# 2022

## 1st Semester Examination

## MCA

### Paper : MCA 102

### (Theory of Computing)

Full Marks : 70 Time : Three Hours

*The figures in the margin indicate full marks.*
*Candidates are required to give their answers in their own words as far as practicable.*

Answer the following questions (any ***five***) : 5×2=10

1. Define Language and Grammar.
2. Find the grammar for the language : $L = a^n b^n c^k$, where $k >= 3$, $n > o$.
3. Define Finite Automata.
4. Find the language generated by the grammar $S \rightarrow aSb/aAb$, $A \rightarrow bAa/ba$.
5. What is dead state? Give an example.
6. Why an FA with ε transition is called NFA?
7. Find the RE for the following :

   Set of languages of all strings of 0 and 1 containing exactly two 0's.

   Set of all strings of 0 and 1 that does not end with 11.

P.T.O.

8. Define CNF and GNF.

Answer the following questions (any ***four***) : 4×15=60

9. What is Chomsky hierarchy? What are the advantages of it? Differentiate between NFA and DFA. Test whether the strings 0001101 & 00000 are accepted by the following FA or not. Consider $q_0$ is the initial and $q_3$ is the final state.

| Present State | Next State | |
|---|---|---|
| | I/P = 0 | I/P = 1 |
| $q_0$ | $q_2$ | $q_3$ |
| $q_1$ | $q_0$ | $q_2$ |
| $q_2$ | $q_1$ | $q_3$ |
| $q_3$ | $q_3$ | $q_1$ |

(5+2)+4+4

10. Convert the following NFA to an equivalent DFA. Consider $q_0$ is the initial and $q_3$ is the final state.

| Present State | Next State | |
|---|---|---|
| | I/P = 0 | I/P = 1 |
| $q_0$ | $q_0, q_1$ | $q_0, q_2$ |
| $q_1$ | $q_3$ | - |
| $q_2$ | - | $q_3$ |
| $q_3$ | $q_3$ | $q_3$ |

Define Mealy machine and Moore machine. Convert the

following Mealy machine to an equivalent Moore machine by the tabular format.

| Present State | I/P = 0 | | I/P = 1 | |
|---|---|---|---|---|
| | Next State | O/P | Next State | O/P |
| $q_0$ | $q_0$ | 1 | $q_1$ | 0 |
| $q_1$ | $q_3$ | 1 | $q_3$ | 1 |
| $q_2$ | $q_1$ | 1 | $q_2$ | 1 |
| $q_3$ | $q_2$ | 0 | $q_0$ | 1 |

5+4+6

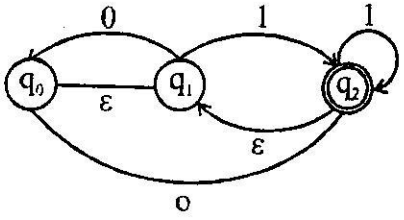
11. What is the necessity to converting an NFA to a DFA? Construct minimum state automation from the following transitional table.

| Present State | Next State | |
|---|---|---|
| | I/P = a | I/P = b |
| → A | B | F |
| B | A | F |
| C | G | A |
| D | H | B |
| E | A | G |
| F | H | C |
| G | A | D |
| H | A | C |

*Here, F, G and H are the final states.*

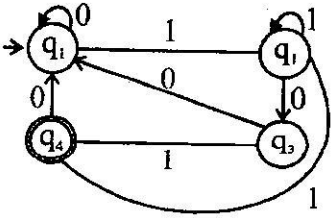
P.T.O.

Convert the following NFA with null move to equivalent DFA.




3+6+6

12. Construct an RE from the given FA by Arden's theorem




Construct an FA equivalent to the RE, L = (a + b) + a (a + b) * (ab + ba). Construct the regular grammar for the RE a*b(a + b)*. 5+5+5

13. Write the closure properties of Regular set with examples. What are Unit production & Null production in CFG? How to remove them? Simplify the following CFG :

$S \rightarrow AB/aB$, $A \rightarrow BC/B/a$, $B \rightarrow C$, $C \rightarrow b/\varepsilon$

5+(2+4)+4

14. Explain linear grammar with example. What is ambiguity in CFG? Check whether the following grammar is ambiguous or not.

$S \rightarrow a/Sa/bSS/SSb/SbS$

Write the closure properties of CFG with example.

3+3+4+5

15. (a) Construct a PDA to accept $L = (a, b)^+$ with equal number of 'a' and 'b' by Empty Stack.

(b) Mention the differences between DPDA and NPDA.

(c) Design a PDA for even palindrome over (0,1).

6+3+6=15

16. (a) Define the mathematical model of Turing Machine.

(b) How Turing Machine is differing from other automata?

(c) Design a Turing Machine for

$L = \{WcW^R \mid W \in (a, b)^*\}$. 5+4+6=15