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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  $F = (C \times 9/5) + 32$  and  $K = C + 273$ . [5 marks]

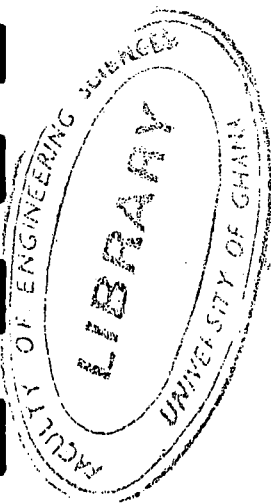
(d) Assume the value  $S = 3.34567$ . Find what the value of S will be if the following Matlab commands are used? [4 marks]

- (i) `ceil()`
- (ii) `fix()`
- (iii) `round()`
- (iv) `floor()`

B2. (a) Assume the voice signal from a microphone is represented as  $y = \cos(2x)$ . 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  $y = 50*(\text{minimum})$  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  $(\text{base area})*(\text{height})$ . 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.

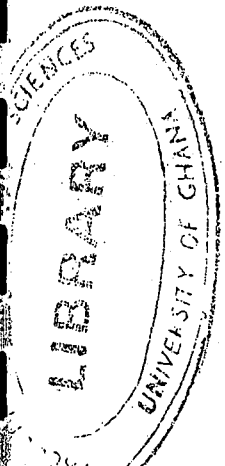
(ii) Write the content of the matrix  $W$  for the weight of the rocks where the acceleration due to gravity ( $g$ ) is given as  $9.8m/s^2$ .

(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	$f(x) \Sigma =$		$=\text{SIN}(\text{RADIANS}(2*\text{PI}()*\text{A3}))+2*\text{A3}$			
	A		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						