Problem 10.21:

21. Use Transfer Function blocks to construct a Simulink model to plot the solution of the following equations for $0 \leq t \leq 2$

$$3\ddot{x} + 15\dot{x} + 18x = f(t) \qquad x(0) = \dot{x}(0) = 0$$
$$2\ddot{y} + 16\dot{y} + 50y = x(t) \qquad y(0) = \dot{y}(0) = 0$$

where $f(t) = 50u_s(t)$. At the output of the first block there is a saturation that limits x to be $|x| \leq 1$. This limits the input to the second block.

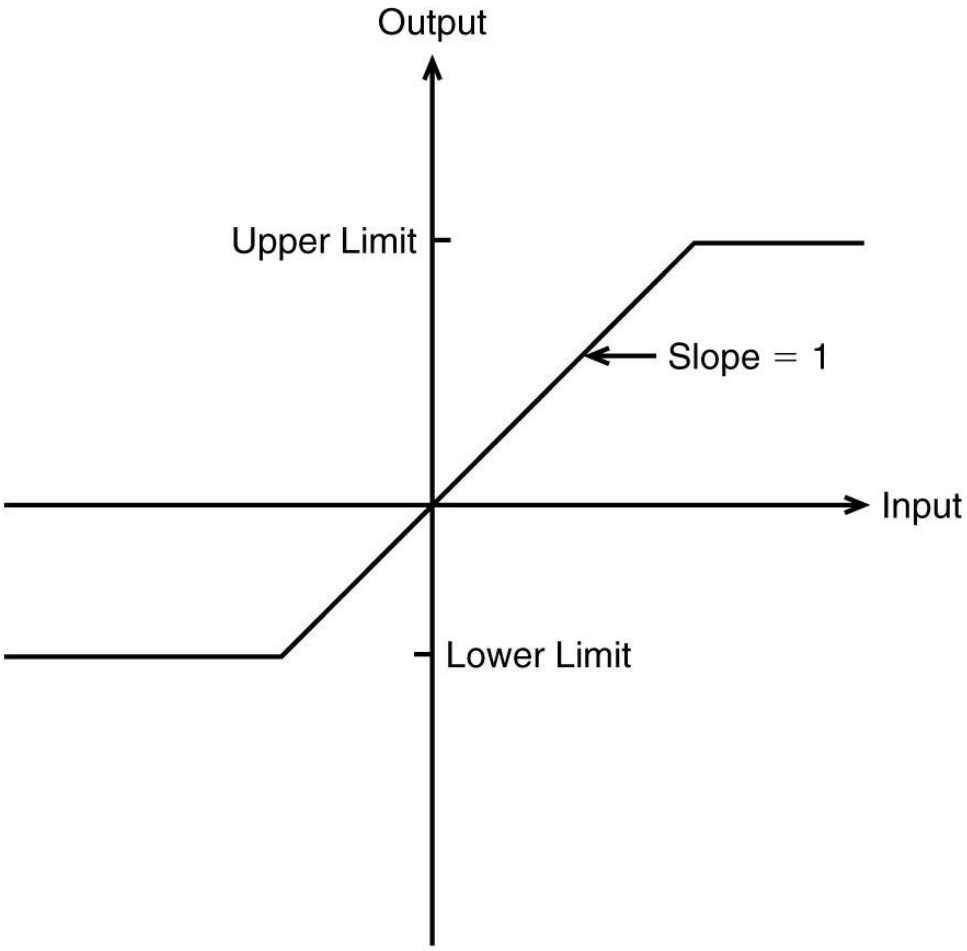
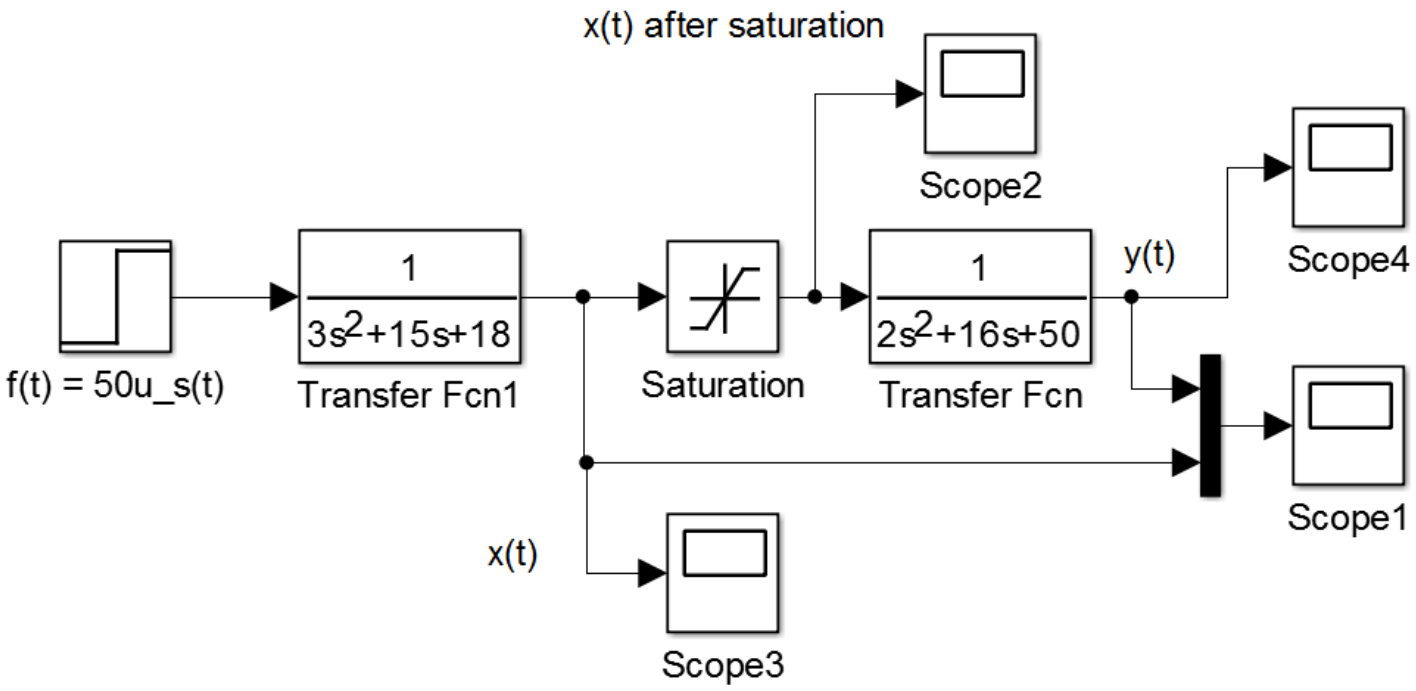
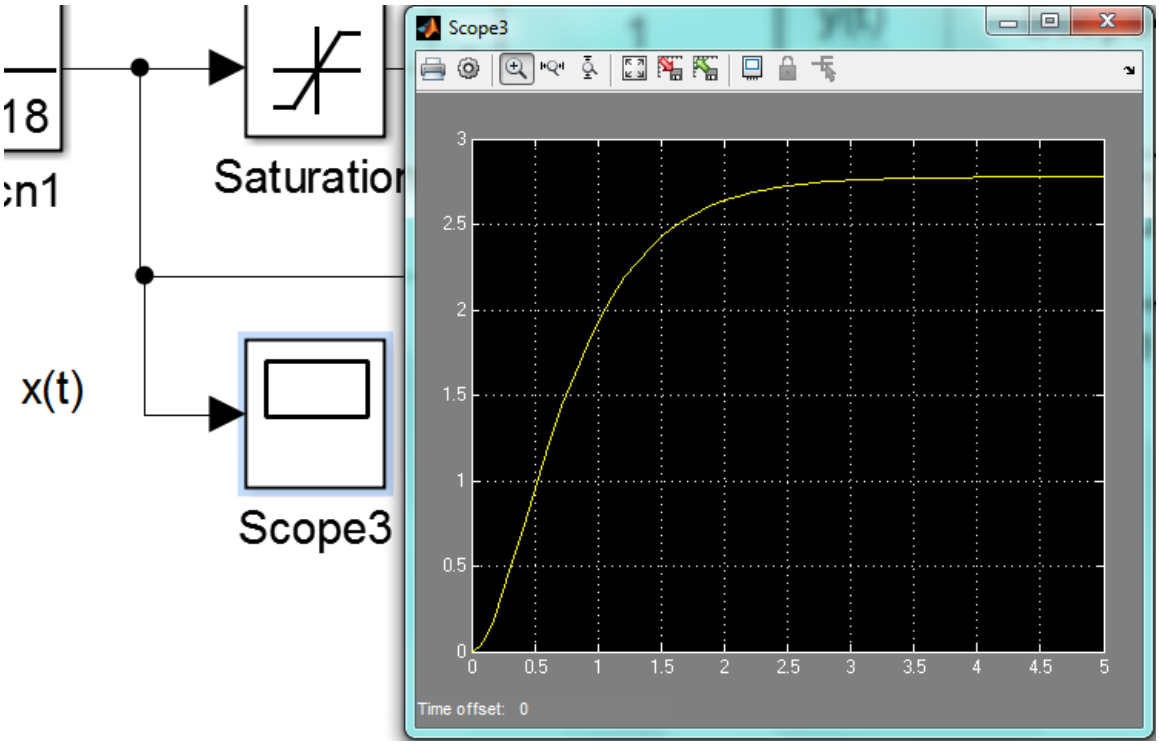
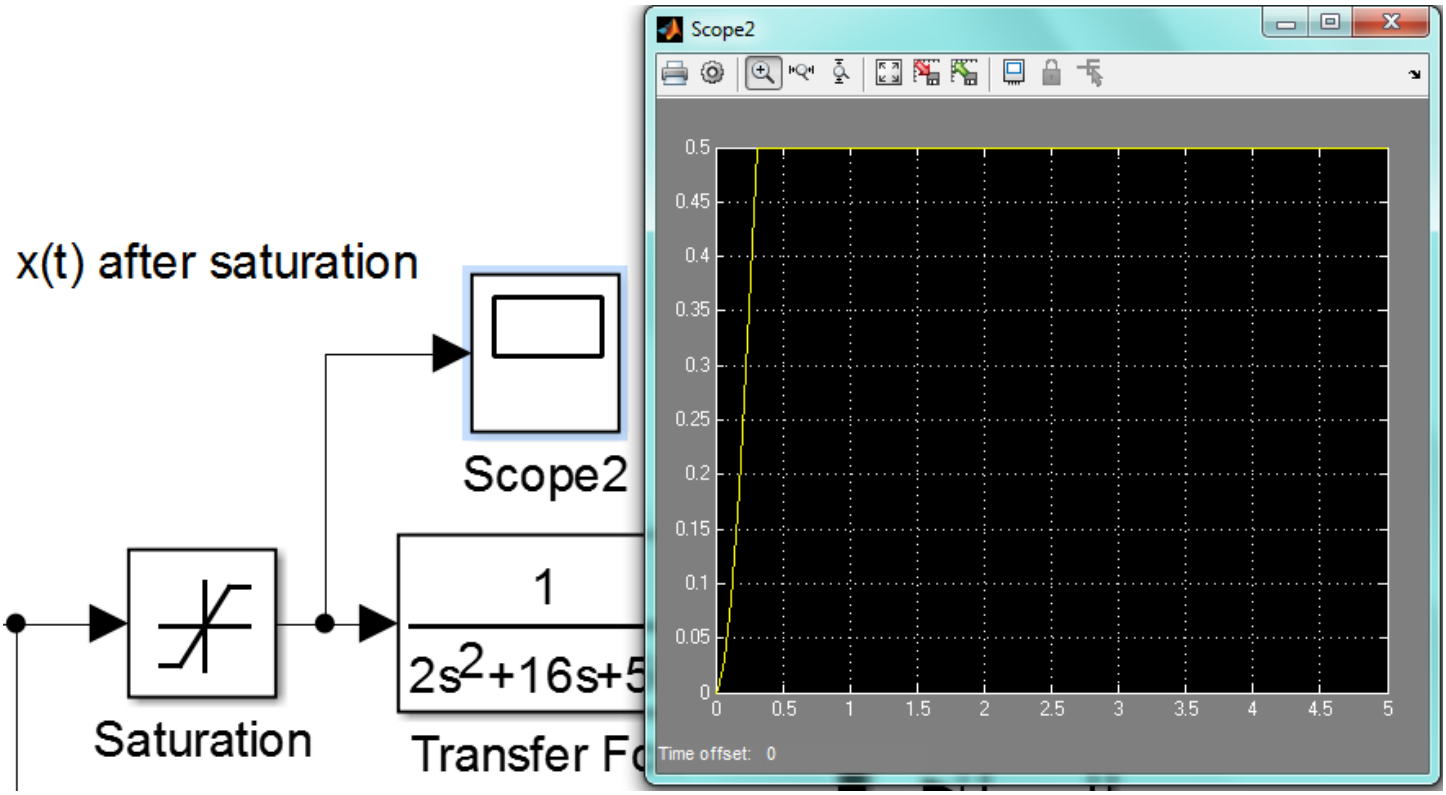
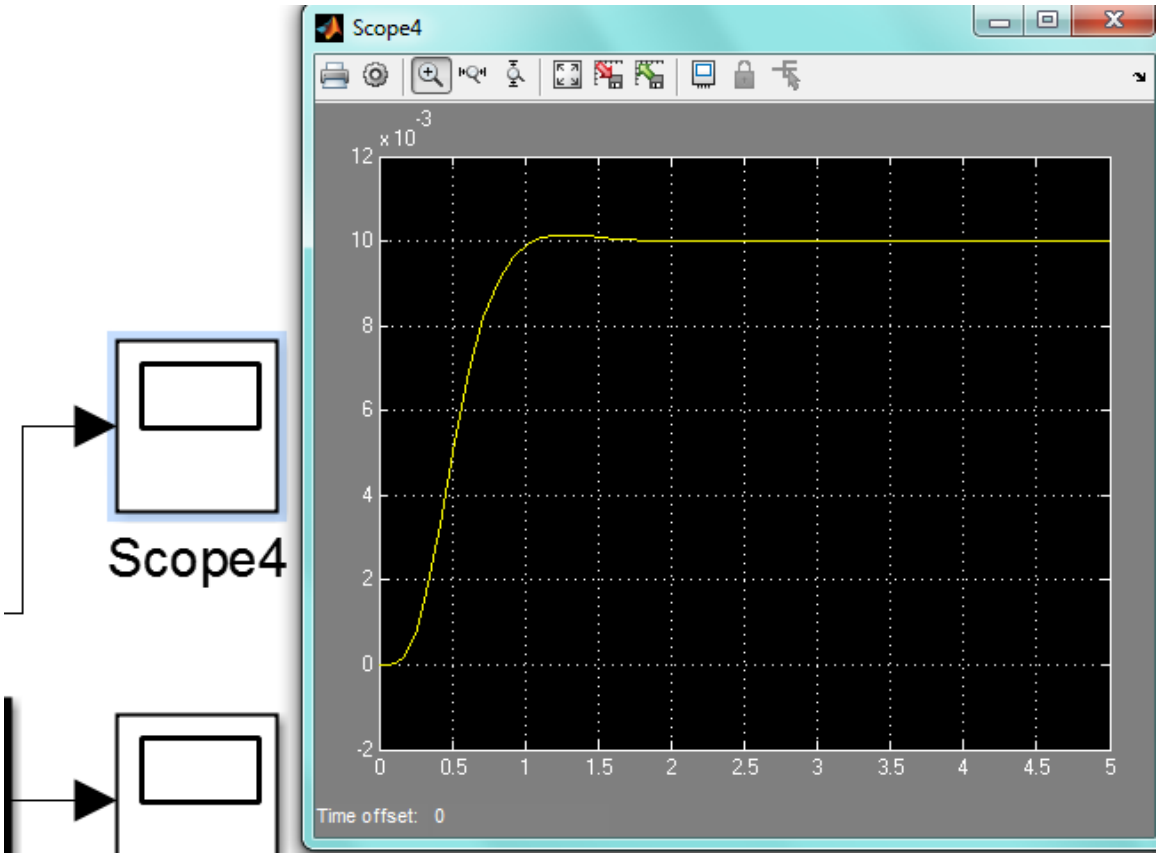


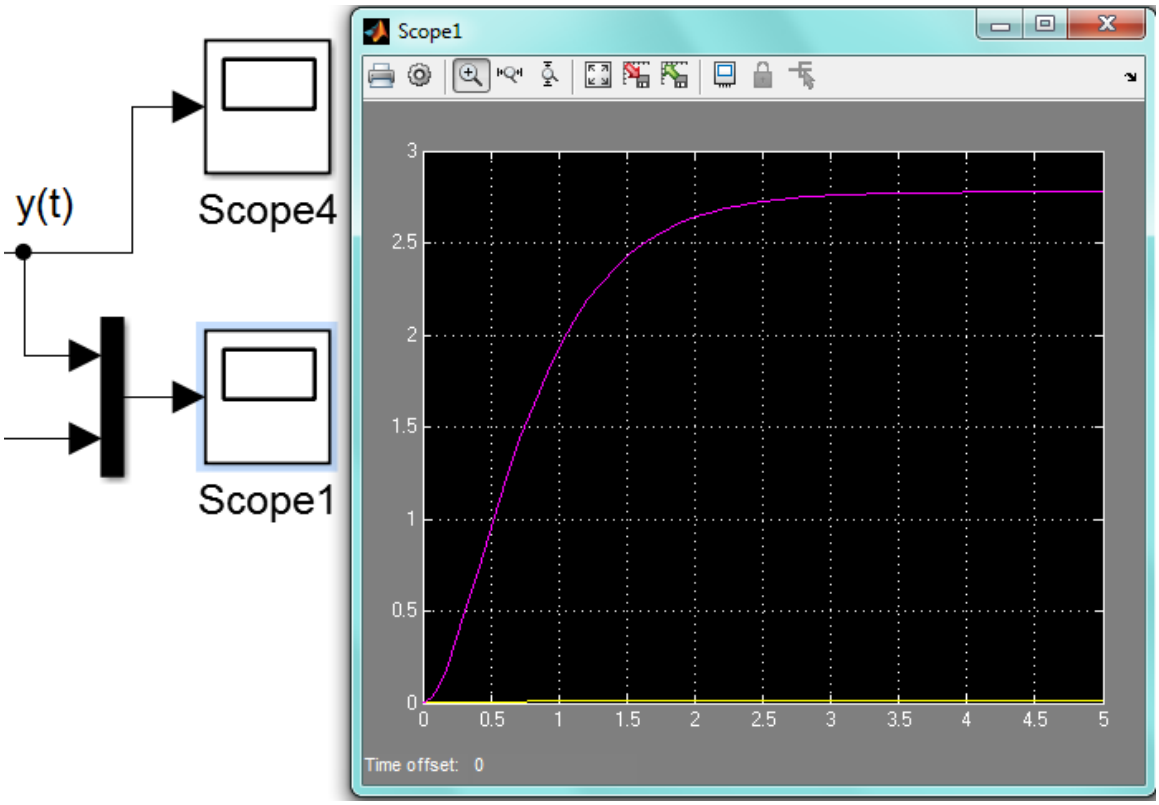
Figure 10.4–1 The saturation nonlinearity.


x(t) after saturation
Scope2
Scope4
y(t)
1
3s2+15s+18
f(t) = 50u_s(t)
Transfer Fcn1
Saturation
1
2s2+16s+50
Transfer Fcn
Scope1
x(t)
Scope3


18
cn1
Saturation
x(t)
Scope3
Scope3
3
2.5
2
1.5
1
0.5
0
0
0.5
1
1.5
2
2.5
3
3.5
4
4.5
5
Time offset: 0


x(t) after saturation
Scope2
1
2s2+16s+5
Saturation
Transfer Fc
Scope2
0.5
0.45
0.4
0.35
0.3
0.25
0.2
0.15
0.1
0.05
0
0
0.5
1
1.5
2
2.5
3
3.5
4
4.5
5
Time offset: 0


Scope4
Scope4
x 10-3
12
10
8
6
4
2
0
-2
0
0.5
1
1.5
2
2.5
3
3.5
4
4.5
5
Time offset: 0


y(t)
Scope4
Scope1
Scope1
3
2.5
2
1.5
1
0.5
0
0
0.5
1
1.5
2
2.5
3
3.5
4
4.5
5
Time offset: 0