

# Midterm Exam III

1	2	3	4

Last Name: \_\_\_\_\_

First Name: \_\_\_\_\_

ID: \_\_\_\_\_ Section: \_\_\_\_\_

Math 2243,  
April 28, 2004

**There are 4 partial credit questions.  
NO GRAPHIC CALCULATORS are permitted. GOOD LUCK !**

1. Answer all the following questions :

- a) Is there any injective linear transformation  $T : R^3 \rightarrow R^2$ . If yes, give an example.**[5 pts.]**
- b) Give an example of a matrix satisfying the equation  $A^2 + 2A + I_2 = 0$ .(Hint: remember that every matrix satisfies its own characteristic equation).**[5 pts.]**
- c) Let  $T : R^2 \rightarrow R^2$  be the reflection about the line of equation  $x = y$ .Find the eigenspaces of  $T$ .**[15 pts.]**

**2.**

- a) Using the conservation of energy principle(kinetic+potential=constant) write down the equation of motion for a simple pendulum(interpreting the angle made the pendulum with the vertical equilibrium position as of function of time).DO NOT ATTEMPT TO SOLVE THE EQUATION YOU GET!**[10 pts.]**
- b) Is the equation you obtain in part *a*) a linear differential equation? **[10 pts.]**

**3.** Solve the Initial-Value-Problem

$$y'' + y' = e^{-t}; y(0) = 0; y'(0) = 0$$

(Hint: try a particular solution  $y_p(t) = te^{-t}$ ) [**35 pts.**]

4. Let  $v_0 = \langle 1, 0, -1 \rangle \in R^3$  and  $T : R^3 \rightarrow R^3$  be the linear transformation defined as

$$T(v) = v \times v_0.$$

What is the kernell and the range of this linear transformation?[**15 pts.**] What is the matrix of the linear transformation?[**10 pts.**]