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**