CSC 2262, Spring 2020, Lab 5a

Gilpin's system for modeling the behavior of three interacting species is given by the following differential equations:

$$\frac{dx}{dt} + Ax^2 + Akxy + Bxz = x$$

$$\frac{dy}{dt} + Ckxy + Ay^2 + Ayz = y$$

$$\frac{dz}{dt} - Dxz - Eyz = -z$$

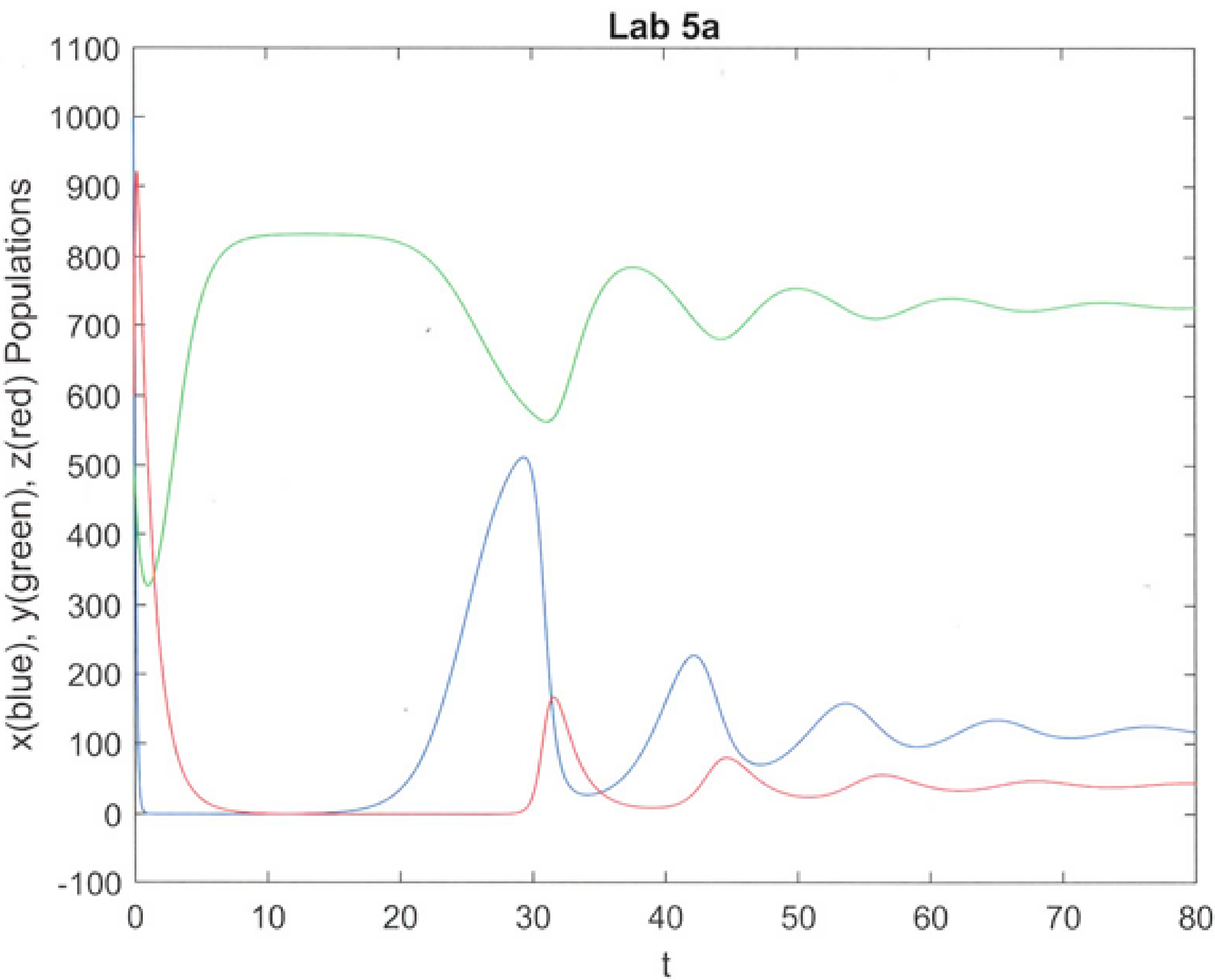
where A = .0012, B = .011, C = .0014, D = .006, E = .0004, k = .45, and x, y and z are the populations of the three species.

Write a MATLAB program as follows:

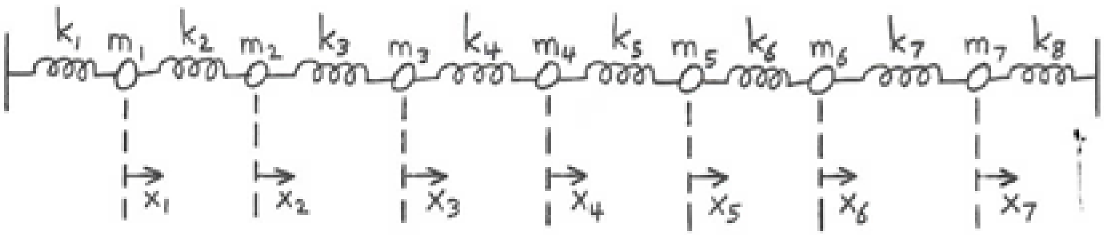
1) t will go from 0 to 80 sec in steps of .001 sec .

2) Calculate x, y and z for each value of t. Use 1e-7 as the accuracy factors and 1000, 500 and 600 as the initial values of x, y and z.

3) Plot x, y and z versus t using the colors blue, green and red. The graph should look like the one on the attached sheet.


Lab 5a
x(blue), y(green), z(red) Populations
t
1100
1000
900
800
700
600
500
400
300
200
100
0
-100
0
10
20
30
40
50
60
70
80

CSC 2262, Spring 2020, Lab 5b




In the damped mass-spring system shown above, the masses $m_1$, $m_2$, $m_3$, $m_4$, $m_5$, $m_6$ and $m_7$ are .9, .5, .6, .2, .8, .7 and .3, the spring constants $k_1$, $k_2$, $k_3$, $k_4$, $k_5$, $k_6$, $k_7$ and $k_8$ are 3.5, 5.4, 4.4, 4.9, 4.7, 5.3, 3.9 and 5.2, the damping constants $c_1$, $c_2$, $c_3$, $c_4$, $c_5$, $c_6$, $c_7$ and $c_8$ are .20, .12, .24, .32, .14, .28, .36 and .22, and $x_1$, $x_2$, $x_3$, $x_4$, $x_5$, $x_6$ and $x_7$ are the displacements of $m_1$, $m_2$, $m_3$, $m_4$, $m_5$, $m_6$ and $m_7$ from their equilibrium positions.

Write a MATLAB program as follows:

1) t will go from 0 to 3 sec in steps of .001 sec.
2) Calculate the displacements and velocities of the masses for each value of t. Use 1e-7 as the accuracy factors, .6, .4, .7, .8, .5, .2 and .3 as the initial values of $x_1$, $x_2$, $x_3$, $x_4$, $x_5$, $x_6$ and $x_7$ , and 0 as the initial values of the velocities.
3) Plot $x_1$, $x_2$, $x_3$, $x_4$, $x_5$, $x_6$ and $x_7$ versus t using the colors yellow, red, green, blue, magenta, black and cyan and the t axis in black.
4) In a separate figure, plot the velocities $v_1$, $v_2$, $v_3$, $v_4$, $v_5$, $v_6$ and $v_7$ versus t using the colors yellow, red, green, blue, magenta, black and cyan and the t axis in black.

The graphs should look like the ones on the attached sheets.

Equations

$$m_1\frac{d^2x_1}{dt^2} = -k_1x_1 + k_2(x_2-x_1) - c_1V_1 + c_2(V_2-V_1)$$

$$m_2\frac{d^2x_2}{dt^2} = -k_2(x_2-x_1) + k_3(x_3-x_2) - c_2(V_2-V_1) + c_3(V_3-V_2)$$

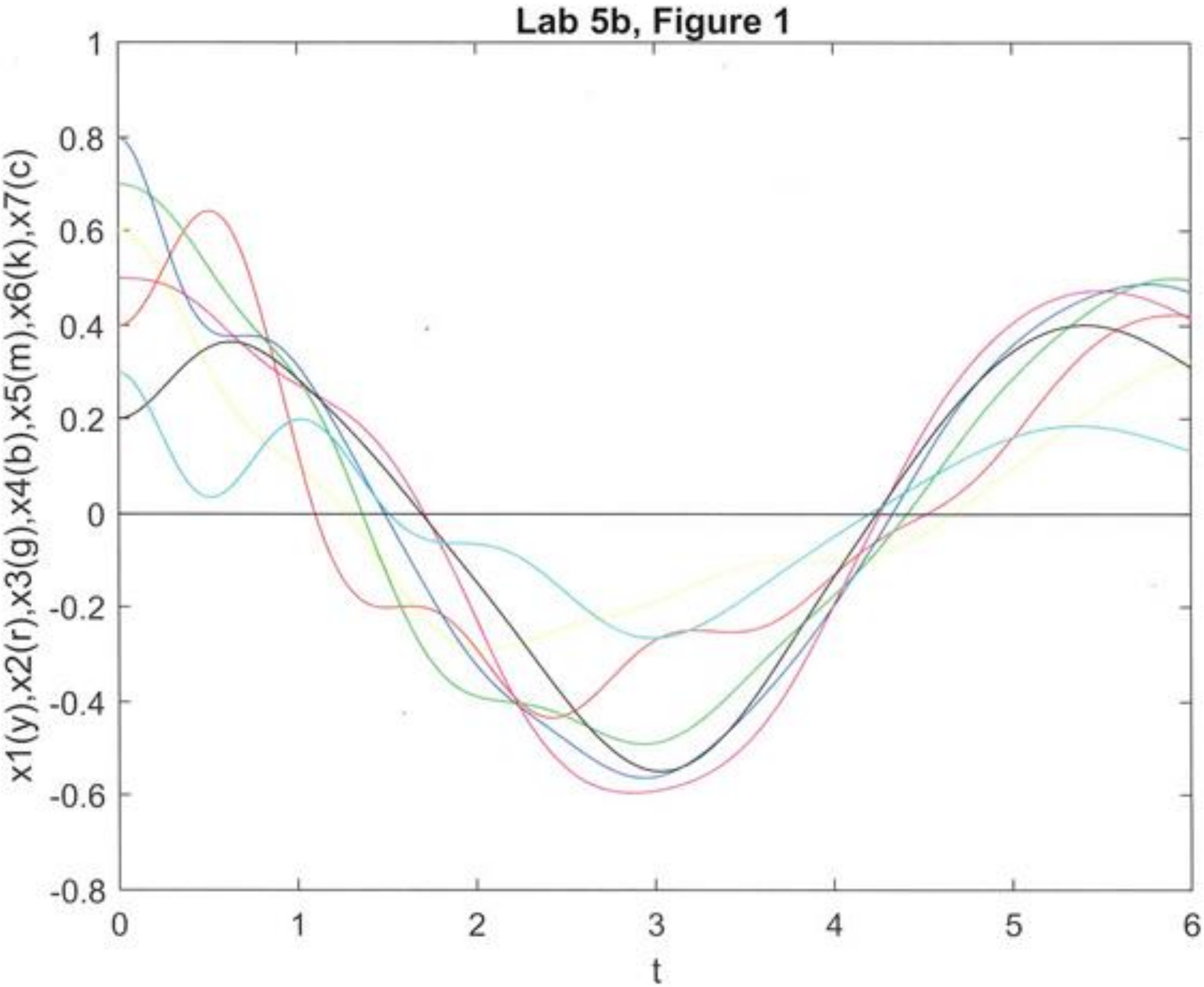
$$m_3\frac{d^2x_3}{dt^2} = -k_3(x_3-x_2) + k_4(x_4-x_3) - c_3(V_3-V_2) + c_4(V_4-V_3)$$

$$m_4\frac{d^2x_4}{dt^2} = -k_4(x_4-x_3) + k_5(x_5-x_4) - c_4(V_4-V_3) + c_5(V_5-V_4)$$

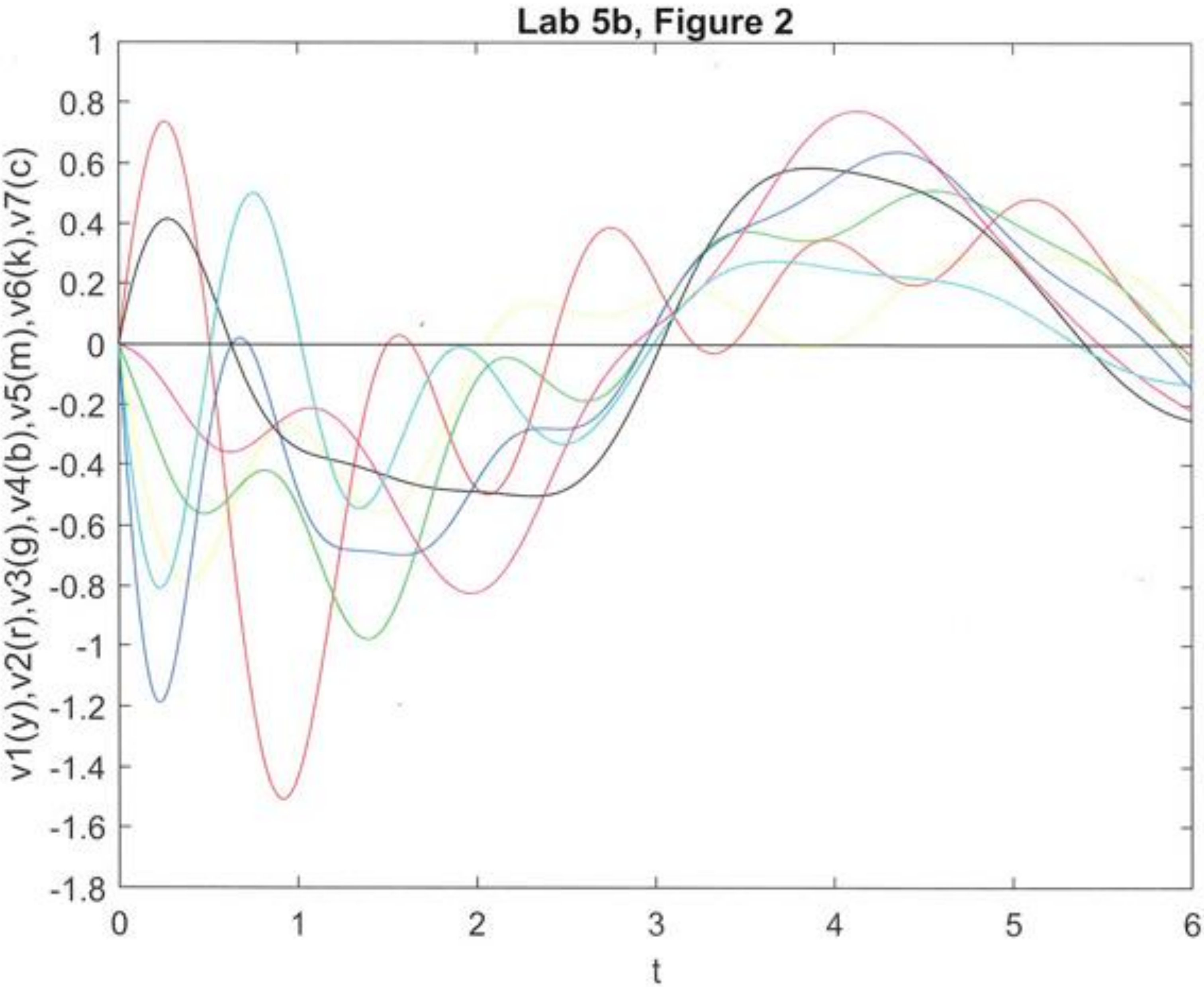
$$m_5\frac{d^2x_5}{dt^2} = -k_5(x_5-x_4) + k_6(x_6-x_5) - c_5(V_5-V_4) + c_6(V_6-V_5)$$

$$m_6\frac{d^2x_6}{dt^2} = -k_6(x_6-x_5) + k_7(x_7-x_6) - c_6(V_6-V_5) + c_7(V_7-V_6)$$

$$m_7\frac{d^2x_7}{dt^2} = -k_7(x_7-x_6) - k_8x_7 - c_7(V_7-V_6) - c_8V_7$$



Lab 5b, Figure 1
x1(y),x2(r),x3(g),x4(b),x5(m),x6(k),x7(c)
t
1
0.8
0.6
0.4
0.2
0
-0.2
-0.4
-0.6
-0.8
0
1
2
3
4
5
6



Lab 5b, Figure 2
v1(y),v2(r),v3(g),v4(b),v5(m),v6(k),v7(c)
t
0
1
2
3
4
5
6
1
0.8
0.6
0.4
0.2
0
-0.2
-0.4
-0.6
-0.8
-1
-1.2
-1.4
-1.6
-1.8