

CHUKA



UNIVERSITY

UNIVERSITY EXAMINATIONS

EXAMINATION FOR THE AWARD OF DEGREE OF BACHELOR OF SCIENCE IN  
COMPUTER SCIENCE

COSC 327: COMPILER CONSTRUCTION

STREAMS: BSC (COMP. SCI) Y3S2

TIME: 2 HOURS

DAY/DATE: MONDAY 08/4/2019

2.30 P.M. – 4.30 P.M.

INSTRUCTIONS: Answer Question One and any other two questions

**Question One (Compulsory) (30 marks)**

- (a) Explain the difference between a compiler and an interpreter. (4 marks)
- (b) Explain when a grammar  $G$  is said to be ambiguous. Give an example to illustrate your answer together with a demonstration that it's indeed ambiguous. (4 marks)
- (c) At a given point in the execution of a program, what can be considered as garbage? How can garbage be located in memory? (4 marks)
- (d) Explain two reasons why stack is used for storing procedure calls in compiler construction. (4 marks)
- (e) Using a C sample code illustration, explain the difference between formal parameters and actual parameters in functions. (4 marks)
- (f) Identify four reasons of creating intermediate code during compilation as opposed to directly translating source code to machine code. (4 marks)
- (g) Discuss the three rules of code optimization. (6 marks)

**Question Two (20 marks)**

- (a) State and explain the two major operations on a symbol table. (4 marks)

(b) Consider an optimization that replaces any expression of the form

$$0 \times e$$

with  $0$ , where  $e$  is an arbitrary expression. Why might this rule be useful in a compiler's optimization phase? Is it always correct? (6 marks)

(c) Let  $G$  be the following grammar:

$$\begin{aligned} S &\rightarrow A \\ A &\rightarrow B \mid B a A \\ B &\rightarrow b C \\ C &\rightarrow Cb \mid Cc \mid \epsilon \end{aligned}$$

Modify  $G$  to produce a new grammar,  $G'$ . Show that  $G'$  is LL(1). Describe the condition(s) that  $G'$  meets that makes it LL(1). (10 marks)

**Question Three (20 marks)**

(a) Explain what a symbol table is and state its importance in compilation process.(4 marks)

(b) Describe four optimizations likely to be performed on a piece of code during compilation. (8 marks)

(d) Consider the following grammar:

$$\begin{aligned} S &\rightarrow ( L ) \\ &\quad \mid a \\ L &\rightarrow L , S \\ &\quad \mid S \end{aligned}$$

Under this grammar, derive the parse tree of the sentence (a, ((a, a), a)) (8 marks)

**Question Four (20 marks)**

(a) Given production rules, generate a parse tree for the input string:

$$b = a * x / y + z * x/y;$$

Use left most derivation. Show all the steps involved. (10 marks)

The production rules:

$$\begin{aligned} E &\rightarrow E + E \\ E &\rightarrow E / E \\ E &\rightarrow E * E \\ E &\rightarrow id \\ E &\rightarrow num \end{aligned}$$

(c) For each of the production rules (c) above, write their corresponding semantic rules. (4 marks)

(d) Generate a Directed Acyclic Graph from the syntax tree in (a) above. (6 marks)

**Question Five (20 marks)**

(a) Outline four semantic errors that a compiler should check and report. (4 marks)

(b) Explain the following compilation stages. (8 marks)

- (i) Syntax analysis
- (ii) semantic analysis
- (iii) code generation
- (iv) code optimization

(c) Three address code and instructions for the instructions shown below and represent them in a quadruple. (8 marks)

```
y = z * x
while (y > z) {
    x = y * z
    y = z - x
    z = y * z
}
```

