NATIONAL OPEN UNIVERSITY OF NIGERIA
14-16 AHMADU BELLO WAY, VICTORIA ISLAND, LAGOS
SCHOOL OF SCIENCES AND TECHNOLOGY
JANUARY/FEBRUARY 2013 EXAMINATION

Course Code: CIT 342 ***Time:*** 2½ hrs
Course Title: Formal Languages and Automata Theory

***Course Credit Unit*:** 3
Instruction: Answer any five (5) questions. Each question carries 14 marks

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 three sentential form of this grammar) 3 marks
c) State and describe the various components of a formal grammar.) 6 marks
d) What do you understand by the term *automata theory*?) 3 marks

2a) Define leftmost and rightmost derivation of a grammar. State the distinction between the two.) 6 marks
b) Now 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) 3 marks
ii) rightmost derivation) 3 marks
c) Draw the derivation tree for the leftmost derivation in question (2b) above.) 2 marks

3a) When is a grammar said to be in **Chomsky normal form?**) 3 marks
b) Prove that the context-free languages are closed under the formation of union.) 5 marks
c) In the context of automata theory, briefly describe the following terms:
i. Recognised language)

ii. Run) 2 marks each
iii. Transducer)

4a) Enumerate the different ways of using a grammar.) 4 marks
b) Briefly explain the concept of ambiguity in grammars) 3 marks
c) What do you understand by *inherently ambiguous language?*) 2 marks
d) Distinguish between a word and a vocabulary in formal language. Use examples to illustrate your answer) 5 marks

5a) Define a pushdown automata (PDA)) 4 marks
b) Proof that for any regular language there is a DPDA that accepts it (3 marks)
c) When is a grammar said to be in *Greibach Normal Form?* (3 marks)
d) State the characteristics of grammars in *Greibach Normal Form)* 2 marks
e) State the use(s) of Greibach Normal Form (2 marks)

6a) Formally define Type 1 grammar) 3 marks
b) List and describe the types of PDAs.) 4 marks
c) List the three ways of defining a language) 3 marks
d) Is an NFA more powerful than a DFA? Explain (4 marks)

7a) State Godel incompleteness theorem) 2 marks
b) Define context-sensitive grammars) 3 marks
c) What do you understand by decision problems?) 2 marks
d) When is formal system said to be:
i) Complete?)
ii) Inconsistent?) 2marks each
e) How can an automaton, as a computer, handle non-determinism? (3 marks)