

**NATIONAL OPEN UNIVERSITY OF NIGERIA**

**University Village, 91 Cadastral Zone, Nnamdi Azikwe Expressway, Jabi, Abuja**

**FACULTY OF SCIENCES**

**APRIL, 2019 EXAMINATIONS**

**COURSE CODE:** CIT342

**COURSE TITLE:** Formal Languages and Automata Theory

**CREDIT:** 3 Units

**TIME ALLOWED:** 2½ Hours

**INSTRUCTION:** Answer Question 1 and any other FOUR (4) Questions

1a) Distinguish between a word and a vocabulary in formal language. Use examples to illustrate your answer ***(3 marks)***

b) Let V be a set of strings. Is V+ = V\*? Justify your answer. ***(3 marks)***

c) Enumerate the components of a formal grammar. ***(4 marks)***

d) Compare context-free grammar and regular grammar ***(4 marks)***

e) Differentiate between an alphabet and a language ***(2 marks)***

f) Enumerate any **two** of the typical questions being asked about formalism in formal language theory. ***(2 marks)***

g) Define automata theory. ***(2 marks)***

h) State the **two** ways of implementing a DFA. ***(2 marks)***

2a) Formally define an automaton ***(5 marks)***

b) Briefly describe any two of the popular variations in the definition of different components of automata. ***(7 marks)***

**3a)** List any four types of automata and state their respective recognizable language. ***(6 marks)***

b) In the context of automata theory, briefly describe the following terms:

1. Recognised language ***(2 marks)***
2. Run ***(2 marks)***
3. Transducer ***(2 marks)***

4a) Thinking of an automaton as a computer, state the way(s) it can handle non-determinism? ***(2 marks)***

b) Is a Non-Deterministic Finite Automaton (NFA) more powerful than a Deterministic Finite Automaton (DFA)? Explain. ***(4 marks)***

c) State the precedence of the following with respect to regular expressions: ***(2 marks)***

1. Kleene Star
2. Concatenation
3. Union
4. Parentheses

d) Briefly explain the concept of ambiguity in grammars. ***(4 marks)***

5a) Describe the types of Push Down Automata (PDAs). ***(3 marks)***

b) Give the formal definition of a PDA ***(4 marks)***

c) List any two ways of defining a language ***(2 marks)***

d) Enumerate any two of the mathematical concepts needed to proof the Halting Problem. ***(3 marks)***

6a) What does it mean to say a formally stated problem is:

* 1. Unsolvable? ***(1 mark)***
  2. Provably unsolvable? ***(1 mark)***
  3. Undecidable? ***(1 mark)***

b) State the Halting Problem. ***(2 marks)***

c) (i) State Godel incompleteness theorem. ***(2 marks)***

(ii) Basically, what did Godel prove? ***(2 marks)***

d) When is formal system said to be:

i) Complete? ***(1½ marks)***

ii) Inconsistent? ***(1½ marks)***