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 → aSb

S → 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 Σ= *{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 → a, S → aAB, A→ aA, A → a, B → bB, B → 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)*
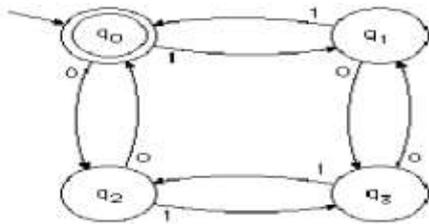
4 c) Produce four strings from the regular grammar $L(G)= \{a^n b^n c^n | n \geq 1\}$ *(2 marks)*

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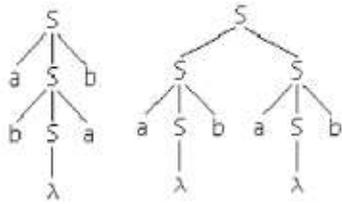
5c) How does a computer handle non-determinism? *(3 marks)*

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