AFRICA UNIVERSITY
A United Methodist-Related Institution

"Investing in Africa's Future"

COLLEGE OF BUSINESS PEACE LEADERSHIP AND GOVERNANCE

NCSC 117: THEORY OF COMPUTING

END OF SECOND SEMESTER EXAMINATIONS

AUGUST 2023

LECTURER: Dr T MASUNDA

DURATION: 3 HOURS

INSTRUCTIONS

Answer **ALL** the questions in this paper

Total possible mark is **100.**

Start **each** question on a new page on your answer sheet.

The marks allocated to **each** question are shown at the end of the section.

1. Alan Turing was a
   a) Mathematician
   b) Futurist
   c) Physicist
   d) Teacher (1 mark)

2. What was the enigma machine designed for? Explain what motivated its manufacture, when it was used and how did the machine work. (4 marks)

3. Name these operations $\cap$ $\cup$ (2 marks)

4. 3. If S { a,b,c,d,e,g,j,k,o,z} then True or False (4 marks)
   a. g $\notin$ S (1 mark)
   b. c $\in$ S (1 mark)
   c. o $\notin$ S (1 mark)
   d. t $\notin$ S (1 mark)

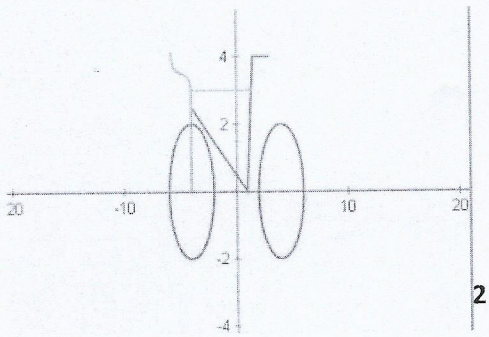
5. If N ={5,7,9,2} and O = {x, +}
   a)Calculate the Cartesian Product of NxO
   b)Calculate the Cartesian Product of NxOxN (16 marks)

6. A relation is a function when each input value (x) has exactly one output value (y). TRUE or FALSE? (1 mark)

7. Is this Relation a function? Explain (2 marks)

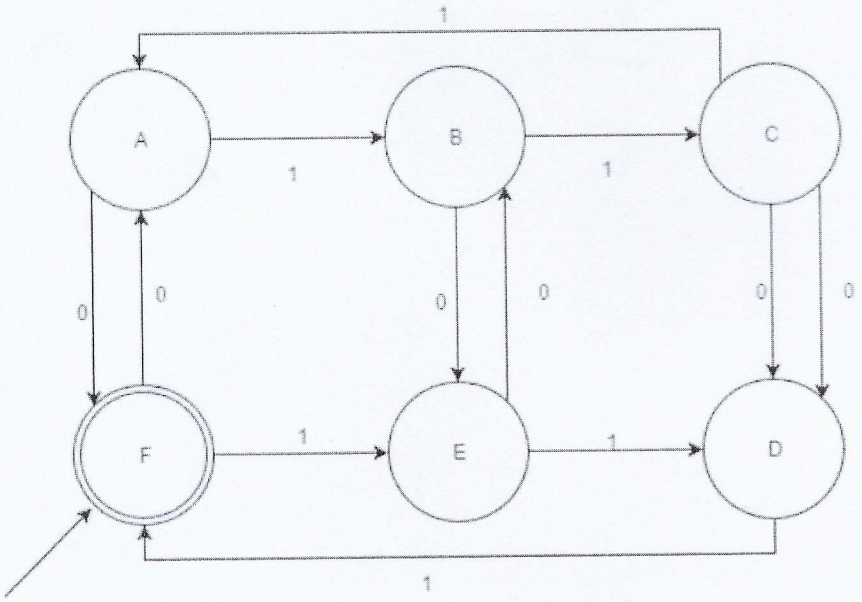
x	y
0	2
1	4
1	4
2	6
3	8
4	10

8. Is this Relation a function? Explain (2 marks)



9. What is the definition of a DFA and what does it do? (4 marks)

8. What are the input strings that can be extracted from this DFA? (3 marks)



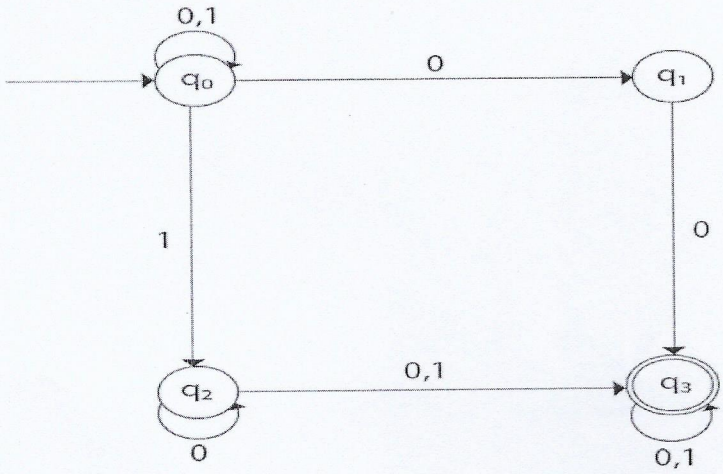
9. What are the maximum number of transition which can be performed over a state in a DFA? (1 mark)
$\sum$= {a, b, c}
a) 1
b) 2
c) 3
d) 4

10. Why is Push Down Automata better than DFA and NFA? (3 marks)

11. Draw an NFA with 2 accept states (5 marks)

12. Explain the 5 tuples of a DFA $\{Q, \Sigma, q, F, \delta\}$ (10 marks)

13. Is this an NFA? Yes? Or No? Give your reasons. (4 marks)



14. What is involved when you parse data in context free language? Explain with a diagram how data is parsed. (5 marks)
15. Given the context free grammar

$$S \rightarrow aSa \mid bSb \mid c$$

Show the steps you take to generate the string **abcba** (8 marks)

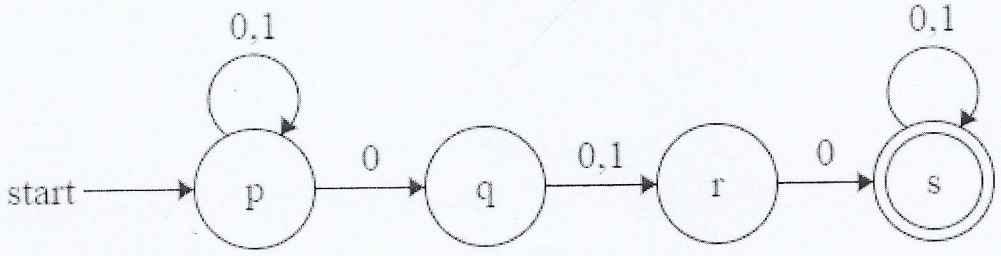
16. Write these in their order of complexity **Pushdown Automata, Turing Machine, Finite State Automaton.** (3 marks)

17. The Tape in a Turing machine is finite. True or False (1 mark)

18. Give the definition of an algorithm. (2 marks)

19. Moore and Mealy machines are both finite state machines. True or False (1 mark)

20. What do we mean by reducing a problem in Theory of computing? (3 marks)
21. Draw the transition function for the DFA below: (15 marks)



END OF EXAMINATION