



NATIONAL OPEN UNIVERSITY OF NIGERIA
PLOT 91, CADASTRAL ZONE, NNAMDI AZIKIWE EXPRESSWAY, JABI-ABUJA
FACULTY OF COMPUTING
DEPARTMENT OF COMPUTER SCIENCE
2025_2 EXAMINATIONS

COURSE CODE : CIT342

COURSE CREDIT : 3 units

COURSE TITLE: Formal Languages and Automata Theory

TIME ALLOWED: 3 Hours

INSTRUCTION: Answer Question **ONE** (1) and any other **THREE** (3) Questions

- 1ai) What is an automaton? **(2marks)**
- 1aii) Enumerate the formal constituents of an automaton. **(6 marks)**
- 1b) In the context of English language, how is an alphabet related to a string in language theory?
(2 marks)
- 1c) Determine and state any four elements the set $\{0,1\}^*$ **(1 mark)**
- 1d) If f_1 is a binary representation over $\{0,1\}$ of the natural numbers, produce seven strings of $f_1(5)$ and $f_1(7)$ **(3½ marks)**
- 1e) Describe the two kinds of move a Non-deterministic Pushdown Automata (NPDA) can make?
(5 marks)
- 1f) What is a useless symbol? **(1½ marks)**
- 1g) Explain how a useless symbol be made useful? **(4 marks)**

TOTAL = 25 MARKS

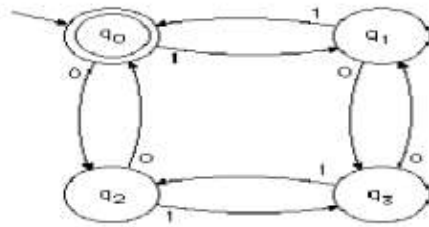
- 2a) When is a language categorised as being “ambiguous”? **(3 marks)**
- 2b) Use the production rules below to prove if, by parsing, the string *aababb* makes the grammar ambiguous **(4 marks)**
- $S \rightarrow aSb$
- $S \rightarrow ba$
- 2c) Briefly explain how to remove useless symbol from a grammar. **(3 marks)**
- 2d) State the rules that guide the definition of a formal language over alphabet $\Sigma = \{0,1,2,3,4,5,6,7,8,9,+,=\}$ **(5 marks)**

TOTAL = 15 MARKS

- 3a) Consider the grammar $G = (\{S, a, b\}, \{a, b\}, S, P)$ where $P = \{S \rightarrow a, S \rightarrow aAB, A \rightarrow aA, A \rightarrow a, B \rightarrow bB, B \rightarrow b\}$, produce an equivalent NPDA using a table format and parse the string *aabb* with the grammar and the NPDA. **(10 marks)**
- 3b) Apart from Chomsky grammar types, list two other newly derived grammars **(5 marks)**

TOTAL = 15 MARKS

- 4a. Outline four examples of analytic grammar formalisms used by language machine (LM). **(8 marks)**
- 4b) Determine if the string 10010011 is recognizable by using the mapping function transition **(5 marks)**

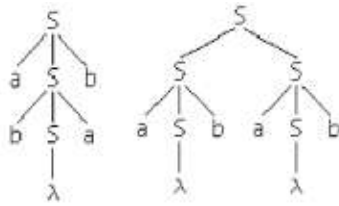


4 c) Produce four strings from the regular grammar $L(G) = \{a^n b^n c^n | n \geq 1\}$ (2 marks)

TOTAL = 15 MARKS

5 a) Enumerate the states that are needed to convert from CFG to NPDA (4 ½ marks)

5b) Using the diagrams below to further illustrate your response parsing the string *abab*, define an ambiguous grammar (7½ marks)



5c) How does a computer handle non-determinism? (3 marks)

TOTAL = 15 MARKS

6a) Briefly describe “formal grammar” (6 marks)

6b) State the rules of precedence in forming regular expressions? (6 marks)

6c) Describe the “Reverse of a string” and its effect on the language alphabet? (3 marks)

TOTAL = 15 MARKS