UNIVERSITY OF GHANA, LEGON

FIRST SEMESTER EXAMINATION 2014/2015

LEVEL 100: BACHELOR OF SCIENCE IN ENGINEERING

CPEN 101: ENGINEERING COMPUTATIONAL TOOLS (2 Credits)

TIME: TWO (2) HOURS

INSTRUCTIONS

Answer all Questions in Section A and any three (3) questions from Section B.

SECTION A (40 Marks)

A1. Give a well labeled diagram of the architecture of a typical computer system and briefly explain the function of each component. [5 marks]

A2. Give two (2) differences between Application software and Operating System (OS) software. [3 marks]

A3. Explain the difference between computer hardware and software. Briefly describe any three (3) programming paradigms you are familiar with and give one example of each type. [8 marks]

A4. Briefly explain the difference between the following in relation to engineering problem solving process. [6 marks]

(i) Theory and Data.

(ii) Mathematical model and Numeric/graphic result.

(iii) Implementation and Problem definition

A5. Explain the difference between the following regarding spreadsheet: [4 marks]

(i) Cell Address and Row

(ii) Workbook and worksheet

A6. Briefly explain the significance of report writing or documentation of results in engineering problem solving. [2 marks]

A7. What would be the output of the following statements in the Matlab command window? [2 marks]

(i) >> *a* = [1 2 3 4; 10 20 30 40; 5 6 7 8]

(ii) >> 3*a'

A8. Assume the length and breadth of a rectangle are denoted as variables "*L*" and

"*B*" respectively. Write a short code in Matlab to find the area and perimeter of the rectangle if $a=3$ and $b=7$. [4 mark]

A9. List three (3) open source engineering computational software tools that could be used to analyze WASSCE aggregate of first year students. [3 marks]

A10. Use Table 1 below to find the output of the following lookup function: [3 marks]

VLOOKUP("FPEN112", A2:D10, 3, True).

SECTION B (60 Marks)

Answer any three (3) questions from this Section.

B1. (a) Write a Matlab code that will ask for your name and print it out 20 times. [5 marks]

(b) The interest "I" on a principal "*P*" over a time period "*T*" is given by the formula below. Write a Matlab code to calculate the Principal when the rate is 20% per annum and interest is GHC500 for a period of 10 years. [6 marks]

$$I = \frac{P \times R \times T}{100}$$

(c) Write a Matlab code to convert user input temperature values measured in Kelvin (K) to degree Fahrenheit (F). Use F = (C*9/5) + 32 and K = C + 273. [5 marks]

(d) Assume the value S = 3.34567. Find what the value of S will be if the following Matlab commands are used? [4 marks]

(i) ceil()

(ii) fix()

(iii) round()

(iv) floor()

B2. (a) Assume the voice signal from a microphone is represented as $y = a\cos(2x)$. Write a Matlab code to find the differential of y over the interval $x = 0{:}2\pi$ at a step size of 0.01. Assume $a = 6.0$. [4 marks]

(b) Now, write a Matlab function named **firstDiff** to implement the differential in question B2 (a) which takes input as x and returns the output as y. [4 marks]

(c) Suppose the function y given in B2(a) is scaled up by a factor of 10 to give

y_2, write the final expression for y_2 and write a Matlab function to implement the plotting of y_2 for values of $x = 0{:}0.01{:}10$, where $a = 20$. [4 marks]

(**d**) A 3 x 4 matrix is defined as m = [9, 12, 3, 4; 45, 1, 6, 7; 19, 20, 45, 3].

(i) Find the contents of $m(2,1)$, $m(1,2)$, and $m(2,1)*m(1,2)$. [3 marks]

(ii) Find the transpose of the 3 x 4 matrix m. [2 marks]

(iii) Use *'while'* loop in Matlab to find the number of terms required for the sum of the series **x = 1:50** to exceed 800. [3 marks]

B3. (**a**) Table 2 below shows the duration and cost for conversation on a mobile phone. Use the Table to answer the following:

(i) Write an expression in Excel to find the output value y = 50*(*minimum*) of the values in column B and **20*y**. [5 marks]

(ii) Write an expression (or formula) to find the gradient of the values using cells B3 and B9. [3 marks]

(**b**) How would you implement equation y in B3 (a) (i) in Matlab? [3 mark]

(ii) Using a "*for* loop", indicate how you would find half the sum of all the values under column A of Table 2. [4 marks]

(c) The volume of a cylinder is given by *(base area)*(height)*. Write an expression for the volume of the cylinder if the radius is r and the height is h. Write a Matlab code to compute the volume of the cylinder if $r = 2m$ *and* $h = 3m$. [5 marks]

B4 (**a**) The mass of a sample of rocks gathered from a geological study is given by the matrix M = [1:2:7; 17:3:26; 3:1:6]. [5 marks]

(i) Write the matrix M showing all its elements.

(ii) Write the content of the matrix W for the weight of the rocks where the acceleration due to gravity (g) is given as $9.8 m/s^2$.

(iii) What would be the content of W(2,3) in B4 (a) (ii) above.

(**b**) Use a "*for*" loop instead of a "*while*" loop to accomplish the Matlab code shown below. [4 marks]

```
c=1
while c < 100
  c = c+1
 disp(c)
end
```

(**c**) Use Table 1 below shows the courses taken by a student in a semester and

the grades obtained for the CPA (cumulative point average) computation. Use the Table to find the following: [9 marks]

(i) formula in Excel that will be placed in cell C11 to find the average of the grade point in column C.

(ii) formula in Excel that will be placed in cells E2 to E10 to implement the product of the grade point in column C and the credit in column D.

(iii) formula in Excel that will be placed in cell E11 to find the overall CPA for the student for the semester.

(**d**) Use Table 1 to find the result of the Excel expression below. [2 mark]

*"=IF(C8 > 4, IF(D10 > 4.5, C5*D3, C10*D2), C2*D5)".*

Table 1: CPA calculation

	A	B	C	D	E
1	CODE	GRADE	GRADE POINT	CREDIT	CPA
2	CPEN 205	C	2	2	
3	FAEN 101	D+	1.5	2	
4	FAEN 103	D	1	3	
5	FAEN 105	E	0.5	1	
6	FAEN 109	F	0	2	
7	FAEN 102	A	4	4	
8	FAEN 106	B+	3.5	3	
9	FAEN 208	B	3	2	
10	FPEN 112	C+	2.5	4	
11					
12					

Table 2: Mobile phone call calculation

B3 $f(x)$ Σ = =SIN(RADIANS(2*PI()*A3))+2*A3

	A	B	C	D	E	F
1	DURATION	COST				
2	0	0				
3	1	2.109442607				
4	2	4.217570396				
5	3	6.323084345				
6	4	8.424716834				
7	5	10.52124687				
8	6	12.61151478				
9	7	14.69443608				
10	8	16.76901459				
11	9	18.83435434				
12	10	20.88967036				
13	11	22.93429807				
14	12	24.96770136				
15	13	26.9894789				
16	14	28.99936907				
17	15	30.99725306				
18	16	32.98315628				
19	17	34.95724809				
20						
21						