



NATIONAL OPEN UNIVERSITY OF NIGERIA

University Village, Plot 91, Jabi Cadastral Zone, Nnamdi Azikiwe Expressway, Abuja

FACULTY OF SCIENCES

Computer Science Department

2022_2 EXAMINATION

Course Code: **CIT 316**

Course Title: **Principles and Techniques of Compilers (Compiler Construction I)**

Credit: **3 Units**

Time Allowed: **3 hours**

Instruction: Answer Questions One (1) and any other **THREE (3)** questions

Questions One (25 Marks) – Compulsory

- 1 (a) Explain the term: *Formal Grammar*. **(4 marks)**
- 1 (b) Enumerate three (3) functions of a lexical analyser **(3 marks)**
- 1 (c) Outline the implementation of a *shift-reduce parser* using a stack. **(3 marks)**
- 1 (d) Consider the grammar below:

Sentence → NounPhrase VerbPhrase
 NounPhrase → Art Noun
 VerbPhrase → Verb | Adverb Verb
 Art → the | a | ...
 Verb → jumps | sings | ...
 Noun → dog | cat | ...

For the input: *the dog jumps*, show the implementation of **bottom up parsing** by completing the table below.

Stack	Input Sequence	Action

1 (e) Enumerate the five (5) transformation techniques used by most optimisation algorithms.

(5 marks)

Question Two

2 (a) Outline the steps in *Lex* implementation.

(6 marks)

2 (b) What does a nondeterministic finite automaton (NFA) consist of?

(4 marks)

2 (c) Outline the algorithm for **shift-reduce parsing**.

(2 Marks)

2 (d) Describe three (3) difficulties with top-down parsing.

(3 marks)

Questions Three

3 (a) Describe any three (3) reasons for studying LR grammars?

(3 Marks)

3 (b) Enumerate three (3) benefits of LR parsing.

(3 Marks)

3 (c) Discuss the following (include examples where possible)

i. Errors during Lexical Analysis (3 Marks)

ii. Errors during Syntax Analysis (3 Marks)

iii. Errors during Semantic Analysis (3 Marks)

Question Four

4 (a) Enumerate five (5) common run-time errors which can be detected by most IDEs with its debugging option.

(5 Marks)

4 (b) Describe any three (3) structures which can be used to implement symbol tables (include the computational complexity of each structure)

(6 Marks)

4 (c) Draw a syntax tree for the assignment statement $a:=b*-c+a*-c$.

(4 marks)

Question Five

5 (a) List and discuss two (2) types of grammar

(6 marks)

5 (b) Enumerate three (3) examples of analytic grammar formalisms.

(3 Marks)

5 (c) Describe any three (3) phases of a compiler.

(6 marks)

Question Six

6 (a) Summarize the languages, automata and production rules of Chomsky's Four Types of Grammars by completing the table below:

Grammar	Languages	Automaton	Production rules (constraints)
Type-0			
Type-1			
Type-2			
Type-3			

(6 marks)

6 (b) Using a diagram, show the syntactic divisions within a *Formal System*.

(4 marks)

6 (c) Consider the grammar, below

$$G: E \rightarrow E + T \mid T$$

$$T \rightarrow T * F \mid F$$

$F \rightarrow (E) | i$
Evaluate the augmented grammar.

(5 marks)