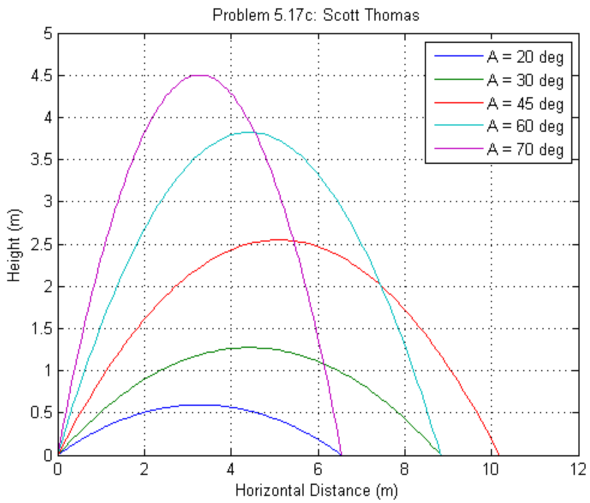
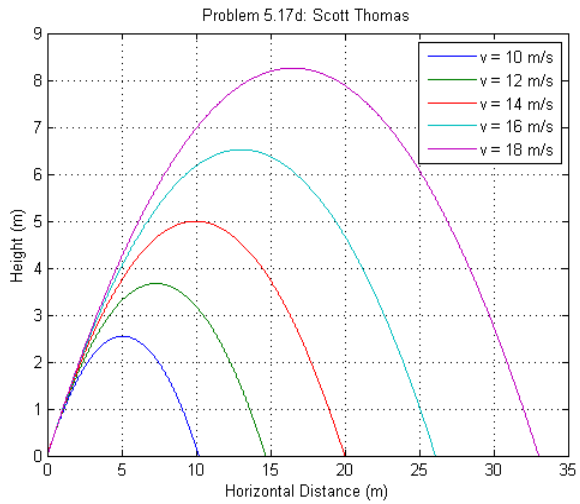
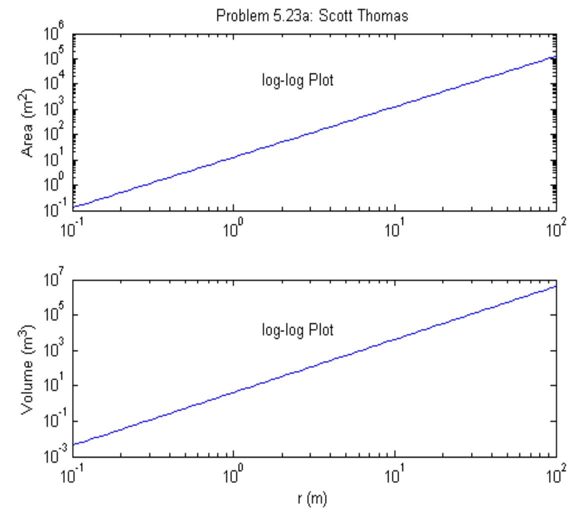
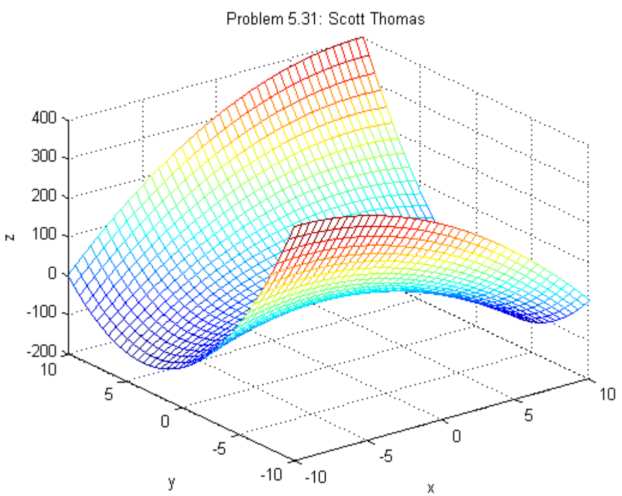
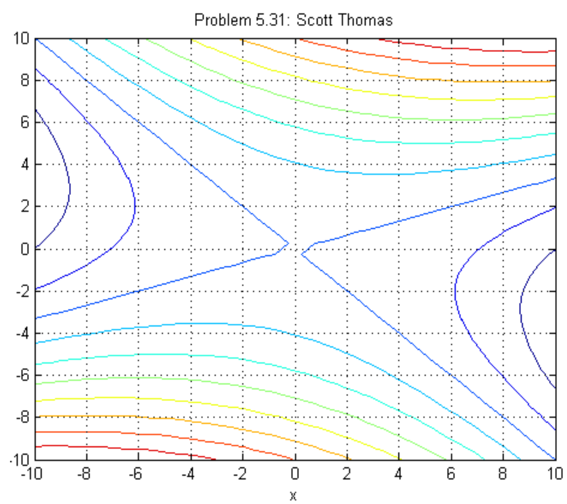
Chapter 5: Advanced Plotting

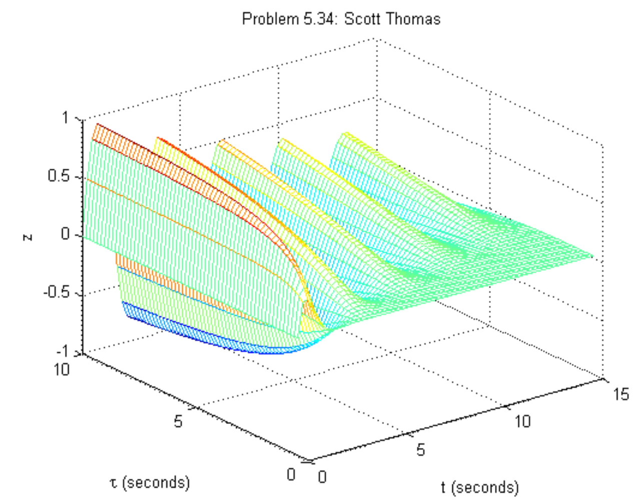




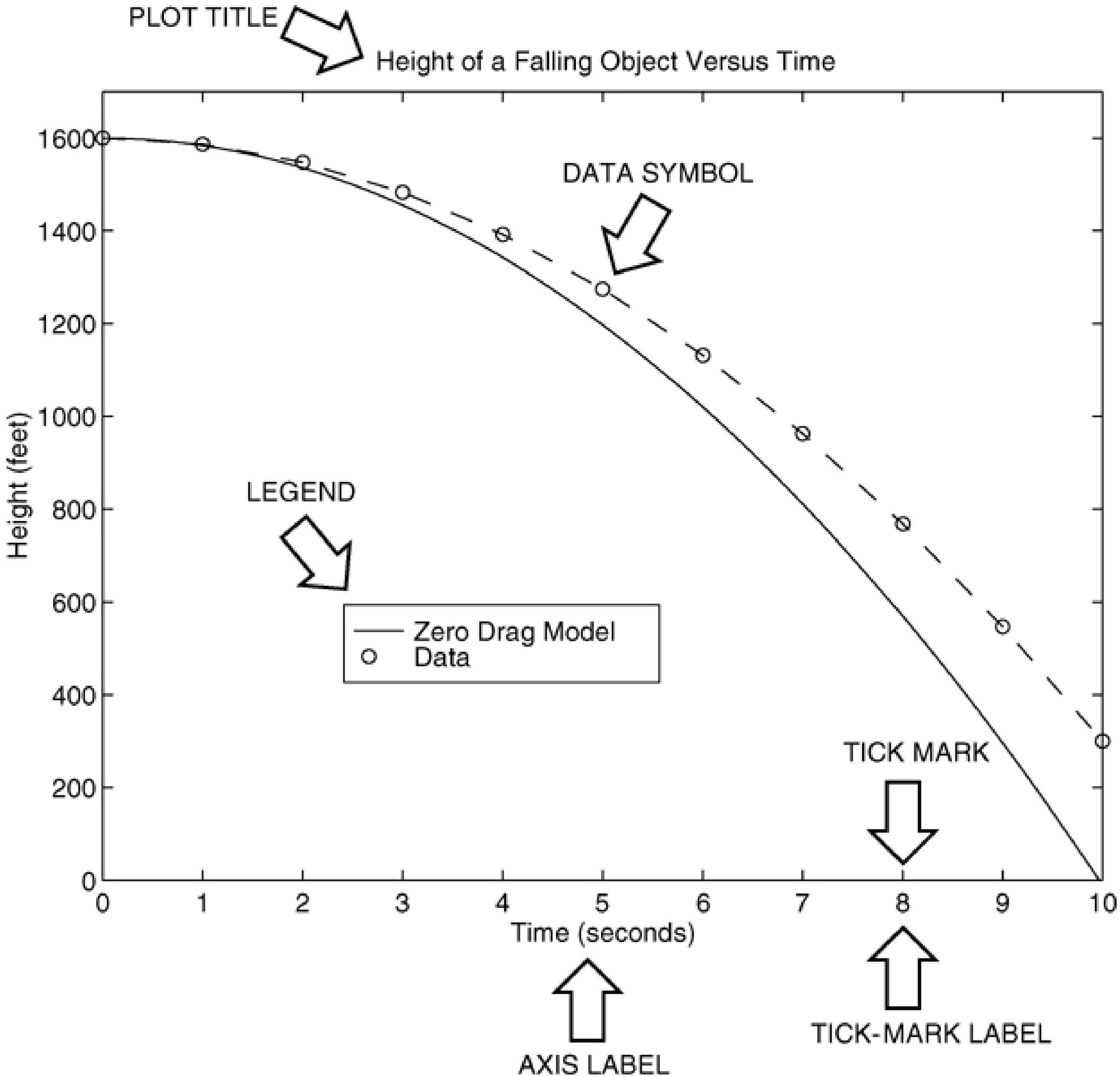




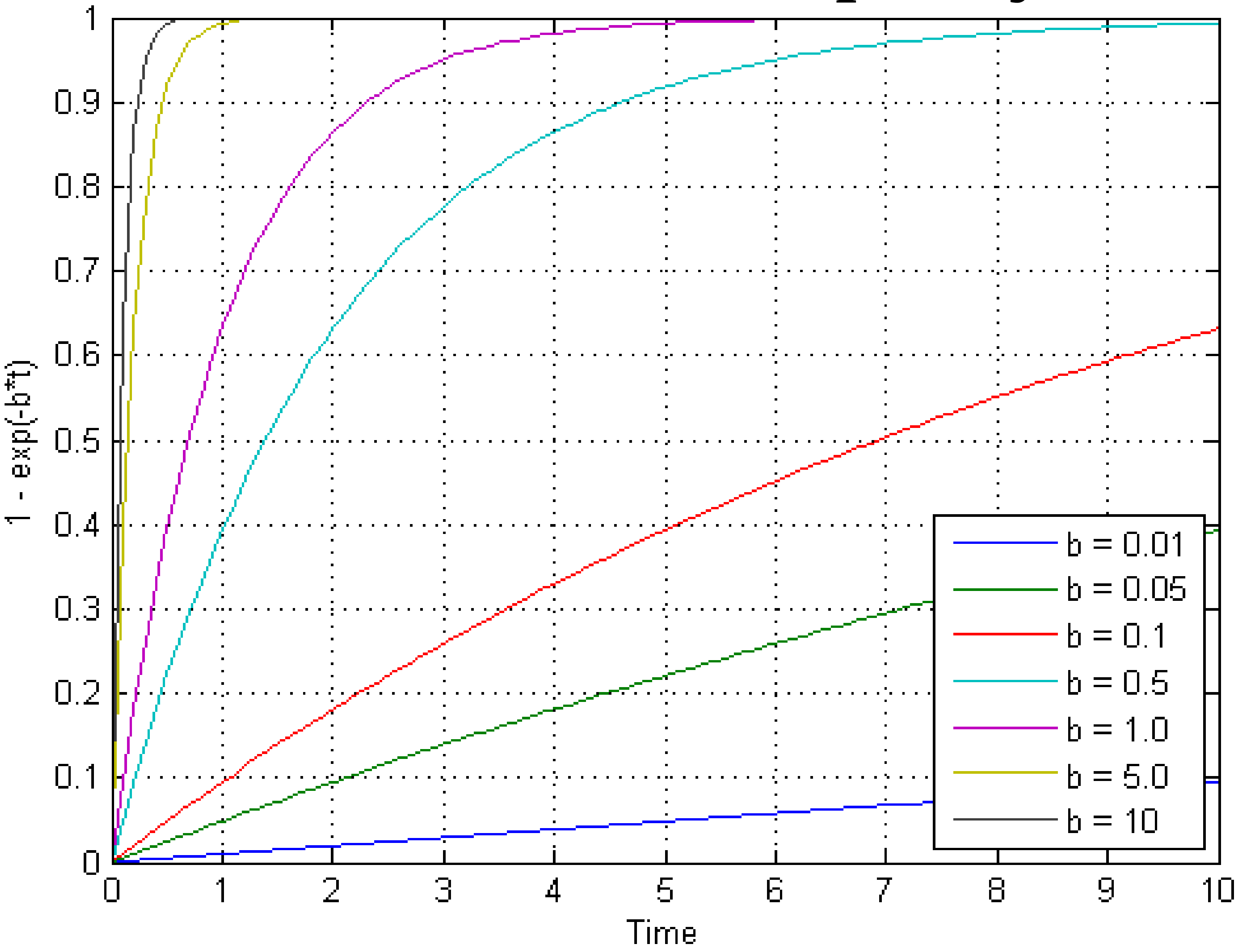




xy Plotting


PLOT TITLE
Height of a Falling Object Versus Time
DATA SYMBOL
LEGEND
Zero Drag Model
Data
TICK MARK
Height (feet)
0
200
400
600
800
1000
1200
1400
1600
0 1 2 3 4 5 6 7 8 9 10
Time (seconds)
AXIS LABEL
TICK-MARK LABEL

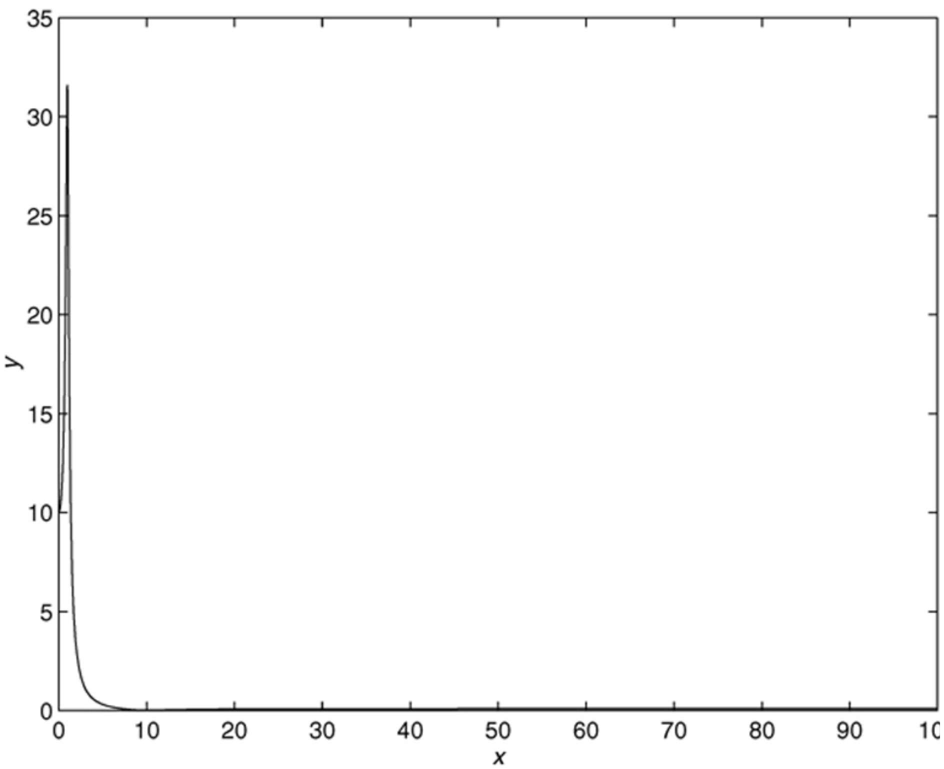
Present Data Compactly



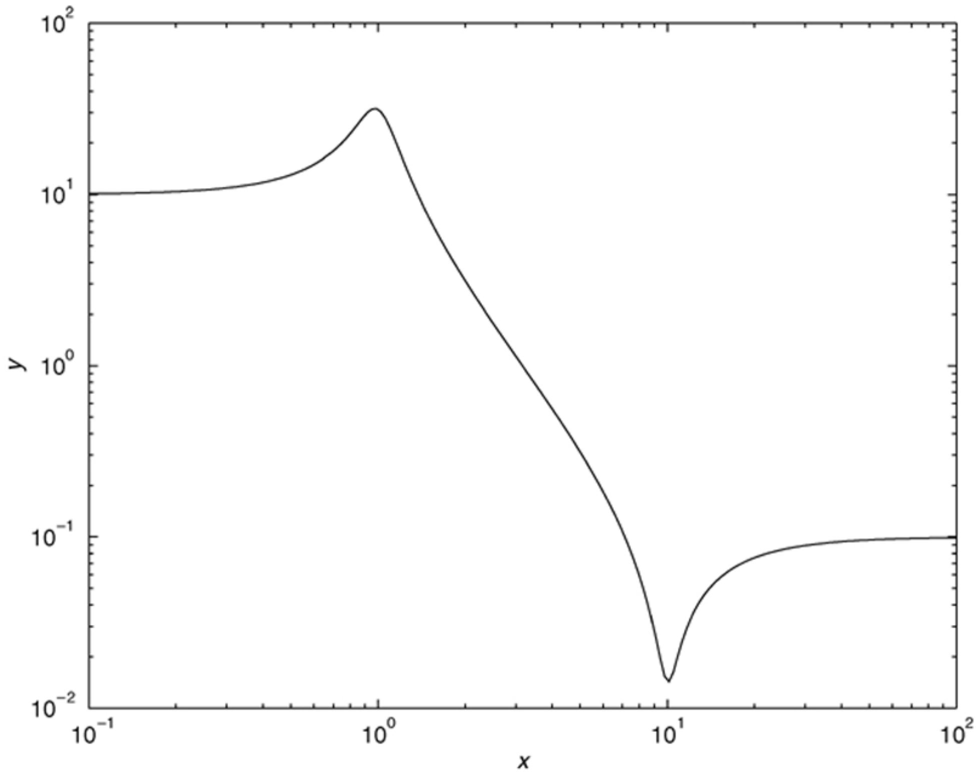
Logarithmic Plotting

log-log Plots are used for Plotting Sudden Changes in Values: loglog(x, y)

Rectangular xy Plot: plot(x, y)



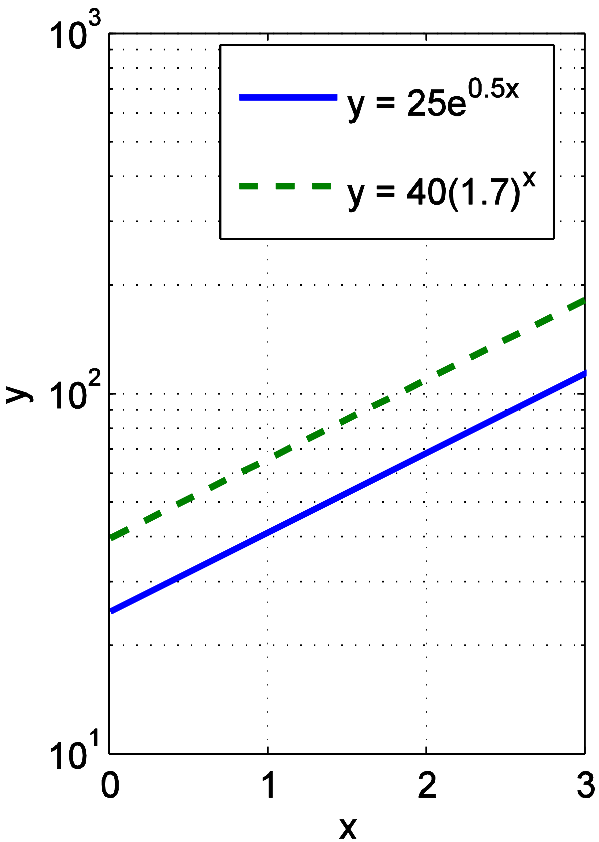
log-log Plot: loglog(x, y)



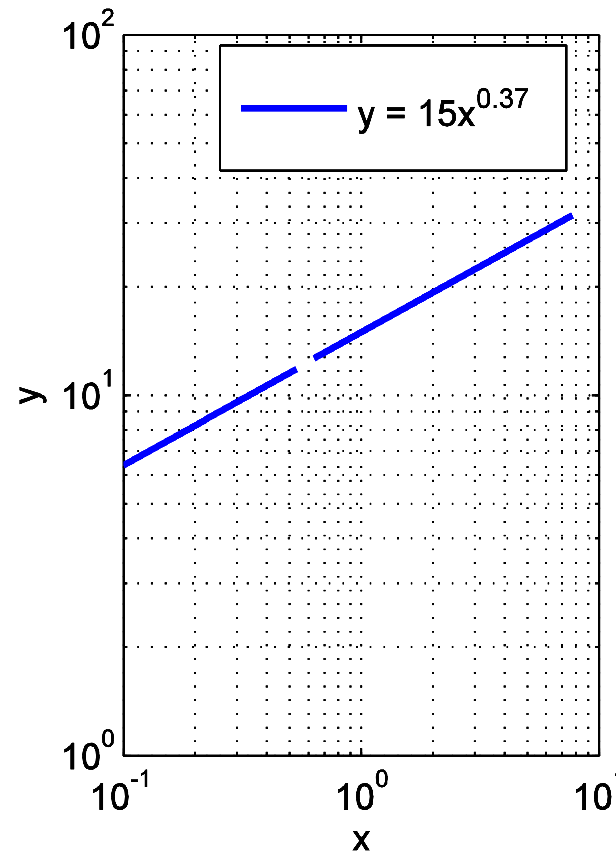
Logarithmic Plotting

Semi-log Plots: Only One Axis is Logarithmic:
semilogx(x, y) or semilogy(x, y)

Semi-log Plot: semilogy(x, y)

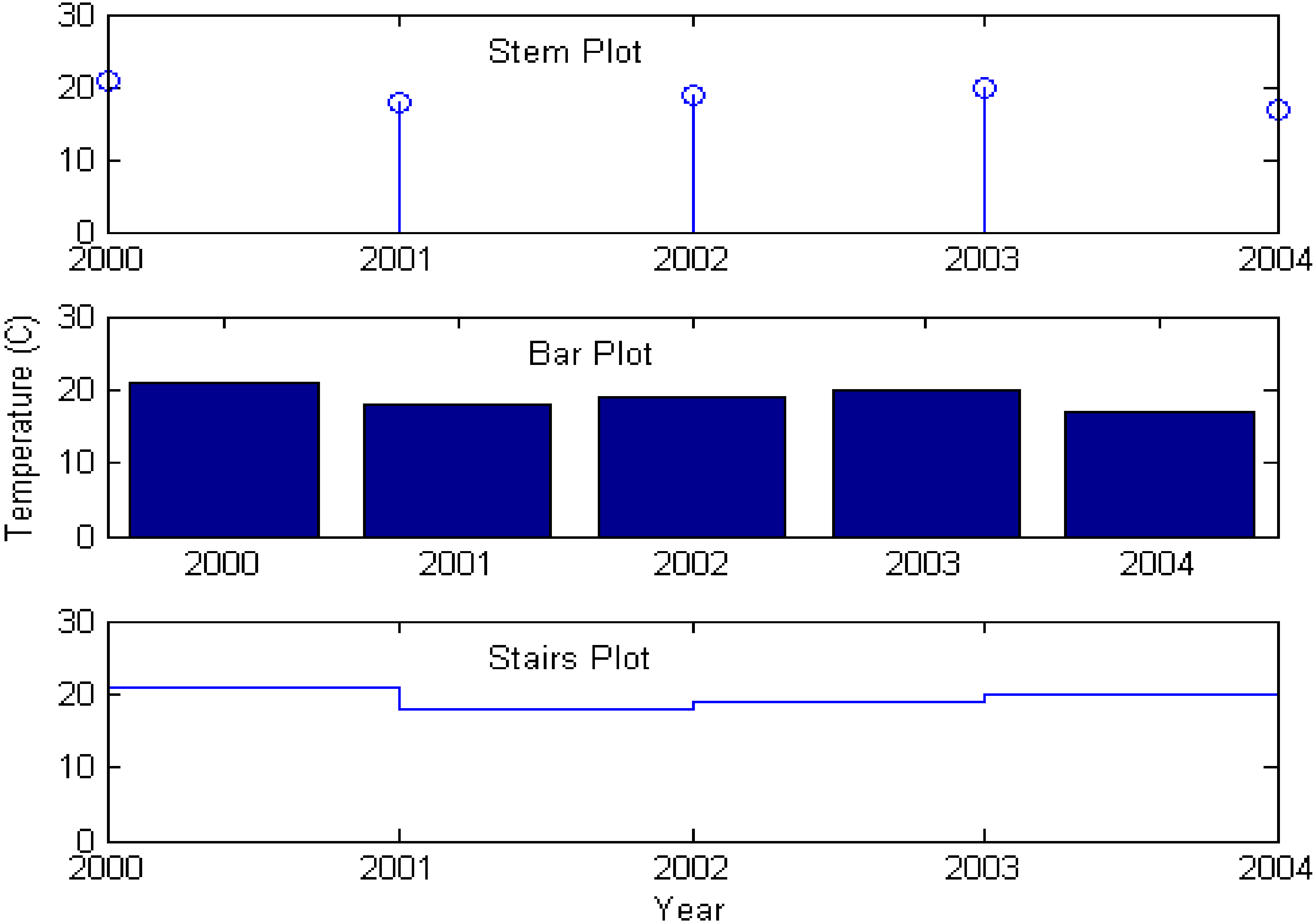


log-log Plot: loglog(x, y)



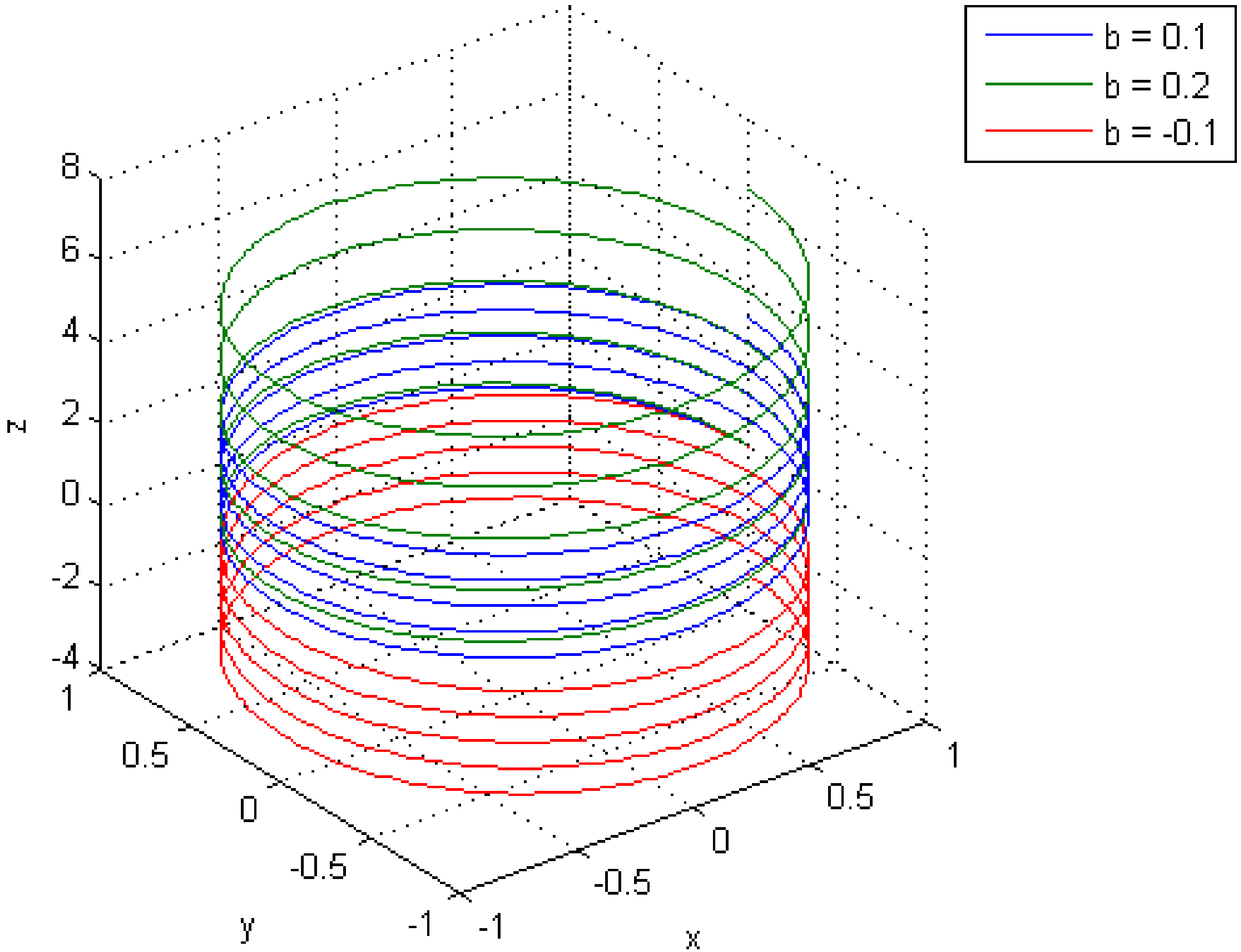
Other Plots

Stem Plots, Bar Plots, Stair Plots:



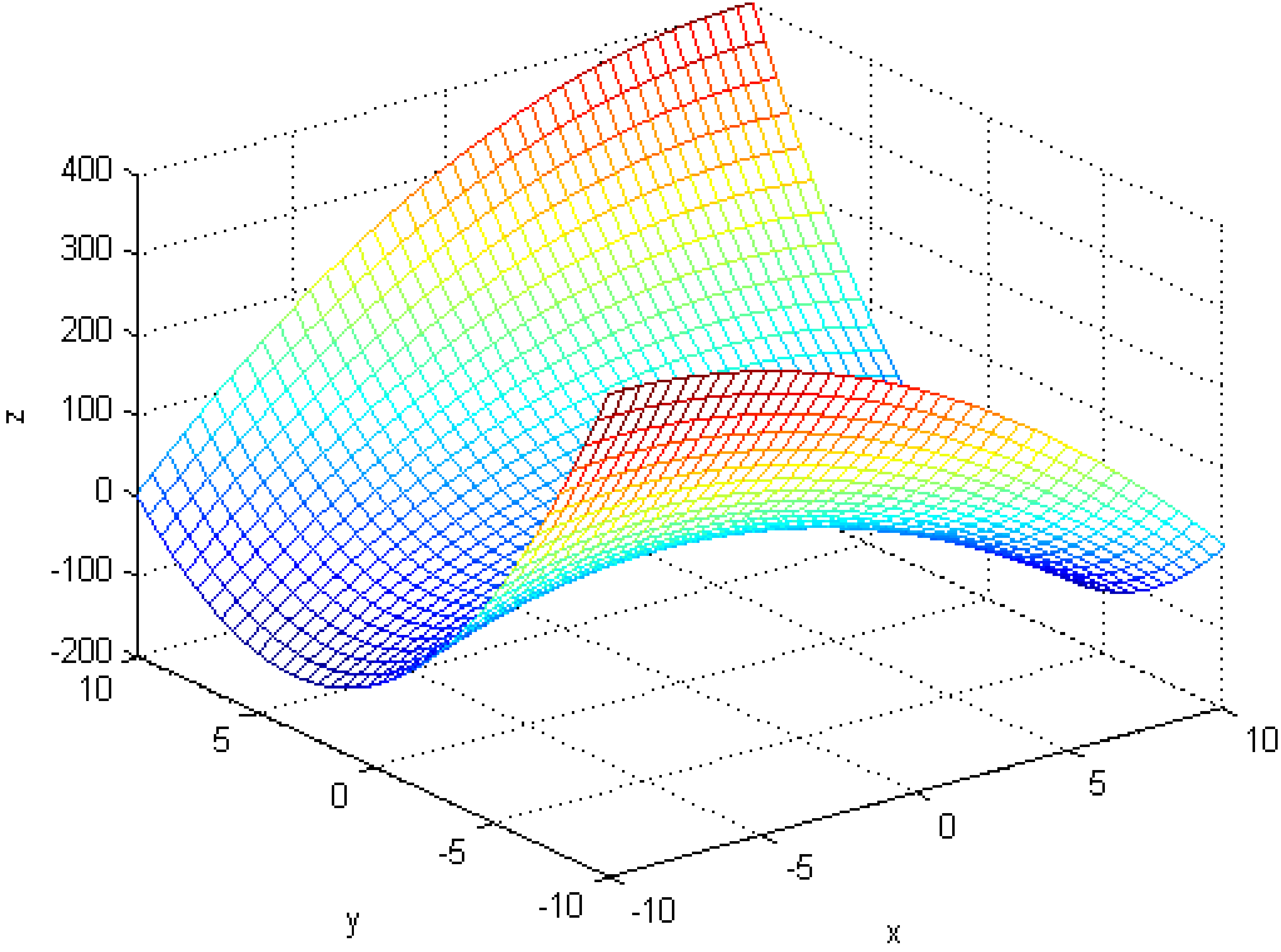
Three-Dimensional Plots

xyz Plots:



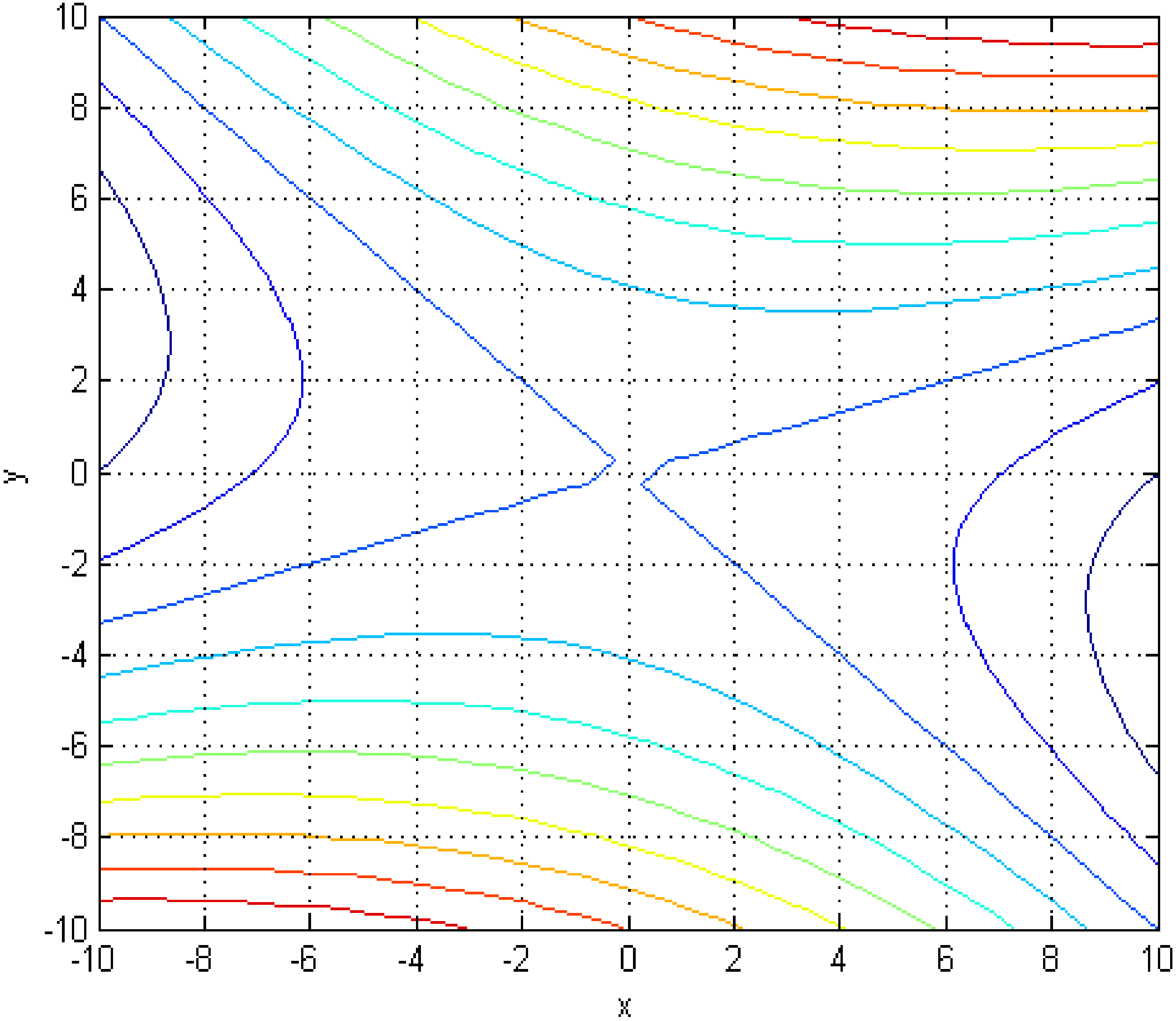
Three-Dimensional Plots

Surface Mesh Plots:



Three-Dimensional Plots

Contour Plots:



Problem 5.3:

a. Estimate the roots of the equation

$$x^3 - 3x^2 + 5x \sin\left(\frac{\pi x}{4} - \frac{5\pi}{4}\right) + 3 = 0$$

by plotting the equation.

b. Use the estimates found in part *a* to find the roots more accurately with the `fzero` function.

Problem 5.3:

$$x^3 - 3x^2 + 5x \sin\left(\frac{\pi x}{4} - \frac{5\pi}{4}\right) + 3 = 0$$

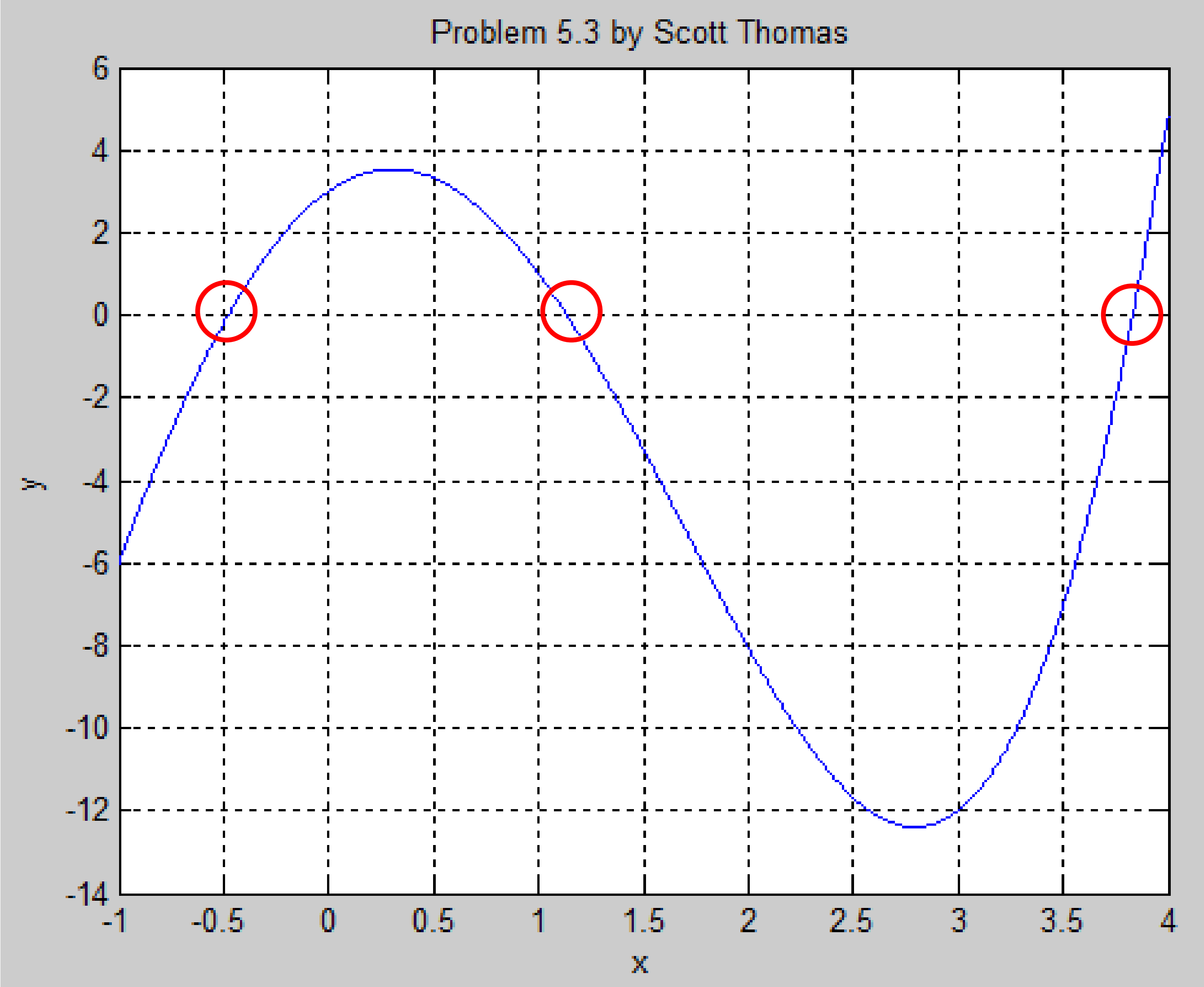
Create a **Function File** to plot the function:

Zeros are near:

$x_1 \cong -0.5$

$x_2 \cong 1.2$

$x_3 \cong 3.8$



Problem 5.3:

fzero

Find root of continuous function of one variable.

x = fzero(fun,x0) tries to find a zero of **fun** near x0, if x0 is a scalar. **fun** is a function handle. The value x returned by fzero is near a point where **fun** changes sign.

Command Window

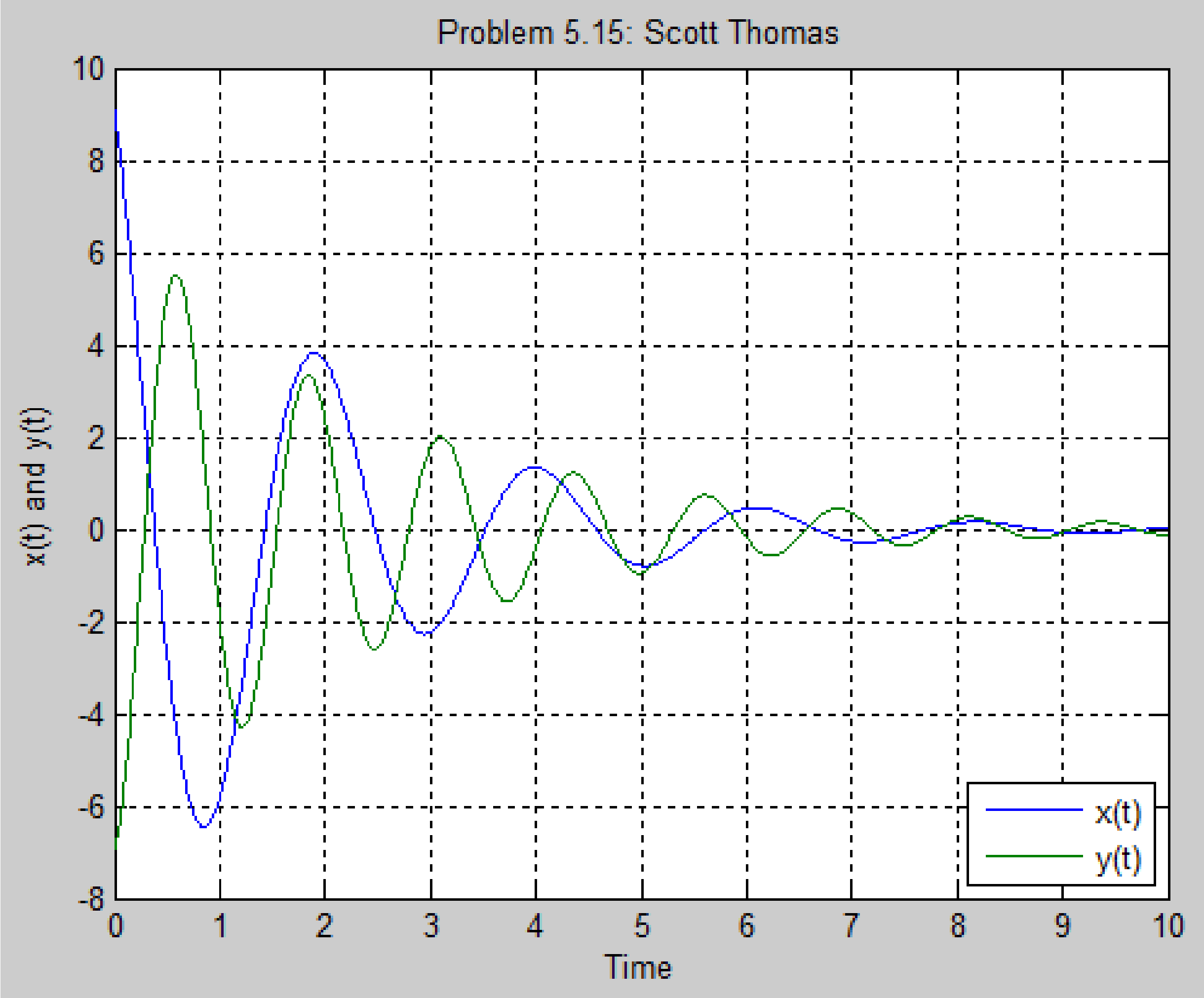
```
Problem 5.3: Scott Thomas
Part a:

x1 =

   -0.5000


x =

   -0.4795


x2 =

    1.2000


x =

    1.1346


x3 =

    3.8000


x =

    3.8318
```

Problem 5.15:

The following functions describe the oscillations in electric circuits and the vibrations of machines and structures. Plot these functions on the same plot. Make sure to provide a plot title, x and y axis labels, and a legend that describes the two graphs.

$$x(t) = 10e^{-0.5t}\sin(3t + 2)$$

$$y(t) = 7e^{-0.4t}\cos(5t - 3)$$



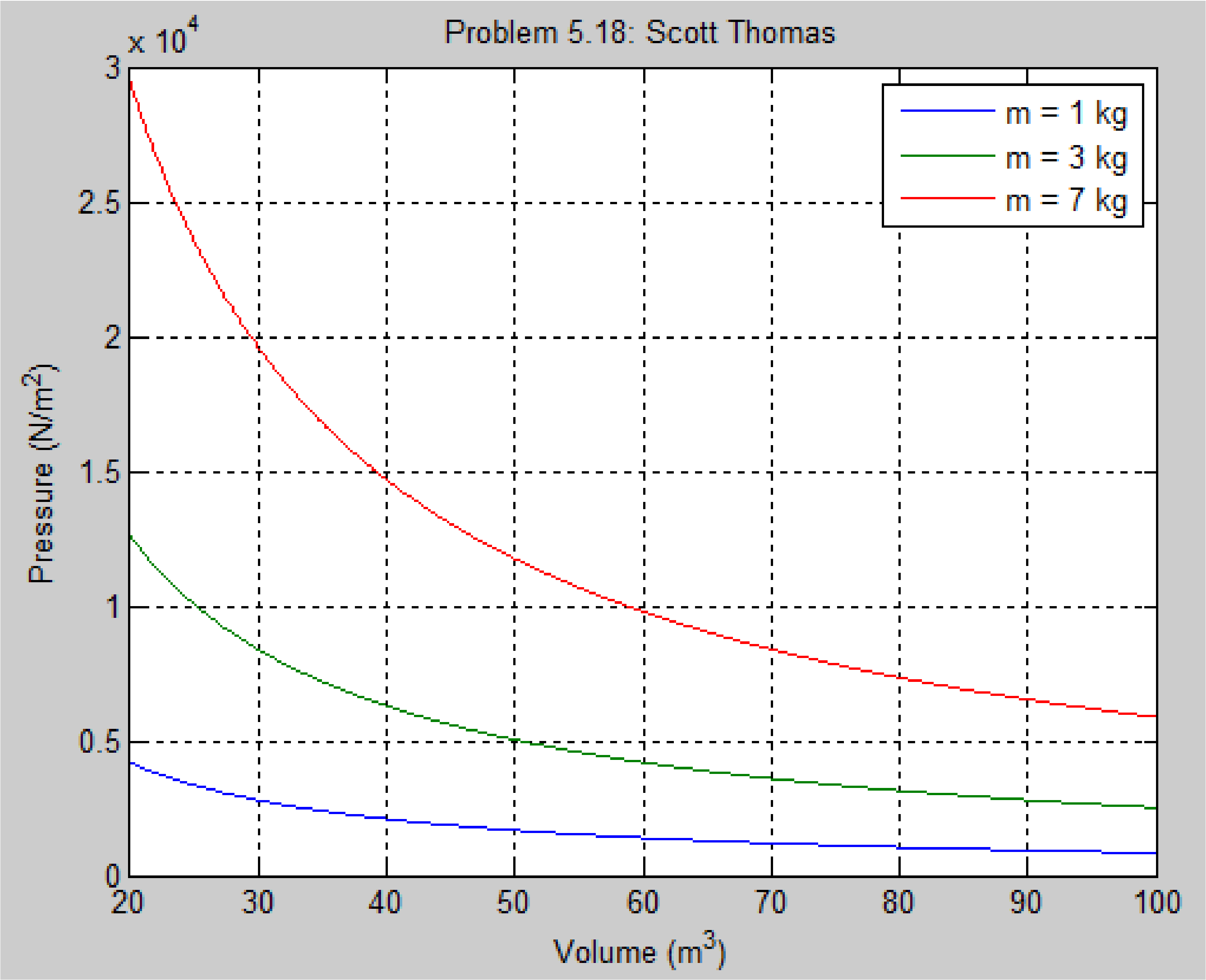
Problem 5.18:

The perfect gas law relates the pressure p, absolute temperature T, mass m, and volume V of a gas. It states that

$$pV = mRT$$

The constant R is the *gas constant*. The value of R for air is 286.7 $(\mathrm{N \cdot m})/(\mathrm{kg \cdot K})$. Suppose air is contained in a chamber at room temperature (20°C = 293 K). Create a plot having three curves of the gas pressure in $\mathrm{N/m^2}$ versus the container volume V in $\mathrm{m^3}$ for $20 \leq V \leq 100$. The three curves correspond to the following masses of air in the container: $m = 1$ kg, $m = 3$ kg, and $m = 7$ kg.

Problem 5.18:


Problem 5.18: Scott Thomas
x 10^4
3
2.5
2
1.5
1
0.5
0
Pressure (N/m^2)
20
30
40
50
60
70
80
90
100
Volume (m^3)
m = 1 kg
m = 3 kg
m = 7 kg

Problem 5.21:

The following table shows the average temperature for each year in a certain city. Plot the data as a stem plot, a bar plot, and a stairs plot using subplots. Use the following command to force the tick mark labels to be whole numbers:

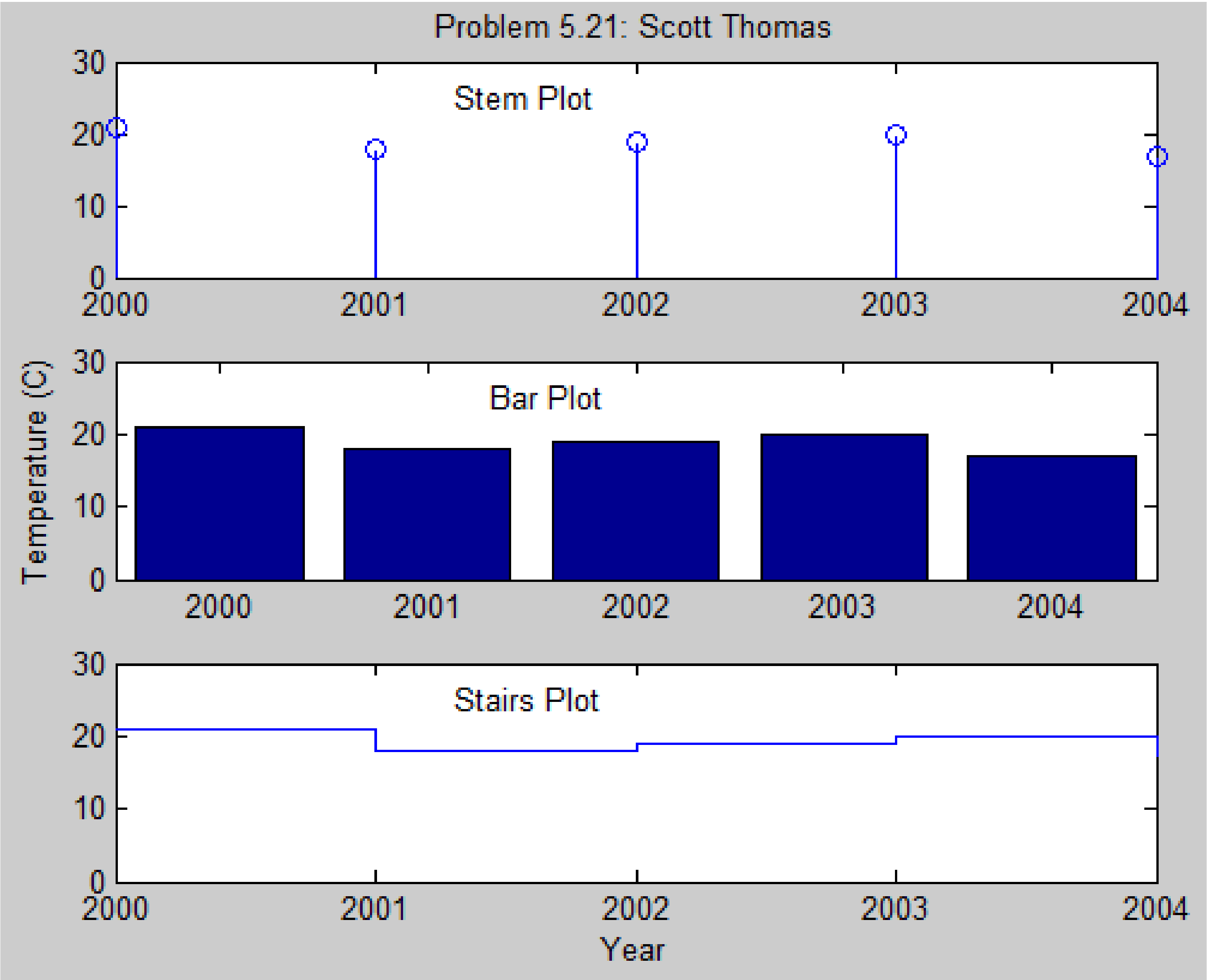
set(gca,'XTick',2000:1:2004)

Year	2000	2001	2002	2003	2004
Temperature (°C)	21	18	19	20	17

text(x, y, 'Stem Plot')

subplot(2,1,1), plot(x)
subplot(2,1,2), plot(y)
plots *x* on the top half of the window and *y* on the bottom half.

Problem 5.21:



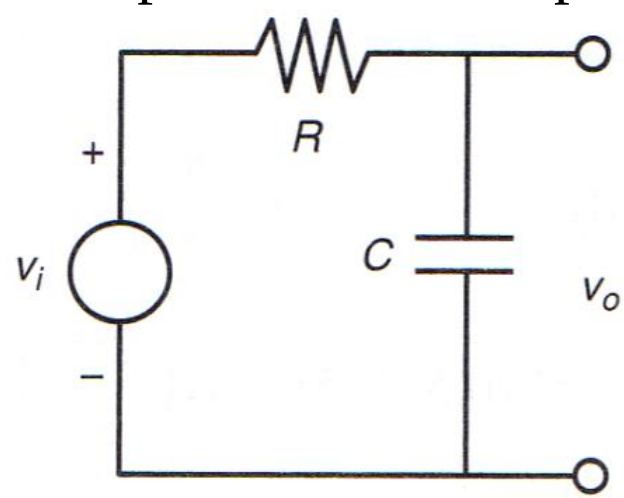
Problem 5.21: Scott Thomas
Stem Plot
Bar Plot
Stairs Plot
Temperature (C)
Year
0
10
20
30
2000
2001
2002
2003
2004

Problem 5.26:

Applying a sinusoidal voltage $v_i = A_i \sin(\omega t)$ to the RC (Resistor-Capacitor) circuit shown results in an output voltage $v_o = A_o \sin(\omega t + \phi)$ that is also sinusoidal with the same frequency but with a different amplitude and shifted in time relative to the input voltage. The frequency response plot is a plot of A_o/A_i versus frequency ω. This ratio depends on ω and *RC* as follows:

$$\frac{A_o}{A_i} = \left|\frac{1}{RCs + 1}\right|$$

where $s = \omega i$. For *RC* = 0.1 s, obtain the log-log plot of $|A_o/A_i|$ versus ω and use it to find the range of frequencies for which the output amplitude A_o is less than 70 percent of the input amplitude A_i.



Problem 5.26:

logspace

Generate logarithmically spaced vectors

Syntax

y = logspace(a,b)

y = logspace(a,b,n)

y = logspace(a,pi)

Description

The logspace function generates logarithmically spaced vectors. Especially useful for creating frequency vectors, it is a logarithmic equivalent of linspace and the ":" or colon operator.

y = logspace(a,b) generates a row vector y of 50 logarithmically spaced points between decades 10^a and 10^b.

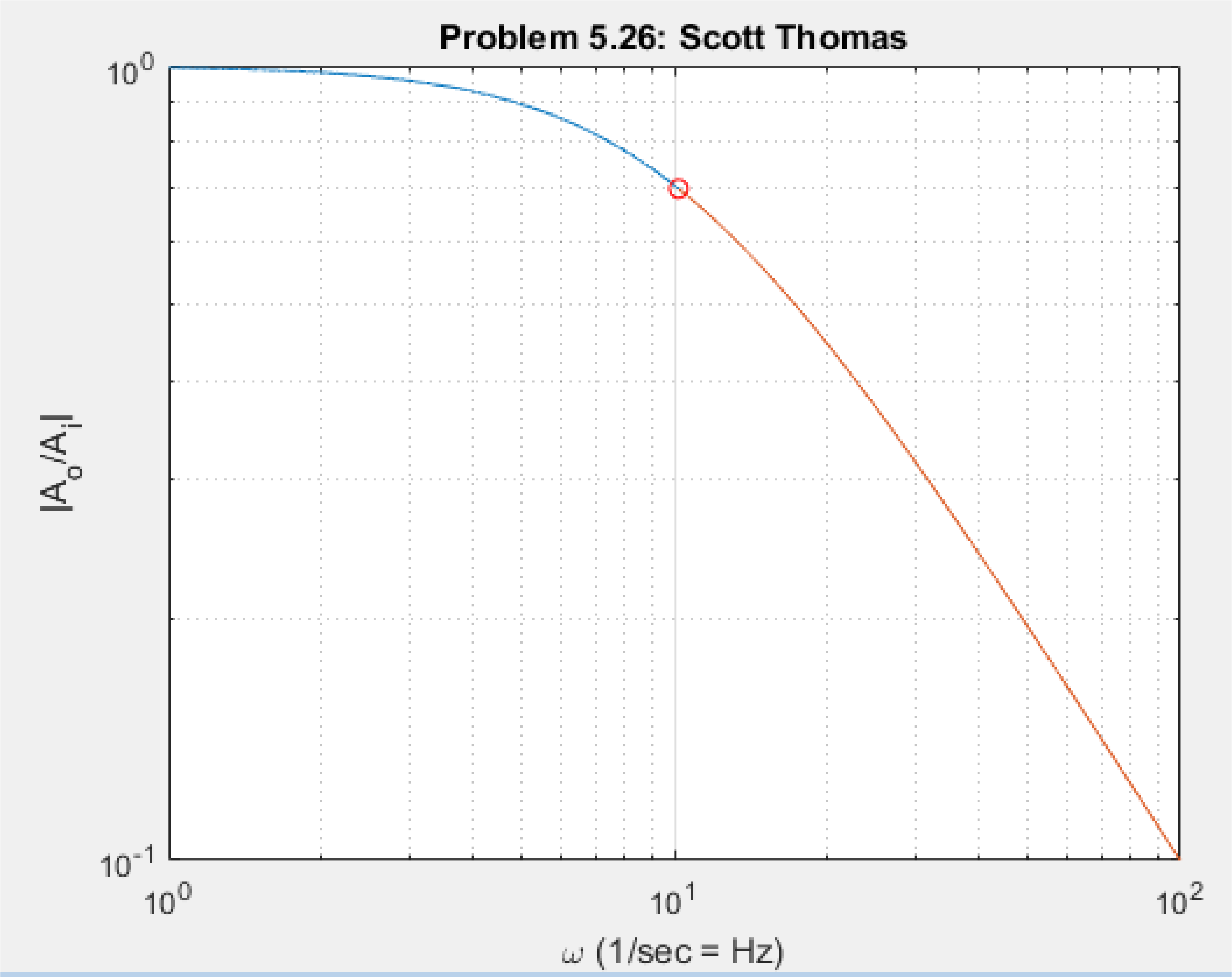
y = logspace(a,b,n) generates n points between decades 10^a and 10^b.

omega = logspace(0,2,N);

set(gca, ‘YTick’, linspace(0.1,1,10))

Problem 5.26:

omega = logspace(0,2,N); use find command to locate ω



Problem 5.28:

The popular amusement ride known as the corkscrew has a helical shape. The parametric equations for a circular helix are

$$x = a \cos t$$

$$y = a \sin t$$

$$z = bt$$

where a is the radius of the helical path and b is a constant that determines the "tightness" of the path. In addition, if $b > 0$, the helix has the shape of a right-handed screw; if $b < 0$, the helix is left-handed.

Obtain the three-dimensional plot of the helix for the following three cases and compare their appearance with one another. Use $0 \leq t \leq 10\pi$ and $a = 1$.

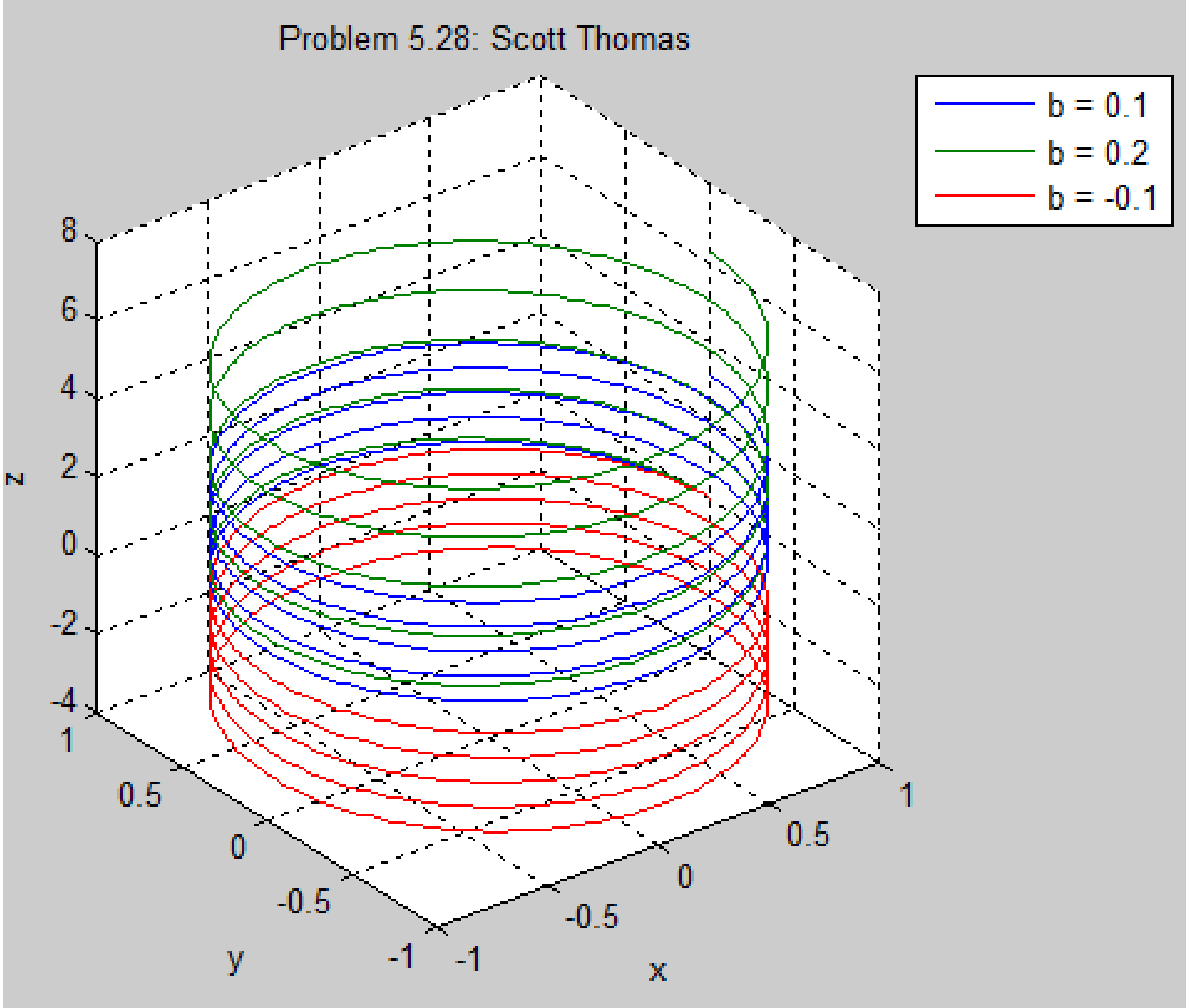
a. $b = 0.1$

b. $b = 0.2$

c. $b = -0.1$

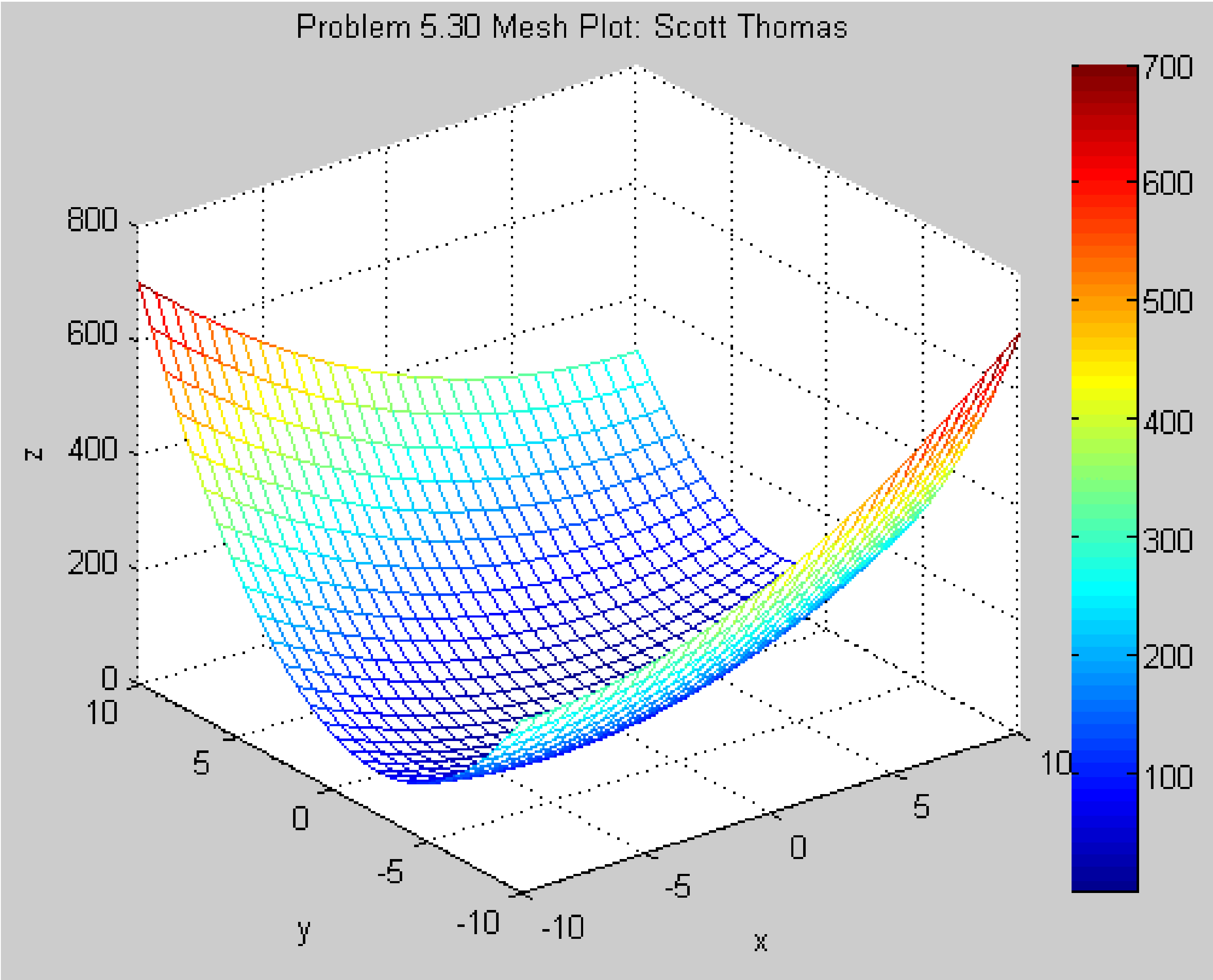
<u>Problem 5.28:</u>

plot3(x,y,z1,x,y,z2,x,y,z3)

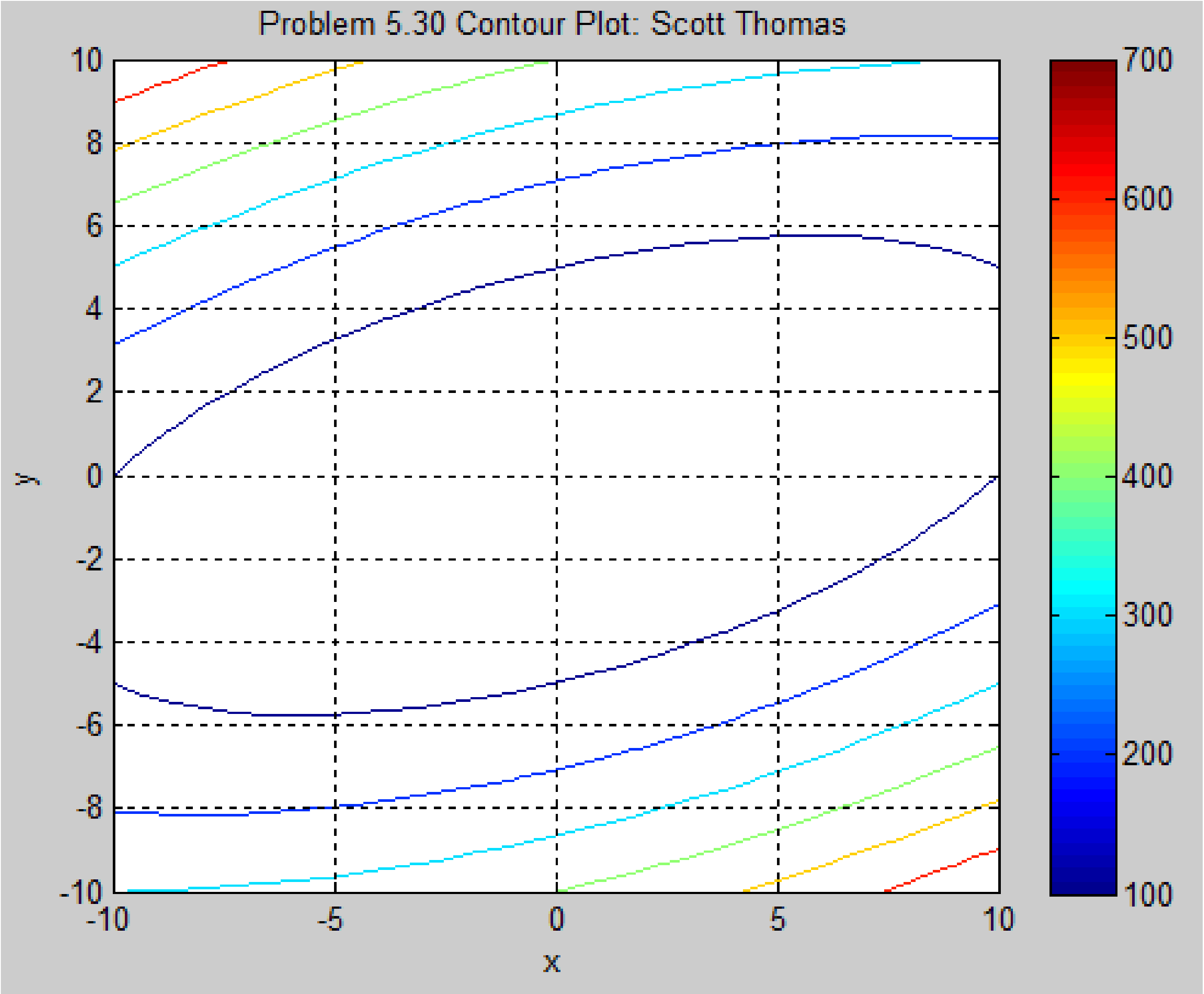


Problem 5.30:

Obtain the surface and contour plots for the function $z = x^2 - 2xy + 4y^2$, showing the minimum at $x = y = 0$.



Problem 5.30:


Problem 5.30 Contour Plot: Scott Thomas
10
8
6
4
2
0
-2
-4
-6
-8
-10
y
-10
-5
0
5
10
x
700
600
500
400
300
200
100