NATIONAL OPEN UNIVERSITY OF NIGERIA
University Village, 91 Cadastral Zone, NnamdiAzikwe Expressway, Jabi, Abuja
FACULTY OF SCIENCES
COMPUTER SCIENCE DEPARTMENT
2023_1 POP EXAMINATION

COURSE CODE: CIT 342
COURSE TITLE: Formal Languages and Automata Theory
CREDIT: 3 Units
TIME ALLOWED: 3 Hours
INSTRUCTION: Answer Question One (1) and any other three (3) questions

1a) What is a sentential form? (2 marks)
b) Consider the linear grammar: ({S, B}, {a, b}, S, {S →aS, S→B, B→bB, B→λ}). Give any four sentential form of this grammar ***(4 marks)***
c) Describe the various components of a formal grammar. ***(6 marks)***
d) In the context of theoretical computer science, define *automata theory?* (3 marks)
e) What do you understand by leftmost and rightmost derivation of a grammar? Are they the same? ***(6 marks)***
f) When is a grammar said to be in **Chomsky normal form?** ***(4 marks)***

2a) Consider the grammar: G = ({S, A, B, C}, {a, b, c}, S, P) where P = {S→ABC, A→aA, A→λ, B→bB, B→λ, C→cC, C→λ}, derive the string ***abbc*** in a
i) leftmost derivation (4 marks)
ii) rightmost derivation (4 marks)
b) Draw the derivation tree for the leftmost derivation in question (2a) above. ***(2 marks)***
c) Prove that the context-free languages are closed under the formation of union. ***(5 marks)***

3a) In the context of automata theory, explain the following terms:
i. Recognised language)
ii. Run) **2 marks each**
iii. Transducer)

b) Enumerate the different ways of using a grammar. **) 5 marks**
c) Write short notes on the concept of ambiguity in grammars. ***) 4 marks***

4a) What is meant by *inherently ambiguous language?* (2 marks)
b) Distinguish between a word and a vocabulary in formal language. Illustrate your answer with examples ***) 5 marks***
c) What is a Pushdown Automata (PDA)) 4 marks
d) Prove that for any regular language there is a DPDA that accepts it (4 marks)

5a) When is a grammar said to be in *Greibach Normal Form?* ***(3 marks)***

b) What are the characteristics of grammars that are in *Greibach Normal Form)* ***2 marks***

c) State the use(s) of Greibach Normal Form ***(2 marks)***

d) Formally define Type 1 grammar ***) 3 marks***

e) Briefly describe the different types of PDAs. ***) 5 marks***

6a) List the three different ways a language can be defined ***) 3 marks***

b) Is an NFA more powerful than a DFA? Explain ***(4 marks)***

c) State Godel incompleteness theorem ***) 2 marks***

d) What do you understand by context-sensitive grammars?) 2 marks

e) When is formal system said to be:

i) Complete?)

ii) Inconsistent?) ***2 marks each***