UNIVERSITY OF GHANA

BACHELOR OF SCIENCE IN ENGINEERING

FIRST SEMESTER EXAMINATIONS, 2012/2013

CPEN 309 PROGRAMMING LANGUAGES FUNDAMENTALS (3 Credits)

TIME ALLOWED: *TWO (2) HOURS*

INSTRUCTION:

Answer ALL questions.

Question 1

(a) Give five reasons why a programmer should have some background in language design, even though he or she may never actually design a programming language.

[5 mark]

(b) Explain the following terms briefly as they apply to programming languages;
   (i) A lexeme
   (ii) A token
   (iii) Recognizers
   (iv) Sentential form
   (v) Ambiguous grammar

[5 marks]

(c) Variables can be characterized as a sextuple of attributes. List five of these attributes.

[5mark]

(d) Consider the following Python declarations.
   Vector = [2, 4, 6, 8, 10, 12, 14, 16]
   Mat = [[1, 2, 3], [4, 5, 6], [7, 8, 9]]
   List the values for the following.
   (i) Vector[3:6]
   (ii) Mat[1]
   (iii) Mat[0] [0:2]
   (iv) Vector[0:7:2]

[4 marks]

(e) Explain briefly, three design issues for arithmetic expressions.

[6 marks]

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Question 2

(a) Selection Statements can be grouped into two major categories. With an example, explain these major categories.

[6 marks]

(b) Assume the following rules of associativity and precedence for expressions:

Precedence	Highest	$*, /$, not
		$+, -, \&$, mod
		$-$ (unary)
		$=, /=, <, <=, >=, >$
		and
	Lowest	or, xor
Associativity	Left to right	

Show the order of evaluation of the following expressions by parenthesizing all sub-expressions and placing a superscript on the right parenthesis to indicate order. For example, for the expression

a + b * c + d

the order of evaluation would be represented as

$((a + (b * c)^1)^2 + d)^3$

(i) (a - b) / c & (d * e / a - 3)
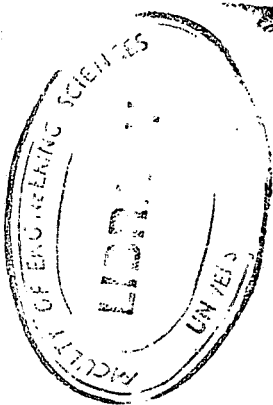
(ii) a > b XOR c OR d <= 17

[8 marks]

(c) Counter-Controlled Loops are examples of Iterative statements; how are counter-controlled loops implemented in FORTRAN 95 and C-based languages syntax.

[11 marks]

Question 3

(a) With an example, explain the four major criteria that can be used to evaluate programming languages.

[12 marks]

(b) Explain the two bottle necks of Von Neumann hardware architecture?

[3 marks]

(c) Use the grammar below to answer the following questions.

```
<assign> → <id> = <expr>
<id> → A | B | C
<expr> → <expr> + <term>
| <term>
<term> → <term> * <factor>
| <factor>
<factor> → ( <expr> )
| <id>
```

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(i) Show left derivation for the sentence A = B + C*A

[5 marks]

(ii) Draw the parse tree for the derivation in 3c(i) above.

[5 marks]

Question 4

(a) Explain briefly all the four possible binding times in programming languages.

[8 marks]

(b) Briefly explain the following terms
   (i) Data type

(ii) Descriptor

   (iii) An array
   (iv) Subscript

[8 marks]

(c) With a well labeled diagram, explain the process of programming language compilation.

[9 marks]

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