ENGR 13100

Fall 2012

Exam 1

INSTRUCTIONS:

Duration: 60 minutes

Keep your eyes on your own work!
Keep your work covered at all times!

1. Each student is responsible for following directions. Read carefully.
2. MATLAB and Excel commands are provided on the next page.
3. This exam consists of 15 questions on 8 pages (4 sheets front *AND* back). Check to be sure that you have all of the pages.
4. Write your name, Section #, and Team # on **both** sides of the **answer sheet**.
5. Closed book and notes.
6. No calculators.
7. Please make sure you return the **answer sheet** (you may keep this booklet).
8. **<u>Element-by-element computations are to use appropriate notation ONLY where necessary.</u>**

Academic Integrity Statement

"I have not used material obtained from any other unauthorized source, either modified or unmodified. Neither have I provided access to my work to another. The solutions I am submitting are my own original work".

Exam 1 Formula Sheet **ENGR 13100 – Fall 2012**

Statistics Equations

$$s^2 = \frac{1}{n-1}\sum_{i=1}^{n}(x_i - \bar{x})^2$$

$$s^2 = \frac{n\sum_{i=1}^{n} x_i^2 - \left(\sum_{i=1}^{n} x_i\right)^2}{n(n-1)}$$

MATLAB Functions / Operators

+ - * / ^ =	ans	grid	max	sort
.* ./ .^	clc	help	mean	sqrt
%	clear	hist	median	std
‘ (transpose)	cos	hold	min	subplot
,	csc	i, j	NaN	sum
:	doc	Inf	ones	tan
;	cumsum	legend	pi	title
[ ] (*null vector*)	exit	length	plot	who
( )	exp	linspace	prod	whos
… (*ellipsis*)	factorial	load	quit	xlabel
abs	figure	log	round	ylabel
acos	format	log10	sec	zeros
asin	fprintf	logspace	sin	
atan	function	lookfor	size	

Selection of MATLAB plot Special Characters

Line Type	Indicator	Point Type	Indicator	Color	Indicator
solid	-	circle	o	blue	b
dotted	:	x-mark	x	green	g
dash-dot	-.	plus	+	red	r
dashed	--	square	s	black	k

Excel Functions

+ - * / ^ =	EXP	MIN	STDEV
$	LN	MODE	SUM
ABS	LOG10	PI	TAN
AVERAGE	MAX	SIN	
COS	MEDIAN	SQRT	

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RECORD ALL ANSWERS ON THE ANSWERSHEET

<u>Problem #1</u> (4 points)

Please indicate TRUE (violation of academic integrity) or FALSE (no violation of academic integrity) for each of the following situation:

A. Isabel copied and pasted content from a text without using quotes even though she included a citation.

B. Stacia looked over to another's paper during a quiz or exam

C. Martin copied someone else's MATLAB code for his individual homework

D. Keri let Joseph look at her MATLAB code. (Focus on Keri's action.)

<u>Problem #2</u> (4 points)

A. In the space provided on the answer sheet, describe how the problem addressed in the book, "The Boy who Harnessed the Wind" (BOY) OR in the in-class activity involving the jelly sandwich (JS), is an example of an engineering problem. Be sure to indicate which topic you have chosen.

B. Of the 13 engineering majors available at Purdue, which 2 are most closely related to the problem in the book OR the jelly sandwich activity? Provide a brief description of how that major is related to the problem.

<u>Problem #3</u> (6 points)

A. List the four roles that should be assigned within a team during every team exercise/activity for this class.

B. Explain one role in detail (1-3 sentences).

<u>Problem #4</u> (5 points)

You are watching a team make no progress on a project. In a five-minute period, John criticizes Fang's idea; Bill and Mary criticized John for what he said to Fang.

A. What phase of team development is this team in?

B. While all of the following are useful tools for functioning in a team, which of the following strategies would help this team resolve this particular conflict? Circle all that apply.

a. Use an agenda
b. Refer to Code of Cooperation
c. Reinforce role of encourager

RECORD ALL ANSWERS ON THE ANSWERSHEET

<u>Problem #5</u> (10 points)

What commands are typed into the Command Window to create the following variables in MATLAB?

A. Create a *row* vector named **row_vector** that has the following elements (in this order):

$$5^{2/7},\ e^{2.5},\ \cos(\pi/3),\ \ln 2, \text{ and } \sqrt{3}.$$

B. Using the variable **row_vector**, create a new row vector named **row_vector2** by raising the value of each element to the power of 2 (i.e., squaring).

C. Create a *column* vector named **column_vector** in which the first element is 15, the elements decrease with decrements of –5, and the last element is –25. Use the most compact way (use only 3 numbers to create this vector).

D. Create the following matrix named **DFT**:

$$DFT = \begin{bmatrix} 2 & 4 & 6 \\ 3 & 6 & 9 \\ 7 & 14 & 21 \end{bmatrix}$$

E. Use the matrix **DFT** to create a six-element column vector named **New_Column** that contains the elements of the first and third columns of **DFT**. Your command should be valid even if elements of **DFT** are changed.

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RECORD ALL ANSWERS ON THE ANSWERSHEET

<u>Problem #6</u> (6 points)

Consider the EXCEL spreadsheet below.

	A	B	C	D	E	F
1	**rate =**	2	4	6	8	10
2	**Occurrence=**	10	5	7	2	4
3						
4	**X**	**Y**	**L**	**W**	**Z**	**V**
5	0.2	0.5	=C2*$A5+D1+B6+C$2			
6	0.4	9				
7	0.6	2				
8	0.8	12				
9						
10						

A. One way to extend the hardcoded (numeric) values in the column labeled X from cells A5:A8 to cells A9 and A10 is to continue typing the next values in the sequence. Using only your mouse, describe how to extend these hardcoded values in A7 and A8 to cells A9 and A10?

B. What value of L will be displayed in cell C5 given the formula shown in cell C5?

C. If the formula displayed in cell C5 were copied and pasted in cell E6, what would be the ***formula*** displayed in cell E6.

<u>Problem #7</u> (6 points)

The following MATLAB command has been entered in the command window:

```
>> S = [0:5:35]
```

A. What is the value of S(3)?

B. How many elements does the vector S contain?

<u>Problem #8</u> (6 points)

Engineers often import large data files into Excel and MATLAB. Name 2 file extensions that have been used in this class to import data in Excel and MATLAB.

RECORD ALL ANSWERS ON THE ANSWERSHEET

<u>Problem #9</u> (8 points)

Match each Excel cell reference (on the left) to one description (on the right).

A. A2

B. $B5

C. C$7

D. M9

a. Relative Addressing

b. Absolute Addressing

c. Absolute Column Relative Row

d. Relative Column Absolute Row

e. None of the above

<u>Problem #10</u> (15 points)

A projectile's vertical height can be described by the following equation:

$$height(t) = (V_0 \sin\theta_0)t - \frac{1}{2}gt^2$$

$$t: time\ in\ seconds$$

$$V_0: initial\ velocity\ in \frac{m}{sec}$$

$$\theta_0: launch\ angle\ in\ degrees$$

$$g: gravitational\ acceleration\ in\ m/sec^2$$

The actual data for the time and height collected from launching a model rocket were saved in a file called **rocket_data.txt**. The time is in the first column, and height is in the second column.

The following MATLAB script has been written to compare the collected data with the predicted results from the equation. However, this script is not working.

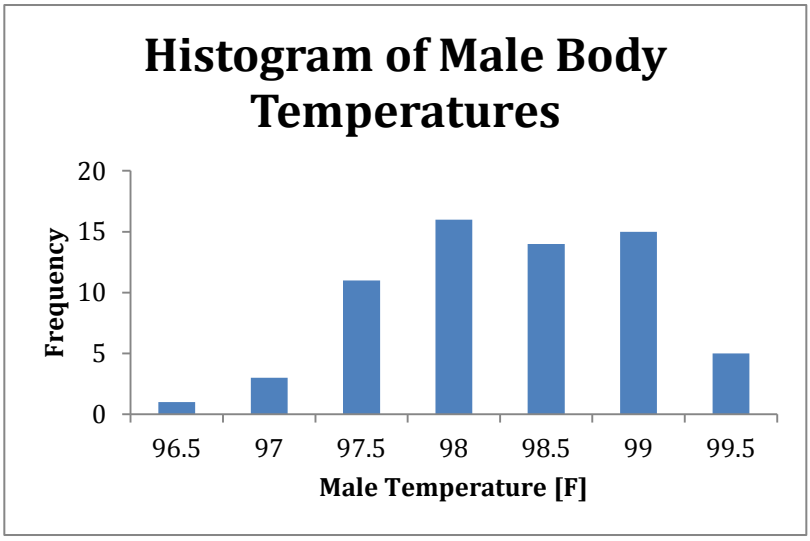
Find 4 errors in the following script (there are more than 4). Cleary indicate the line number where the error is, identify the error within the line, and re-write the entire line (minus the comments) correctly to make it work properly. There is at most one error per line. Missing comments do not count as an error.

1	% --- INPUTS ---
2	th0 = 45; %Launch angle [deg]
3	V0 = 50; %Initial velocity [m/sec]
4	gravity = 9.8; %Gravitational Acceleration [m/sec^2]
5	measured_data = load('rocket_data'); %Load the data
6	actual_time = measured_data(1,:); % Measured time [sec]
7	actual_height = measured_data(:,2); %Measured height [m]
8	
9	% --- CALCULATIONS ---
10	ht_part1 = V0*sin(th0)*actual_time % Calculate predicted height – Part 1
11	ht_part2 = 1/2*gravity*actual_time^2; % Calculate predicted height - Part 2

```
pred_ht = ht_part1 – ht_part2; % Calculate predicted height

% --- OUTPUT ---
plot(actual_time,actual_height,'s')  % Plot empirical height
hold off
plot(actual_time,pred_ht)  % Plot predicted height
grid on
legend('Empirical, Predicted')
title('Empirical and Predicted Rocket Heights')
xlabel('Time')
ylabel='Height [m]'
```

<u>Problem #11</u> (6 points)
The body temperatures (F) of a population of male students are represented in the **Excel** histogram below.



In the histogram above, the number 97 on the Male Temperature [F] axis indicates the value for?: [Circle **one** answer]

a. The left side (lower limit) of the second bin.
b. The center of the second bin.
c. The right side (upper limit) of the second bin.
d. None of above

RECORD ALL ANSWERS ON THE ANSWERSHEET

<u>Problem #12</u> (4 points)
At an automotive company, an industrial engineer records the one-day production results for five assembly lines as noted below:

Line A = 90 cars
Line B = 115 cars
Line C = 110 cars
Line D = 75 cars
Line E = 110 cars

Determine the following output statistics for these 5 production lines.

A. Mean = _____

B. Mode = _____

<u>Problem #13</u> (10 points)
Use **MATLAB** to create the same histogram as in problem 11. Assume the variable **Male_Temperature** is assigned that includes all male temperature data. Also assume that the variable **Bin_Centers** is assigned for use in histogram generation. Using the ENGR 131 programming standards, write a MATLAB script (you may skip the script header and INPUTS section) to:

A. Calculate the mean and the standard deviation of **Male_Temperature**.
B. Generate the histogram above.
C. Use **fprintf** to display the calculated mean and the standard deviation using the format pattern shown below (include units):

Average: 98.1 [F], Standard Deviation: 0.70 [F]

For questions 14 & 15, think about the Model-Eliciting Activities (MEA) and the Mathematical Model Development process.

<u>Problem #14</u> (6 points)
A. Complete the names of the following 3 dimensions that make a mathematical model generalizable.

S_____ M_____ R_____

B. Define or explain **<u>one</u>** of these dimensions (1-2 sentences).

<u>Problem #15</u> (4 points)
Explain the difference between the direct user and the other stakeholders? (1-2 sentences).