Sample Questions for Exam 1

The following are meant to give you some examples of questions that might be asked on the first exam. The sample exam questions do not represent the length or difficulty of the actual exam. The actual exam will have more questions and cover a broader range of topics than what is presented here. For a list of topics and more information about exam 1, see the Exams page of the course web site.

A reference similar to the one below will be provided for you on the exam.

List of Sample MATLAB Commands and other information:

```
A = zeros( r, c )
A = ones( r, c )
A = eye( r, c )
n = length(A)
[nr nc] = size(A)
A'
X = 0 : 0.1 : 10
T = A\b
C = polyfit(XD, YD, d)
Y = polyval(C, X)
Y = spline(XD, YD, X)
int1 = integral( @func, a, b )
root = fzero( @func, x0 )
plot( X, Y, 'r', XD, YD, 'o' );
disp([num2str(x), ' text '] )
M = max(V) % largest value M contained in vector V
M = min(V) % smallest value M contained in vector V
S = sum(V) % sum S of values in vector V
Y = cos(X) % cosine of X where X is given in radians
Y = sin(X) % sine of X where X is given in radians
Y = sqrt(X) % square root of X
Y = log(X) % mathematically, this is Y = ln(X)
Y = exp(X) % mathematically, this is Y = e^X
```

Circumference of a circle with radius = \( r \): \( \text{circ}_{\text{circle}} = 2\pi r \)

Area of a circle with radius = \( r \): \( \text{area}_{\text{circle}} = \pi r^2 \)

Volume of a cylinder with radius = \( r \) and height = \( h \): \( \text{vol}_{\text{cylinder}} = \pi r^2 h \)
3-point Multiple Choice

Choose the one best answer after reading all of the choices.

1) Which MATLAB statement is correct for obtaining a vector where the elements are formed using

\[ y = x \cos(x) + \frac{\sin(x)}{4 + \cos(x)} \]

where \( x \) has been defined as \( x = ( 0 : .01 : 6 ) \)?

A. \( y = x*\cos(x) \ .+ \sin(x)/( 4 + \cos(x) ) \)
B. \( y = x.*\cos(x) + \sin(x)/( 4 + \cos(x) ) \)
C. \( y = x.*\cos(x) + \sin(x)./( 4 + \cos(x) ) \)
D. \( y = x*\cos(x.) \ .+ \sin(x.)/( 4 + \cos(x) ) \)
E. None of these will work with that definition of \( x \).

2) What is the value of \( D \) after the following MATLAB commands are executed:

\[
\begin{align*}
A &= \begin{bmatrix} 1 & 2 \\ 3 & 4 \end{bmatrix}; \\
B &= \begin{bmatrix} 0 & 1 \\ 2 & 1 \end{bmatrix}; \\
C &= A \times B; \\
D &= B \times C;
\end{align*}
\]

A. \[ \begin{bmatrix} 0 & 2 \\ 12 & 4 \end{bmatrix} \]
B. \[ \begin{bmatrix} 0 & 3 \\ 16 & 7 \end{bmatrix} \]
C. \[ \begin{bmatrix} 4 & 2 \\ 8 & 10 \end{bmatrix} \]
D. \[ \begin{bmatrix} 6 & 4 \\ 6 & 8 \end{bmatrix} \]
E. \[ \begin{bmatrix} 8 & 7 \\ 16 & 13 \end{bmatrix} \]

3) Consider the following MATLAB function:

\[
\begin{align*}
\text{function output = midterm( z )} \\
x &= z(1); \\
y &= z(2); \\
w1 &= x^2 + y^2; \\
w2 &= x; \\
output &= [ w1 ; w2 ];
\end{align*}
\]

When \( z = [ 2 \ -1 ] \) what is the value of \( \text{output} \)?

A. \( \begin{bmatrix} 5 \\ -1 \end{bmatrix} \)  B. \( \begin{bmatrix} 5 \\ -1 \end{bmatrix} \)  C. \( \begin{bmatrix} 5 & 2 \end{bmatrix} \)  D. \( \begin{bmatrix} 5 \\ 2 \end{bmatrix} \)
4) Publishing a MATLAB script to HTML creates a document containing which of the following?
   A. only the code and comments
   B. only the unsuppressed output
   C. the code, the comments, and plot figures, but not the unsuppressed output
   D. the code, the comments, the unsuppressed output, plot figures, but not the contents of all variables
   E. the code, the comments, the unsuppressed output, plot figures, and the contents of all variables

5) Consider the following MATLAB function:
   ```matlab
   function output = result(a, b)
   x = a*2 + b;
   y = 2*a + 1;
   output = [x; y]
   ```
   Which of the following is the proper way to call the function for the two input values 2 and 1?
   A. `z = result(2, 1)`
   B. `z = result([2, 1])`
   C. `z = output(2, 1)`
   D. `z = output([2, 1])`

6) Consider the following linear system in upper-triangular form.
   
   $$
   \begin{bmatrix}
   1 & -1 & 2 & 2 \\
   0 & 1 & 2 & 0 \\
   0 & 0 & 2/5 & 1 \\
   0 & 0 & 0 & 3/7 \\
   \end{bmatrix}
   \begin{bmatrix}
   x_1 \\
   x_2 \\
   x_3 \\
   x_4 \\
   \end{bmatrix}
   =
   \begin{bmatrix}
   -2 \\
   1 \\
   12/5 \\
   6/7 \\
   \end{bmatrix}
   $$
   
   What is the solution of this system?
   A. $x_1 = -45, x_2 = -21, x_3 = 11, x_4 = 1$
   B. $x_1 = -1, x_2 = 3, x_3 = -1, x_4 = 2$
   C. $x_1 = -9, x_2 = -1, x_3 = 1, x_4 = 2$
   D. $x_1 = 1, x_2 = 3, x_3 = -1, x_4 = 2$
   E. $x_1 = -10, x_2 = -2, x_3 = 1, x_4 = 2$

7) Which of the following statements would approximate the data points with a cubic polynomial and output the value of the polynomial at $x = 4$? The data is in arrays `xdata` and `ydata`.
   A. `cc = polyfit(xdata, ydata, 4); vv = polyval(cc, 4)`
   B. `cc = polyval(xdata, ydata, 3); vv = polyval(cc, 4)`
   C. `vv = spline(xdata, ydata, 4)`
   D. `cc = polyfit(xdata, ydata, 3); vv = polyval(cc, 4)`
   E. `cc = polyfit(xdata, ydata); vv = polyval(cc, 3, 4)"
1-point Multiple Choice

Choose the one best answer after reading all of the choices.

8) If the coefficient matrix of a linear system is non-singular, this means that there is exactly one solution to the problem (i.e., there is a unique solution to the linear system).
   A. True    B. False

9) Given $N$ data points, $(x_1, y_1), (x_2, y_2), \ldots, (x_N, y_N)$, for which the values of $x_k$ are distinct, there is a unique polynomial of what degree that interpolates these points?
   A. $N + 1$    B. $N$    C. $N - 1$

10) In using the MATLAB command
    
    ```matlab
    coef = polyfit(x, y, 4);
    ```
    
    $\text{coef}(2)$ is the coefficient of which power of $x$?
   A. $x^0$    B. $x^1$    C. $x^2$    D. $x^3$    E. $x^4$

11) Of the three curves shown in the figure, which represents the quadratic polynomial that best fits the data?

   A. curve A    B. curve B    C. curve C
For questions 12 through 16, assume that $\text{vec}$ and $\text{arr}$ have been defined as follows:

$$\text{vec} = [5.1 \ 2.3 \ 1.7];$$
$$\text{arr} = [4 \ 7 \ 8; \ 3 \ 1 \ 6];$$

For each line of MATLAB code, will attempting to execute the code result in an error? Consider each line of code independently of the others. Your answer choices are:

A. Yes; attempting to execute the code will result in MATLAB giving an error message
B. No; the code will execute without any problems

12) $\text{vec2} = \text{vec}^2$
13) $\text{arr}[1,2] = 0;$
14) $\text{A} = [1 \ 2; \ 3 \ 4; \ 5 \ 6 \ 7]$
15) $\sin(\pi) = \text{result};$
16) $\text{plot} = 1 : 2 : 100$

Written Questions

A list of MATLAB statements are provided for you on the first page for your reference. When writing out MATLAB commands, give your answers exactly as you would type them at the keyboard (you do not have to indicate where you hit the <enter> key). Note: the actual exam will provide sufficient space for you to write your answers.

17) For each part, show the contents of the variable after the code has executed. For example, if the code is:

$$\text{x} = [1 \ 2 \ 3; \ 4 \ 5 \ 6];$$
$$\text{x} = \text{x} + 1;$$

you would write:

$$\text{x} = \begin{bmatrix} 2 & 3 & 4 \\ 5 & 6 & 7 \end{bmatrix}$$

Part a) Show the contents of variable $\text{aa}$

$$\text{aa} = [\ 8:-3:0, \ 1:4:12 \ ];$$

Part b) Show the contents of variable $\text{bb}$

$$\text{bb} = [10 \ 20 \ 30 \ 40 \ 50 \ 60];$$
$$\text{bb}(\text{length(\text{bb}))} = \text{bb}(2) + \text{bb}(5);$$

Part c) Show the contents of variable $\text{cc}$

$$\text{cc} = [\ 1, \ 2, \ 3, \ 4; \ 5, \ 6, \ 7, \ 8];$$
$$\text{cc}(\text{:,} \ 2) = 3 + \text{cc}(\text{:,} \ 1);$$

Part d) Show the contents of variable $\text{dd}$

$$\text{dd} = [\ 1, \ 2, \ 3; \ 4, \ 5, \ 6; \ 7, \ 8, \ 9 \ ];$$
$$\text{dd}([1 \ 3], \ 2) = \text{dd}([2 \ 1], \ 3);$$

Part e) Show the contents of variable $\text{ee}$

$$\text{ee} = [\ 2:2:18 \ ];$$
$$\text{ee} = \text{ee}(\ [\ 2:3:8 \ ]);$$
18) Give the MATLAB commands to create a 7x7 matrix with twos in the first and fourth rows and zeroes elsewhere.

19) The surface area $A$ of a sphere of radius $r$ is given by the formula: $A = 4\pi r^2$. Write a MATLAB function named `sphereSurface` that takes the radius of the sphere as a parameter and returns the surface area of the sphere using the formula above. Make sure your function works if a vector of radius values is given (i.e., it should calculate a vector of corresponding surface areas).

20) Given the linear system

$$
\begin{align*}
3u + 7v - 2x + 3y - z &= 37 \\
4u + 3z &= 40 \\
5x - 4y + z &= 12 \\
2y + 9x + 4y + 3z &= 14 \\
5y + 8z &= 20
\end{align*}
$$

Rewrite the linear system so that it is in matrix form $Ax = b$.

21) You are given a set of $(t_k, z_k)$ experimental data points for $k$ from 1 to 90 and where $t$ ranges from 0 to 20. You are to fit the data to a curve of the form

$$z(t) = A + Bt^{1/2} + Ct$$

The data is in arrays `tdata` and `zdata`.

Give MATLAB commands to approximate the data using the curve above and then plot the data points and curve for the range $t = 0$ to 20.

22) Give the MATLAB commands to find the value of $B$ between 3 and 4 necessary so that the wedge-shaped region between the curves has an area of 5.3. To receive full credit, you must write and use at least one anonymous function.

23) Suppose we set $B = 3$. Give the MATLAB commands to find the volume obtained by revolving the wedge-shaped region between the curves around the $y$-axis.