University Examinations 2023/2024

SECOND YEAR SECOND SEMESTER EXAMINATION FOR THE DEGREE OF
BACHELOR OF SCIENCE COMPUTER SCIENCE

CCS 3253: AUTOMATA THEORY
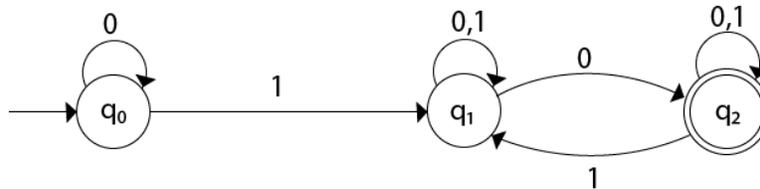
DATE: APRIL 2024   **TIME: 2 HOURS**

INSTRUCTIONS: *Answer question **one** and any other **two** questions*

QUESTION ONE (30 MARKS)

1.   Using an example, differentiate between Kleen closure star ($\sum$*), and Kleen closure plus ($\sum^{+}$)   (4 marks)

2.   Convert the below NFA to a DFA. (Show the steps)   (7 marks)

3.   Outline FOUR differences between DFA and NFA   (4 marks)

4.   Consider the languages L1 = $\emptyset$ and L2 = {a}. Write and explain an output represented with L1L2* U L1*?   (4 marks)

5.   Explain what ambiguous context free grammar is.   (2 marks)

6.	Explain Two differences between a DFA and a PDA (4 marks)

7.	Below is a context free grammar (CFG). Write first 5 members of the language that can be developed with the grammar (5 marks)

$$S => aSa|bSb|a|b$$

SECTION B (Answer **two question** from this section)

QUESTION TWO [20 MARKS]
 With reference to PDA (push down automata), answer the question below:

1.	Explain the tupples / characteristics of a PDA (7 marks)

2.	Construct a PDA for language L = $\{0^n1^m2^m3^n \mid n>=1, m>=1\}$ (8 marks)

3.	Using the PDA developed in (ii) above. Explain whether string1 and string2 below, are

    accepted with the PDA.   string 1 is **0 0 1 1 1 2 2 2 3 3** and string2 is **0 0 0 1 1 2 2 2**

    3 3   (5 marks)

QUESTION THREE [20 MARKS]
1.	Answer the questions below with reference to context free grammar (CFG) below.

$$\begin{aligned}
T &\rightarrow R \\
T &\rightarrow aTc \\
R &\rightarrow \\
R &\rightarrow RbR
\end{aligned}$$

1.	Explain what is a context free grammar (CFG) (3 marks)

2.	Write TWO members of the CFG above, with at least 7 characters (4 marks)

3.	Pick one of the members you have written in (ii) above, and show that is a member of the CFG above. (4 marks)

4.	Using CFG below, develop a syntax tree for the language **aabbbcc**. (5 marks)

5.   Write FOUR members of language L = { x ∈ {a,b}* | |x|≥ 3 and x begins with a }.

(4 marks)

QUESTION FOUR [20 MARKS]

1.   Explain the tuples of a Turing machine   (7 marks)

2.   Differentiate between leftmost derivations, vs. rightmost derivation of CFG trees.

(3 marks)

3.   Answer the questions below with reference to Deterministic finite automata (DFA).

1.   Build a DFA of the language Lx = {m ∈ {0, 1}* | the language begins with 0 and ends with 1}.   (6 marks)

2.   Show that 010011011 is a member of language Lx in b(i) above   (4 marks)

QUESTION FIVE [20 MARKS]

1.   Below is a DFA. Use it to answer the questions below.
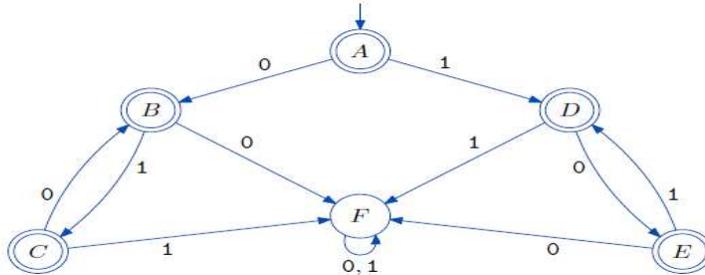
1.Explain what is a trap state, with reference to the above DFA   (3 marks)

2.Write a language that the DFA accepts, explain?   (6 marks)

3.Write a member of the language (ii) above   (2 marks)

4.Draw the state transition table of the above DFA   (5 marks)

5.   Using two language sets A and B such that   L$_A$={a,b}   and L$_B$={c,d,e}

Find the expression:

1. L$_A$ U L$_B$ (2 marks)
2. (L$_A$*)*   (2 marks)