Massachusetts Institute of Technology
Department of Mechanical Engineering

2.003J/1.053J Dynamics & Control I

Fall 2007

Homework 4

Issued: Oct. 5. 2007 **Due**: Oct. 12. 2007

The following three problems aim to get you familiarize with MATLAB functions. You don't need to worry about exceptional cases such as when n is not a non-negative integer in problem 4.3. It is assumed that input arguments are well-defined.

Problem 4.1 : Writing a function to perform multiple matrix operations

Write a function that will calculate the sum, difference, element-by-element multiplication, and matrix multiplication of two arbitrary same size matrices at once. The results of function with given matrices $\begin{bmatrix} 1 & 2 \\ 3 & 4 \end{bmatrix}$ and $\begin{bmatrix} 1 & 3 \\ 2 & 4 \end{bmatrix}$ are shown as below in the command window:

```
>> [s,d,ep,mp]=bop([1 2 ; 3 4],[1 3 ; 2 4])
s =
    2    5
    5    8
d =
    0   -1
    1    0
ep =
    1    6
    6   16
mp =
    5   11
   11   25
```

Function name (and m-file name) should be `'bop_your_kerberos_name'`, and upload it to 2.003 MIT Server site. You also submit print-out of your function. Calculate sum, difference, element-

by-element multiplication, and matrix multiplication of $\begin{bmatrix} 10 & 35 \\ 70 & 100 \end{bmatrix}$ and $\begin{bmatrix} 5 & 3 \\ 9 & 25 \end{bmatrix}$ with your function in this problem.

Problem 4.2 : Integrating two functions numerically over a given interval using function handlers

Evaluate the following two integrals using the `'quad'` function. You don't need to turn in the code electronically. Just manually write down the MATLAB codes that you have used and the evaluation result that you get.

i) $y = \int_1^{10} \left(ax^2 + bx + c \right) dx \quad where \quad a = 1, b = 2, and\ c = 3$

ii) $y = \int_{-\infty}^{+\infty} a \cdot \exp\left(-\left(\frac{x-b}{\sqrt{2}c} \right)^2 \right) dx \quad where \quad a = \frac{1}{\sqrt{2\pi}}, b = 0, and\ c = 1$

Does the `'quad'` function give reasonable results for both functions i) and ii)? For ii), analytically evaluate the Gaussian function (or look it up in an integral table) and compare with your numerical result. Explain any differences.

Problem 4.3 : Calculating the factorial of a non-negative integer

Write a function to calculate the factorial of a non-negative integer, $n!$. It is not allowed to use recursive algorithm you will learn next week in this problem. Function name (and m-file name) should be `'fctrl_your_kerberos_name'` and upload it to 2.003 MIT Server site. You also submit print-out of your function. Calculate 125! with this function.