Problem 10.6:

6. The following equation has no analytical solution even though it is linear.

$$\dot{x} + x = \tan t \qquad x(0) = 0$$

The approximate solution, which is less accurate for large values of t, is

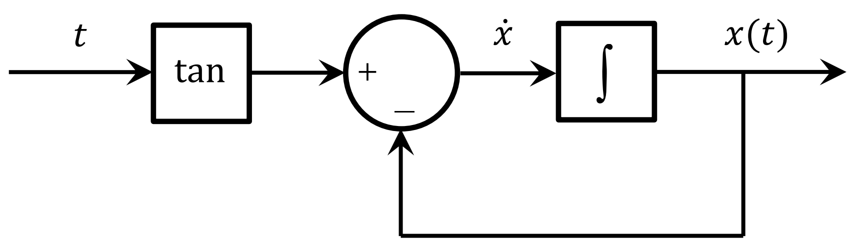
$$x(t) = \frac{1}{3}t^3 - t^2 + 3t - 3 + 3e^{-t}$$

Create a Simulink model to solve this problem, and compare its solution with the approximate solution over the range $0 \leq t \leq 1$.

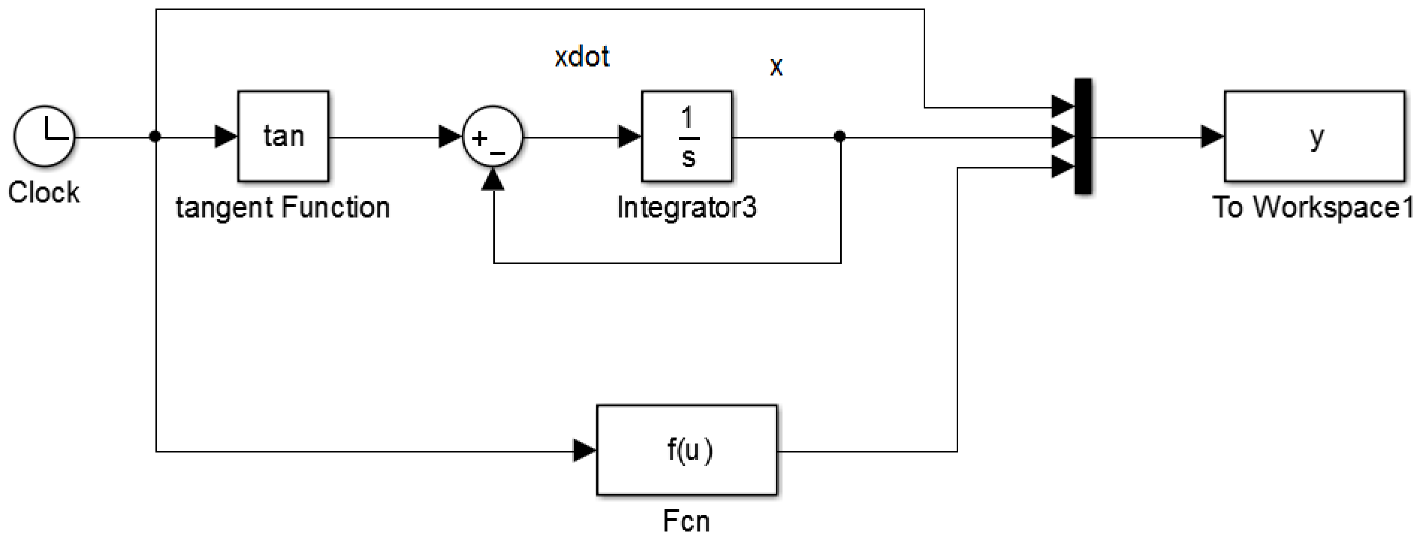
$$\dot{x} = \tan(t) - x$$

$$x = \int [\tan(t) - x]$$

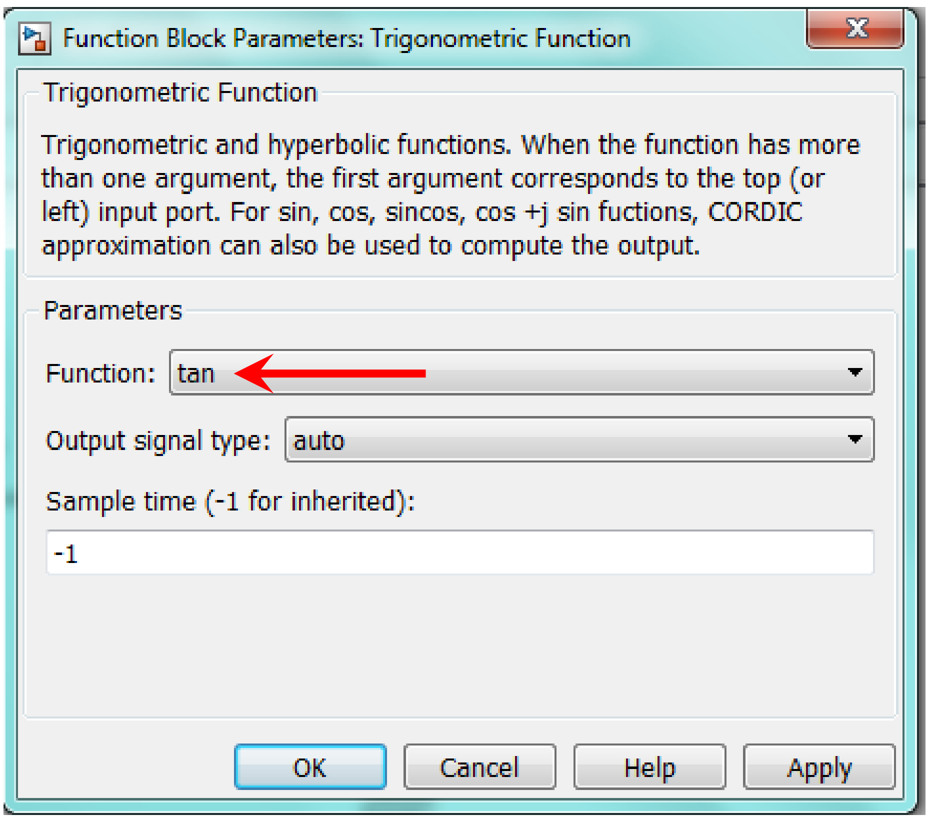
Simulation Diagram:



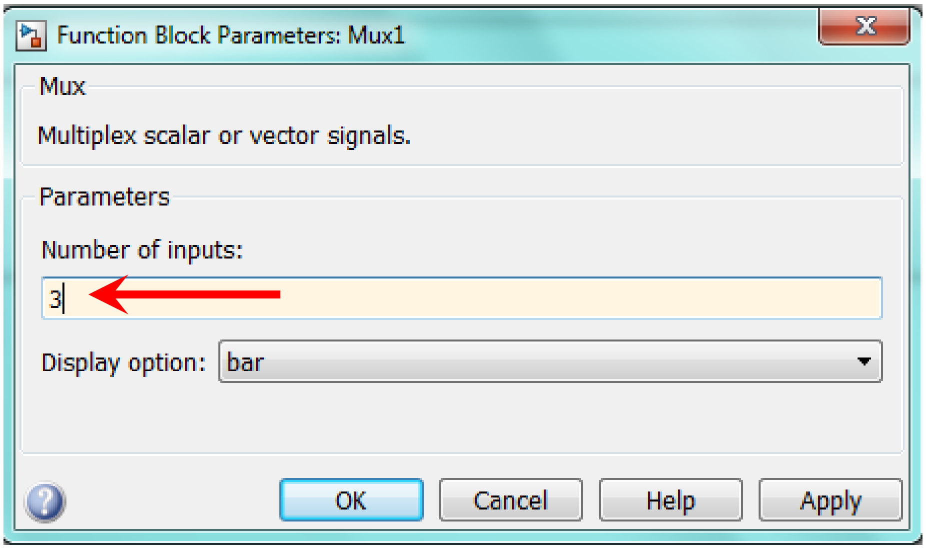
Simulink Model:



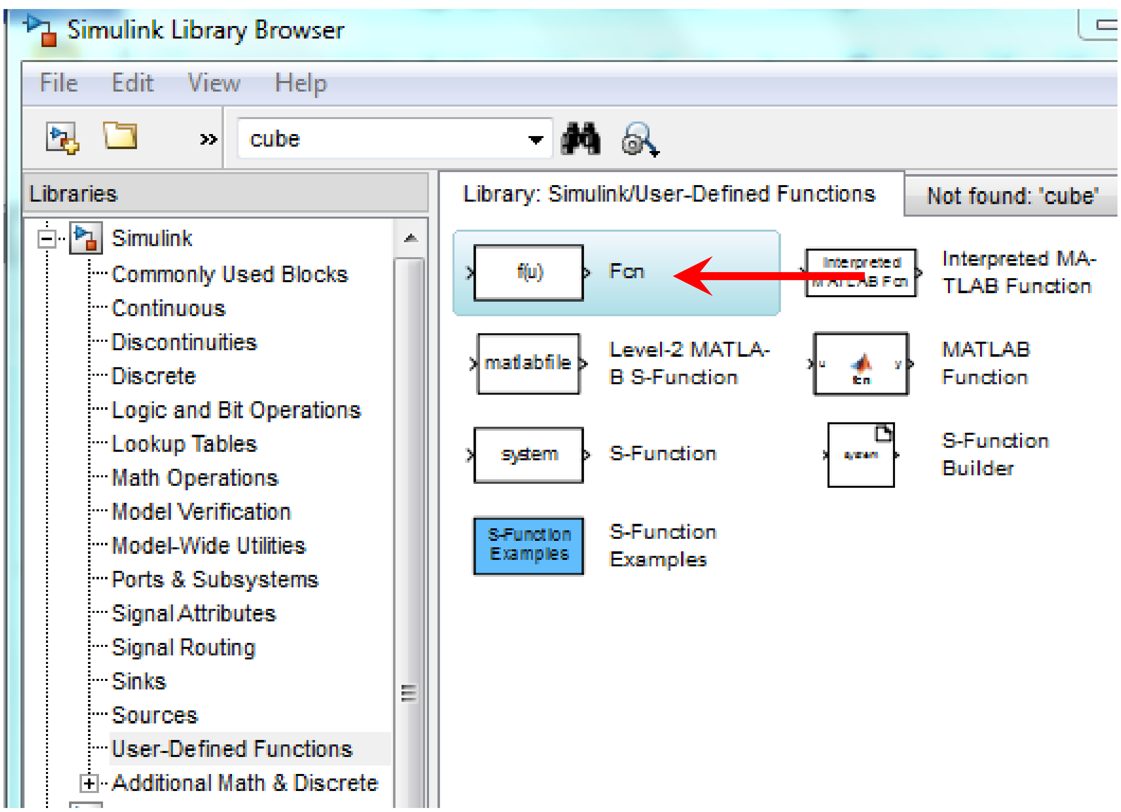
Trigonometric Function Block: Change to tangent

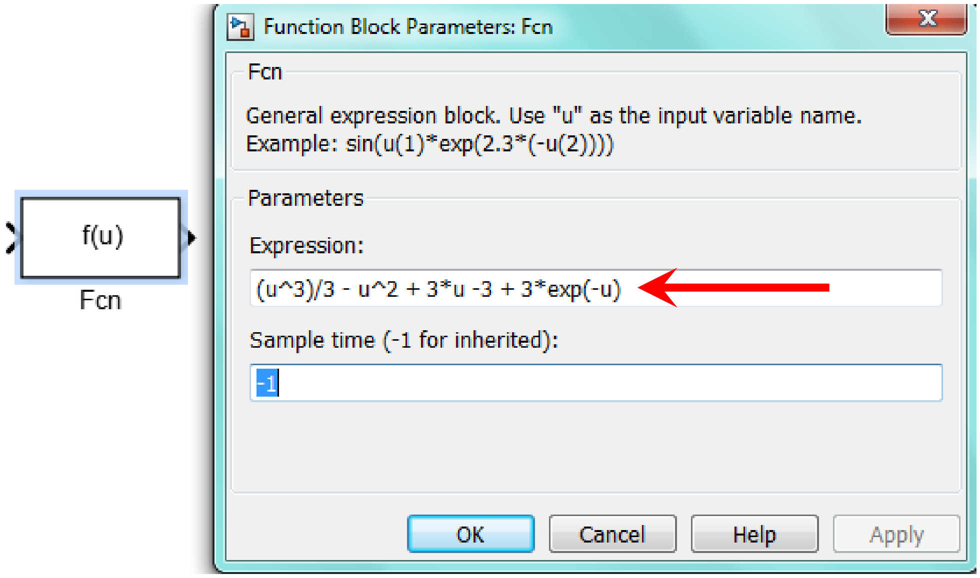


Multiplexer Block: Change to three inputs



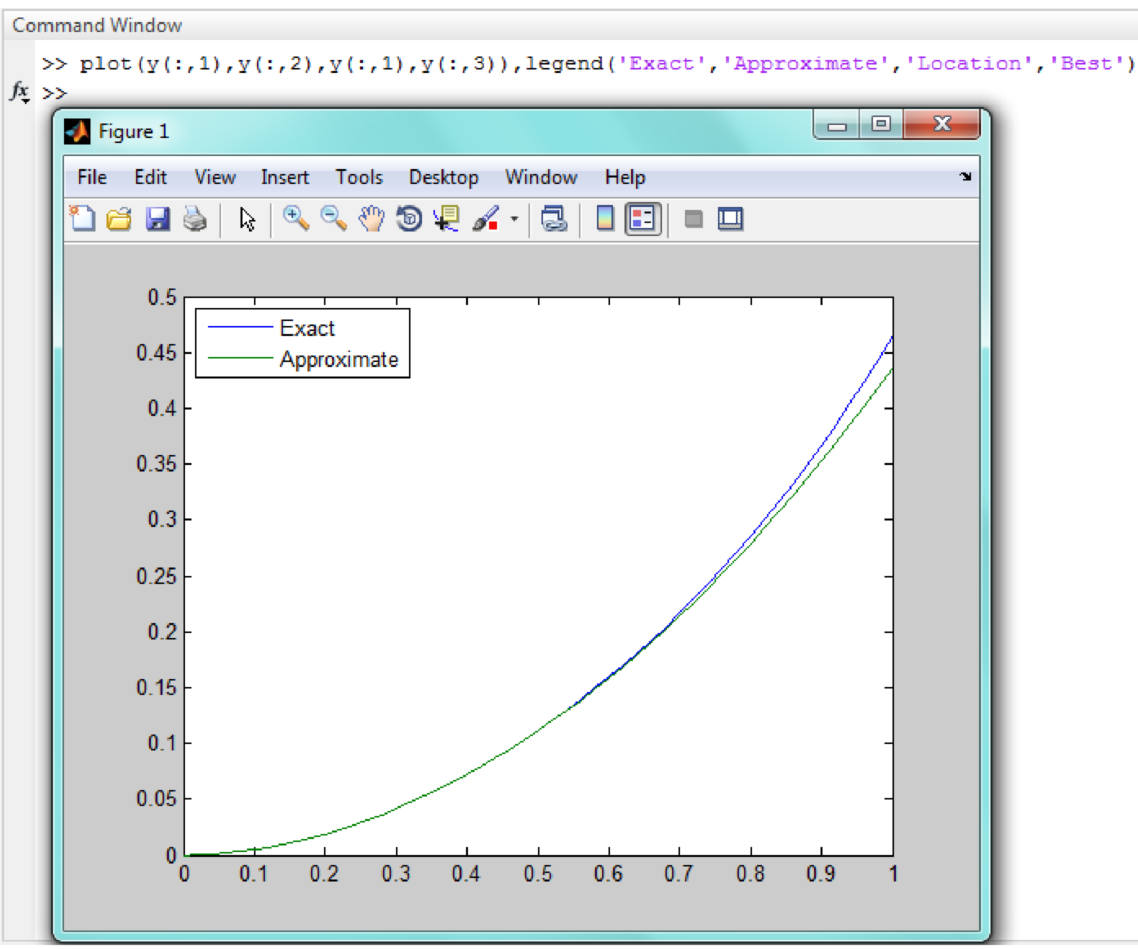
User-Defined Function Block: Use typical MATLAB syntax for math expressions





Command Window: See results

>> plot(y(:,1),y(:,2),y(:,1),y(:,3)),legend('Exact','Approximate','Location','Best')



Check results using ode45:

```
function xdot = f10_6( t,x )
xdot = tan(t) - x;
end
```

```
% Problem 10.6
clear
clc
disp('Problem 10.6: Scott Thomas')

[t,x_exact] = ode45(@f10_6, [0, 1], 0 );

for k = 1:length(t)
x_approx(k) = (t(k)^3)/3 - t(k)^2 + 3*t(k) - 3 + 3*exp(-t(k));
end

plot(t,x_exact,t,x_approx), xlabel('time (s)')
ylabel('Function x(t)')
title('Problem 10.6: Scott Thomas')
legend('Exact','Approximate','Location','Best')
```

```
Problem 10.6: Scott Thomas
```