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NATIONAL OPEN UNIVERSITY OF NIGERIA
University Village, 91 Cadastral Zone, Nnamdi Azikwe Expressway, Jabi, Abuja
FACULTY OF SCIENCES
COMPUTER SCIENCE DEPARTMENT
2021 EXAMINATIONS45678

CIT 342 – Formal Languages and Automata Theory **Credit: 3 units**

TIME ALLOWED: 2½ Hours
INSTRUCTION: Answer Question 1 and any other FOUR (4) Questions

QUESTIONS

1a(i) Determine the four elements of this set {0,1}* (2 marks)

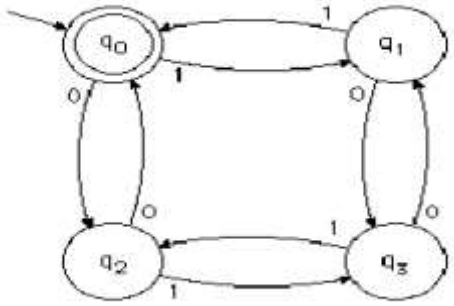
1a(ii). Explain the term "grammar" as it applies to formal language (3 marks)

1a(iii) Use the production rules below to prove if by parsing the string aaababbb makes the grammar ambiguous (2 marks)

$$S \rightarrow aSb$$
$$S \rightarrow ba$$

1b. Explain the differences among the classes of grammar defined by Noam Chomsky (8 marks)

1c. Determine if the string 10010011 is recognizable by using the mapping function transition (2 marks)



1d. Cite five classes of automata and the type of language they recognize (5 marks)

2a. What is parsing? 2 marks

2b. How is Backus-Naur Form used to describe a formal language? 1mark

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2c. State the rules that guide the definition of a formal language over alphabet $\Sigma = \{0,1,2,3,4,5,6,7,8,9,+,=\}$ (3marks)

2d. What is an automaton? What are its formal constituents? 3 marks

2e. How does a computer decide when parsing non deterministic automaton? 2 marks

2f. What makes a language ambiguous? (1 mark)

3a. Using derivation method, parse the string *aabb* using the grammar production below (2 marks)

S→ AS|BS |AB |B |A | $\mathcal{E}$
B →b|S
A→ S |a

3b Produce three strings from the regular grammar $L(G) = \{a^n b^n c^n | n \geq 1\}$ (1 mark)

3c.Apart from Chomsky grammar types, mention two other newly derived grammars (3 marks)

3d(i). List two examplesofanalyticgrammarformalisms. 2 marks

3d(ii) State four rules of precedence in forming regular expressions? 4 marks

4a.What is a vocabulary in respect to language theory? Mention the two approaches that can be used to describe a language over a set of vocabulary (3 marks)

4b Given L_1andL_2 as languages over some common alphabet cite three operations that can be performed over these languages. (3 marks)

4c What kind of questions is the automaton set to answer? (2 marks)

4d. What makes an automaton a nondeterministic? Illustrate with an example (2 marks)

4e. What are the two kinds of move a NPDA can make? (2marks)

5a. How does the automaton run and accept strings? 2 marks

5b What are the meaning of the following rules of regular expressions (3 marks)

i. If r1 is a regular expression, so also is (r1)
ii. If r1 and r2 are regular expression, then so is r1r2
iii. If r1 and r2 are regular expression, then so is r1+r2

5c List three ways that can be used to define a language (3 marks)

5d What is a pigeon hole? What is its usefulness? (2 marks)

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5e. Assume that , Σ = { a, b } , give the regularexpression of

i. All string s containing exactly on a

ii. All strings which contain no run sofas of length greater than two. *(1 Mark)*

6a. How is right-linear grammar differ from left-linear grammar? (2 marks)

6b. What type of regular grammar is represented below and why? (2 marks)

S ➔aX |Xa |a

S $\rightarrow \lambda$

6c. Give the resulting grammar after removing E production in the following grammar (2marks)

$$S \rightarrow AB$$
$$A \rightarrow aAA \mid \varepsilon$$
$$B \rightarrow bBB \mid \varepsilon$$

6d. What does the *pumping lemma* say? (3 marks)

6e Convert this regular expression to context-free grammar (3 marks)

i. L={$a^n b^n$:n0} L = {$a^n b^n$: n≥0}

ii. L={$a^n b^k$:k>n ≥ 0}