Math 310 – Homework #9 Cover Sheet **name**:

- tutorial, check one: ◯ T9:30; ◯ T10:30; ◯ T11:30; ◯ R10:30; ◯ R11:30; ◯ R12:30.

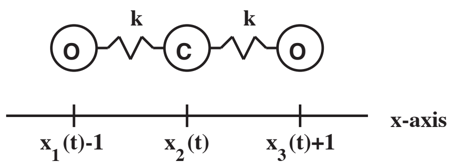
- begin each problem on a new page & clearly identify each question.
- use words to describe your procedures & to interpret your results.
- put boxes around your final results.
- due on friday 15 november at START of lecture.

question #	CONCEPT keywords & MAIN formula/result
7.1.CO_2	concept
	result
# 7.7.3	
# 7.7.6	
# 7.9.2	
#7.9.7	

- problems for submission are indicated in **bold**.
- homework portfolios will also be graded on completeness & presentation (clarity & conciseness).
- maple integer arithmetic may be of some assistance in checking your answers here.

Section 7.1

- practice: # 17 (especially if you need some hints on the question below.)



CO_2 write and solve the ODEs for a mass/spring model of a molecule of CO_2. Denote the atomic masses to be m_C,m_O and the spring constant to be k. Treat only the vibrations of the atoms along the x-axis. The springs are such that the restoring force is zero if their length is 1 — this means that the force is proportional to the difference in the atom positions *minus 1*. In developing your ODEs, use a diagram like Figure 7.1.3b in the text to help your explanations. (Hint: your ODEs should be satisfied by $x_1 = x_2 = x_3 = 0$.)

Section 7.7

#3 also, what is the fundamental matrix solution for which $\mathbf{\Phi}(T) = \mathbf{I}$? (this is a one-liner.)

#6 use maple to multiply & simplify (hint: use *simplify(. . . ,trig)*) the matrix product $\mathbf{\Phi}(t)\mathbf{\Phi}^{-1}(T)$, compare with the matrix $\mathbf{\Phi}(t - T)$, and explain this amazing result.

Section 7.9

- practice: # 1-12

#2 derive the solution by finding a diagonalizing matrix.

#7 derive the solution using the variation of parameters result (equation 29).

Computing Focus

example #1 of section 9.7 (really) – modify the two-component Runge-Kutta code to solve the ODEs of equation (4). The matlab plotting commands:

hold on
plot(y(:,1),y(:,2),'r')
plot(y(1,1),y(1,2),'rx')
plot(y(end,1),y(end,2),'ro')

produce a solution trajectory (red curve) on a phase plane with an X at the initial condition and an O at the end. By running this script for different IVs, reproduce Figure 9.7.1 on page 524. (Type *help clf* and *help hold* at the matlab prompt for info on how to control your plot window.)