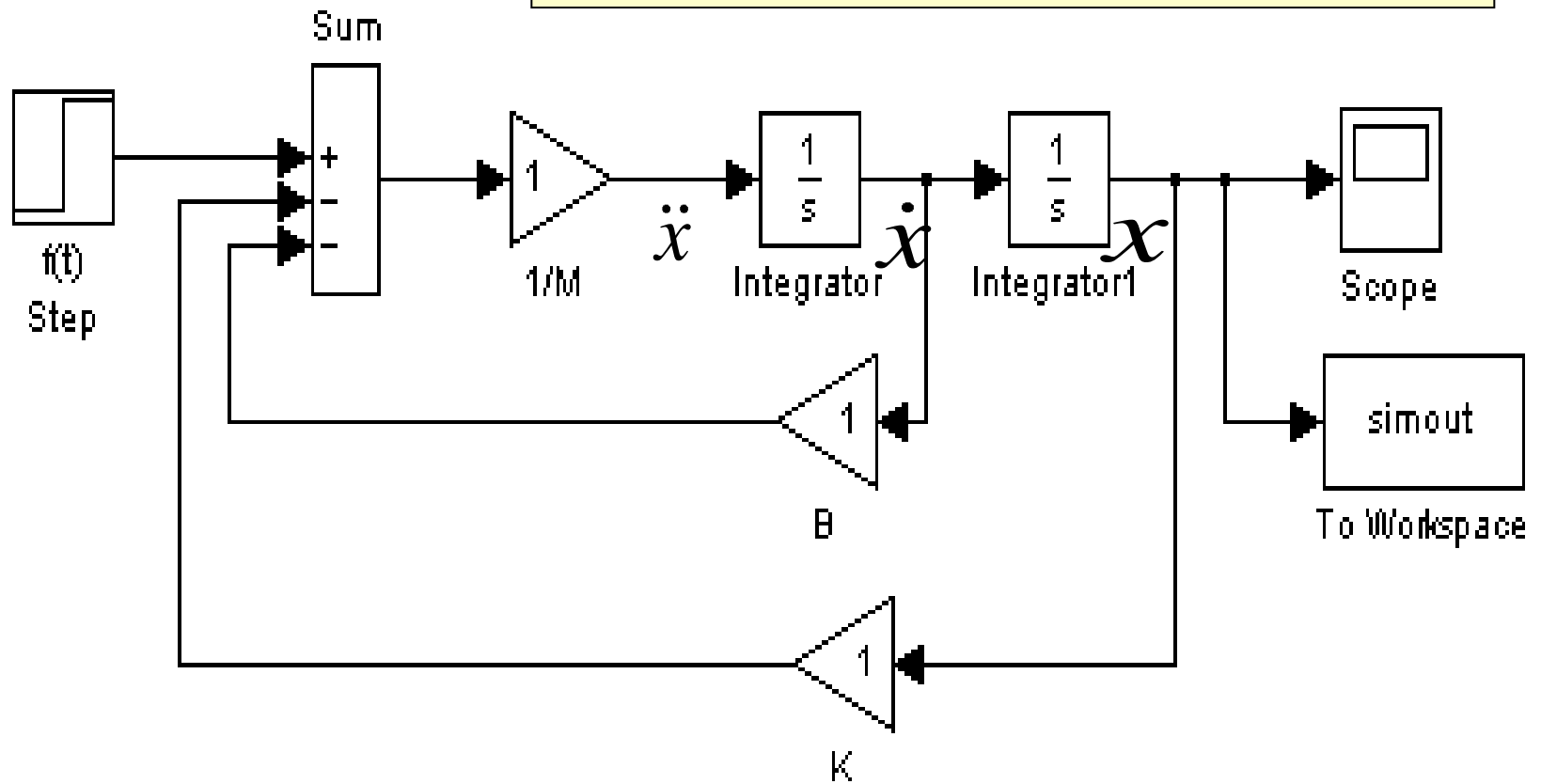
$$\ddot{x} = \frac{1}{M} (-B\dot{x} - Kx + f(t))$$

$M=2\text{kg}$ ;  $B = 2 \text{ Ns/m}$ ;  $K=2 \text{ N/m}$  olsun

$$\ddot{x} = \frac{1}{2} (-2\dot{x} - 2x + f(t))$$

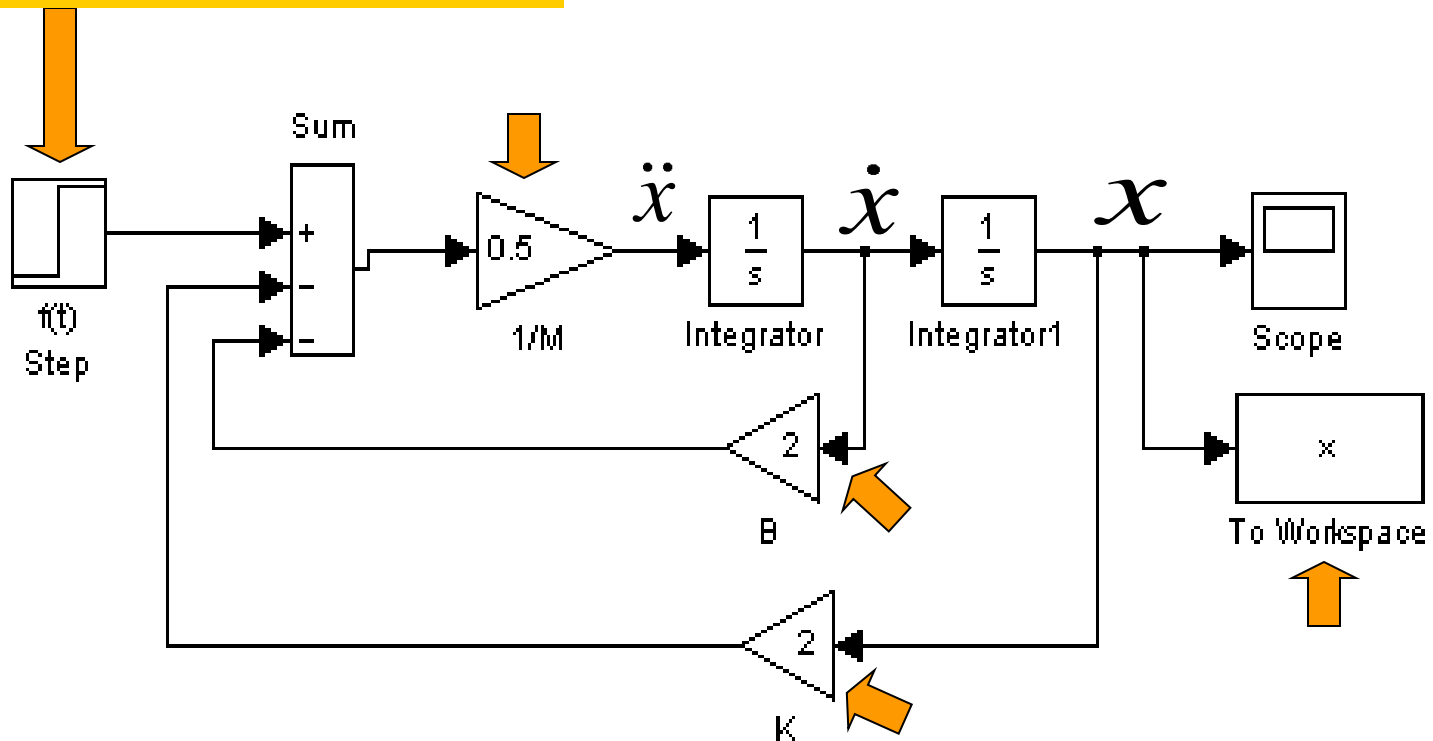


$$\ddot{x} = \frac{1}{2}(-2\dot{x} - 2x + f(t))$$



$$\ddot{x} = \frac{1}{2}(-2\dot{x} - 2x + f(t))$$

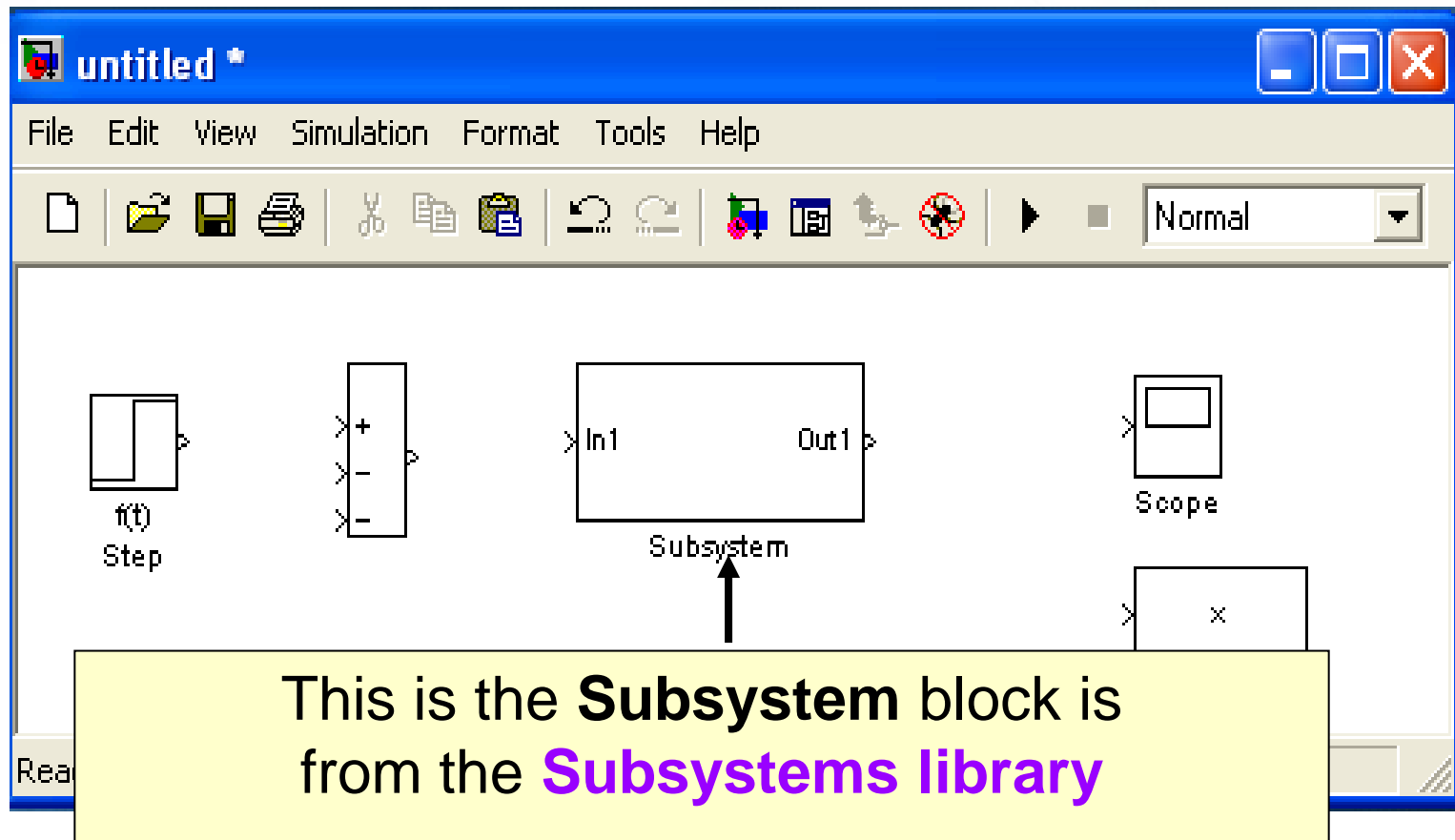
Step time =0 olarak ayarla



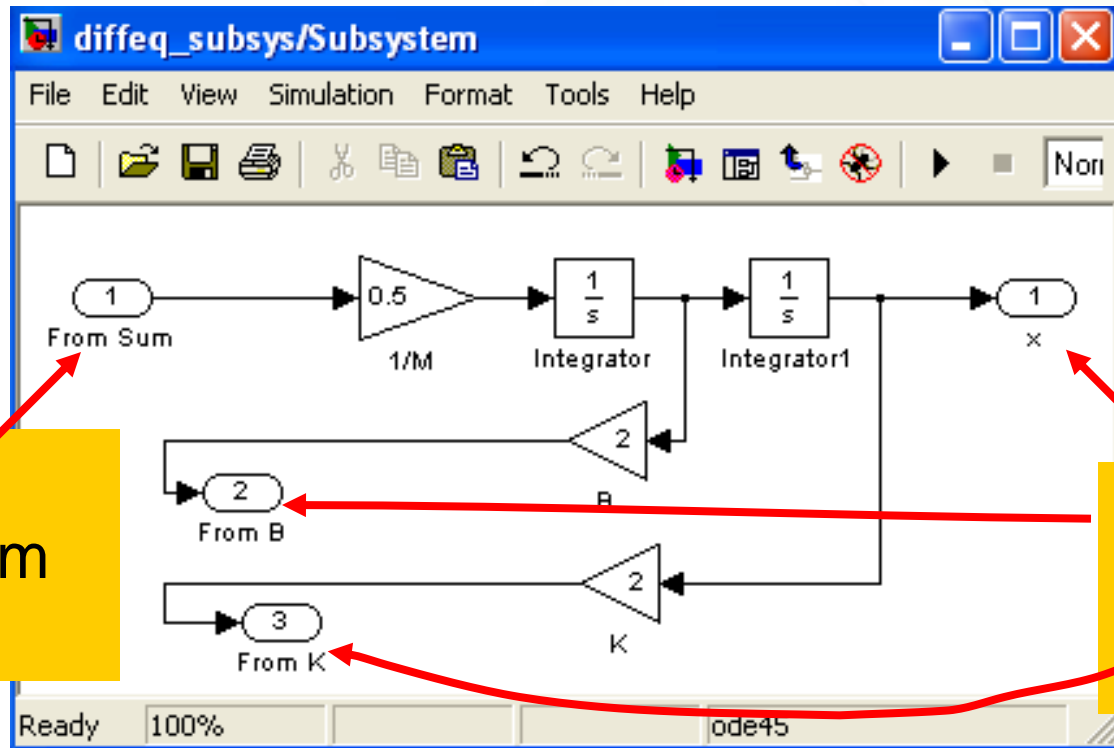
Not: Tüm başlangıç şartlarını= al.

# Create Subsystem

## STEP 1: Creating Blocks (Main window)



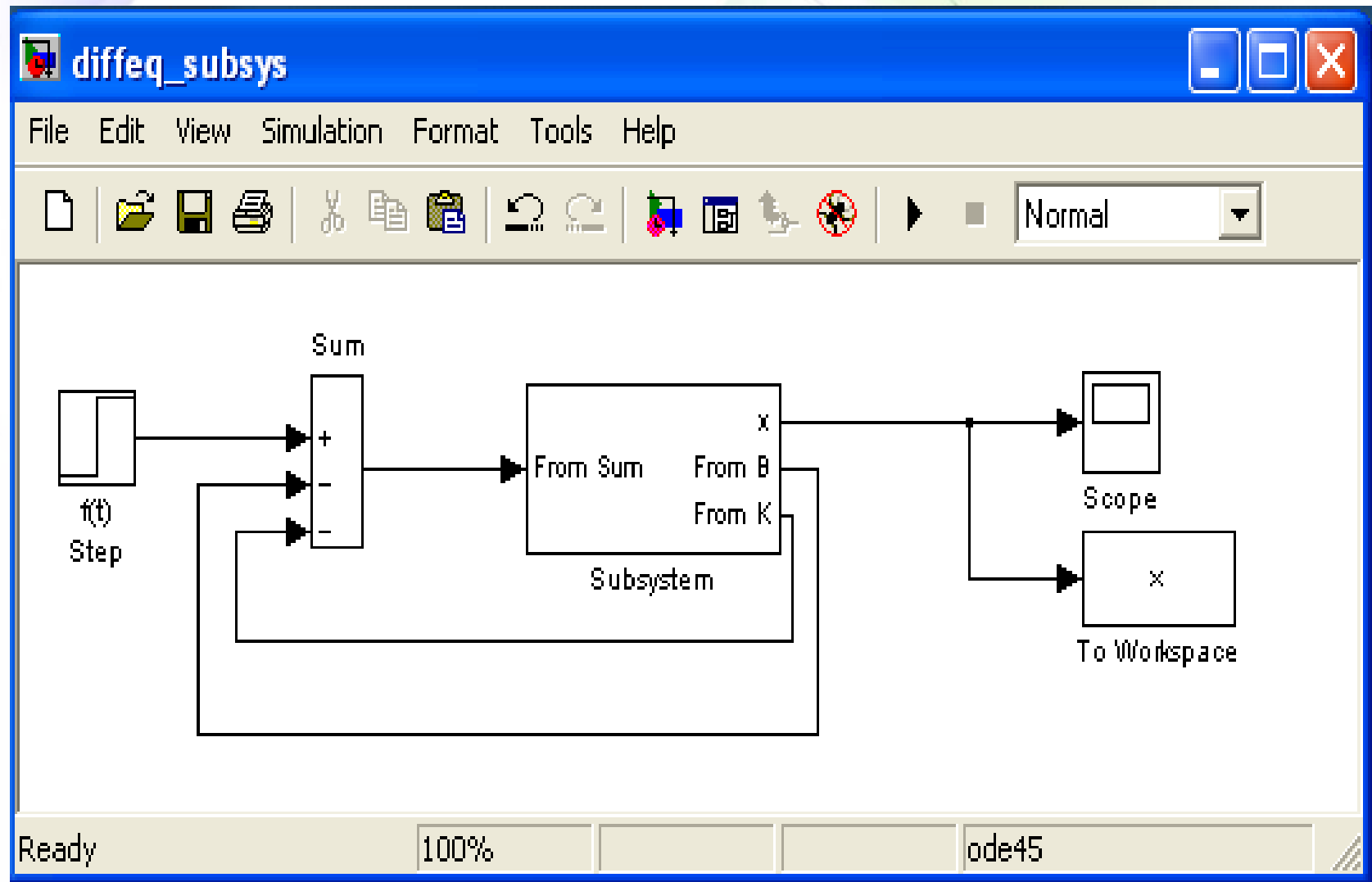
## STEP 2: Double click Subsystem block and create a *model* in the Subsystem block



Inport  
(named from  
"sum")

Output  
(three  
outputs)

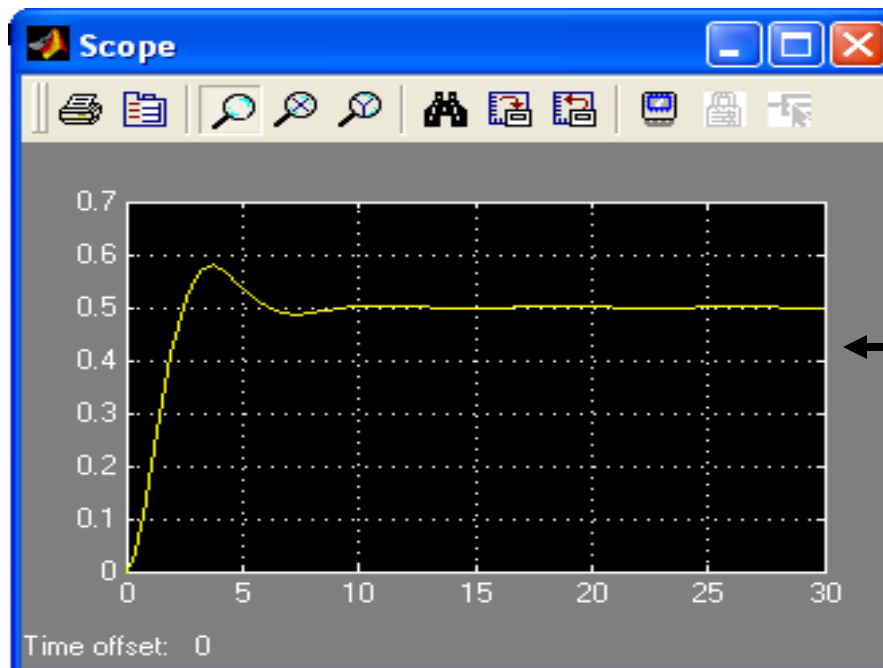
# STEP 3: Making connections (Main window)



STEP 4: Set Parameter (Main window)

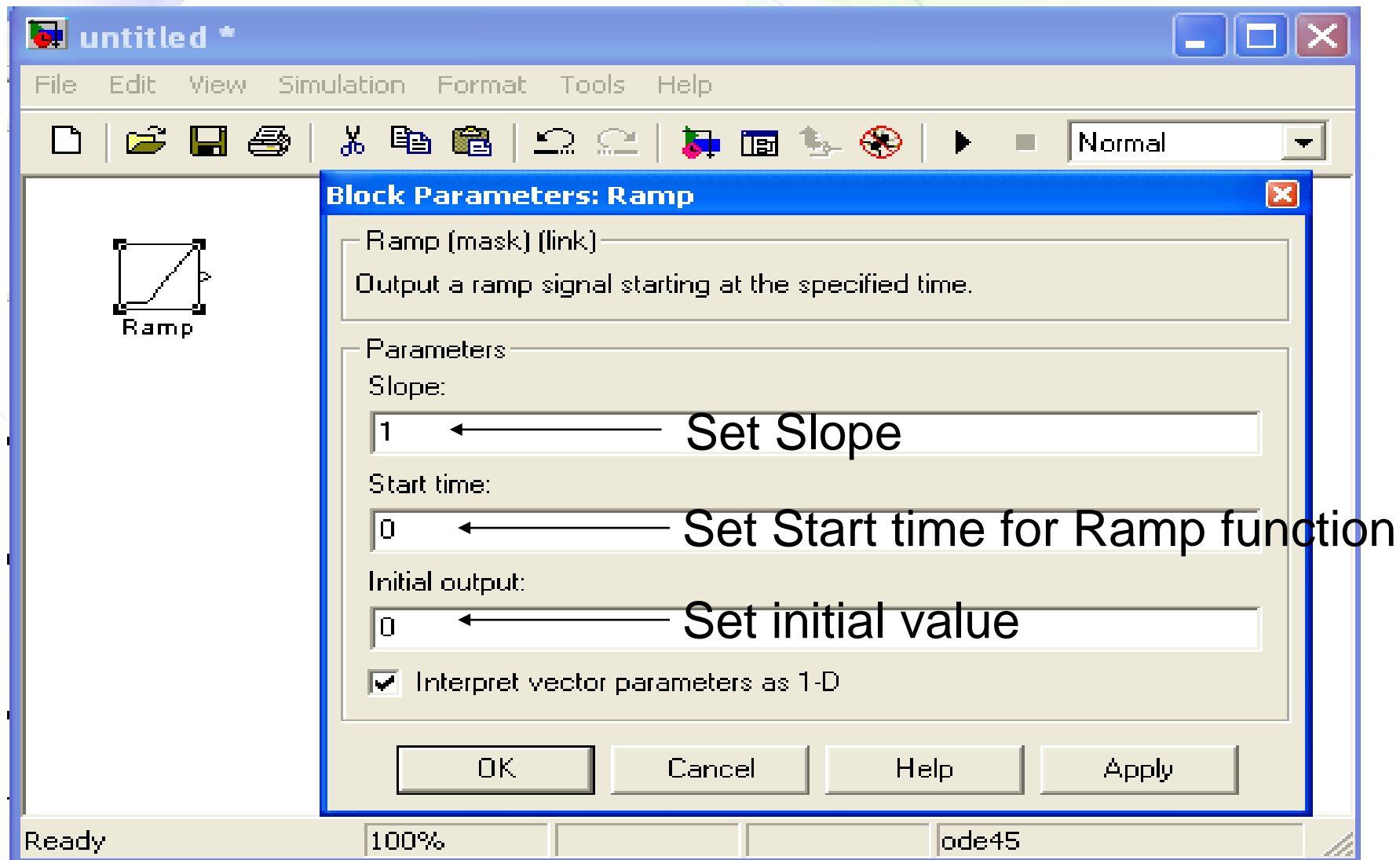
STEP 5: Running Simulation

Then view output response

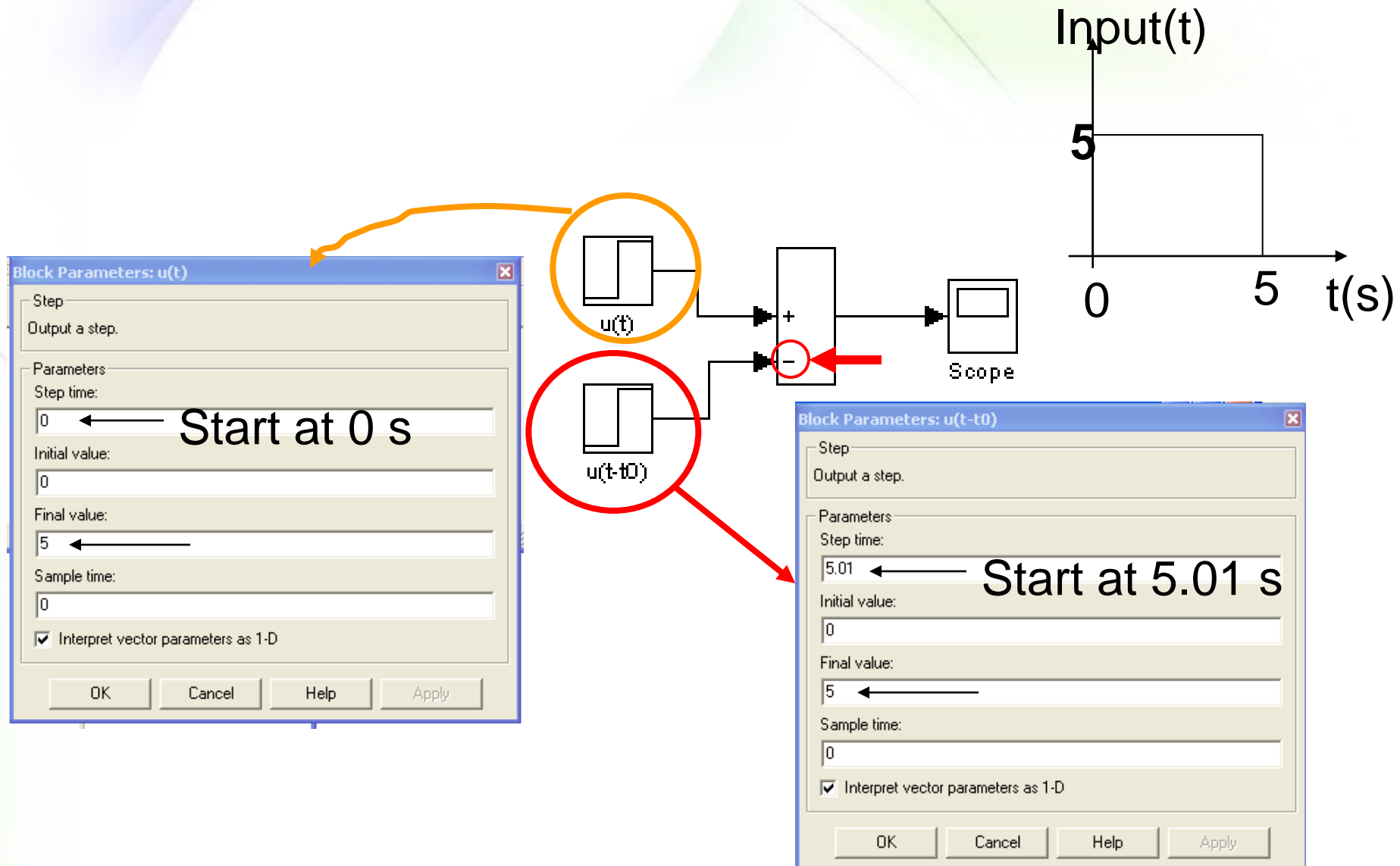


Output from Scope block

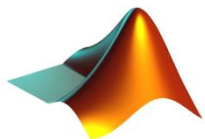
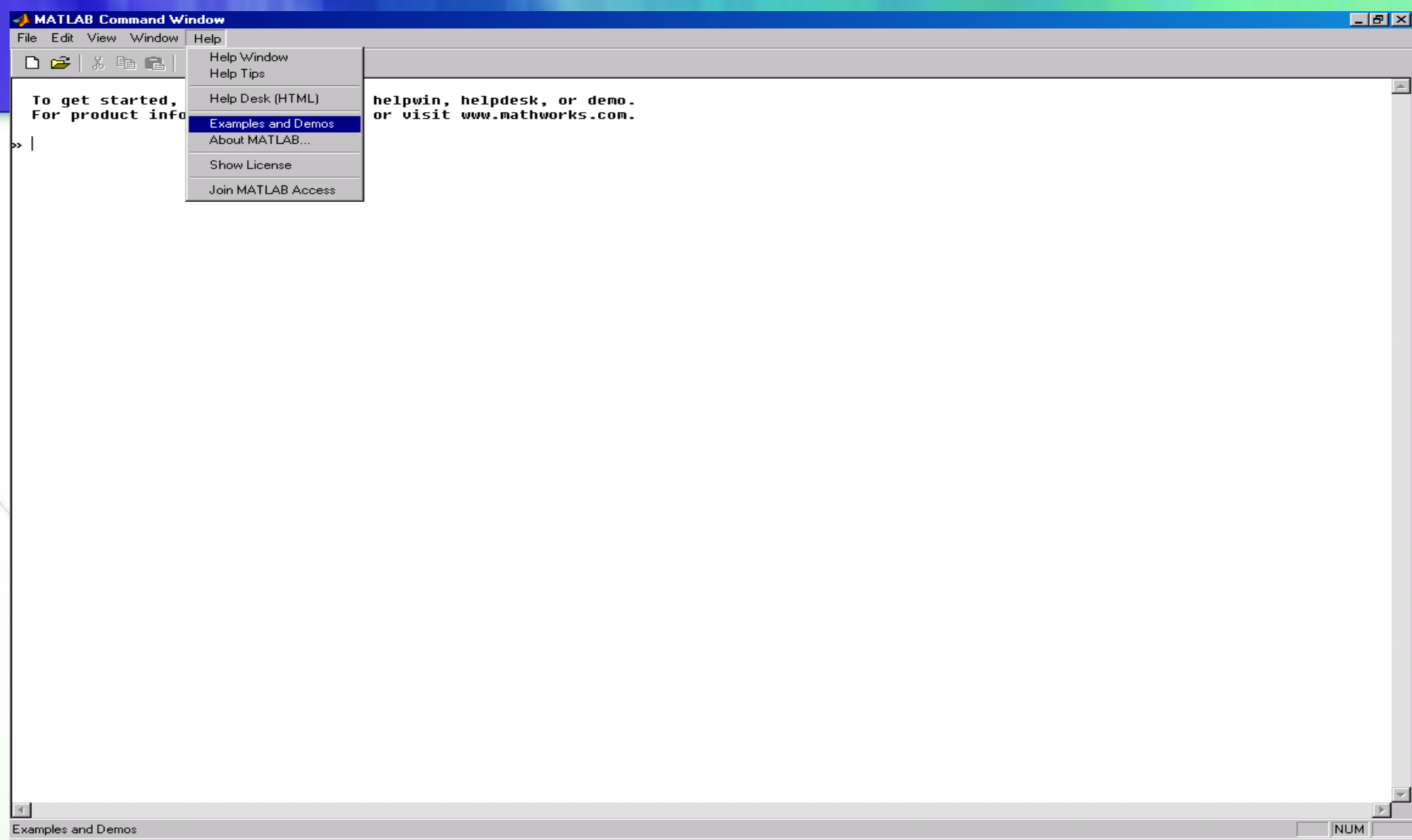
# Ramp Function



# Unit Step Function or Impulse







 **SIMULINK DEMOLARI**

**MATLAB Command Window**  
File Edit View Window Help

To get started, type one of these:  
For product information, type tour

**psbmconv**  
File Edit View Simulation Format Tools

**MATLAB Demo Window**

# MATLAB Demos

- +MATLAB
- +Toolboxes
- Simulink
  - New in Simulink 3
  - New in Simulink 2
  - Simple models
  - Complex models
  - Advanced Products
- Blocksets
  - Dials & Gauges
  - Power System Blockset**
  - Fixed Point
  - DSP Blockset
  - Nonlinear Control Design
- +Stateflow

**Power System Blockset**

The Power System Blockset provides the ability to model and simulate electrical power systems and drives within the Simulink Environment. Applications of the Blockset include analysis and modeling of power utility distribution networks and self-contained power systems such as those for ships, aircraft and spacecraft.

- Transient Analysis (sim)
- Linear Transformer (sim)
- Saturable Transformer (sim)
- AC Surge Arrester (sim)
- Three-Phase Rectifier (sim)
- Thyristor Converter (sim)
- Ideal Switch (sim)
- Mosfet Converter (sim)**
- Gto Buck Converter (sim)

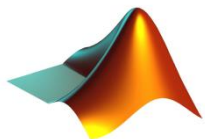
Close Run Mosfet Converter ...

**MOSFET in Zero-Current-Quasi-Resonant Converter**  
Double click on the More Info button (?) for details

More Info

Ready 100% ode15s

NUM



**DEMO EKRANI**