**Final Assessment Test (FAT) – November/December 2022**
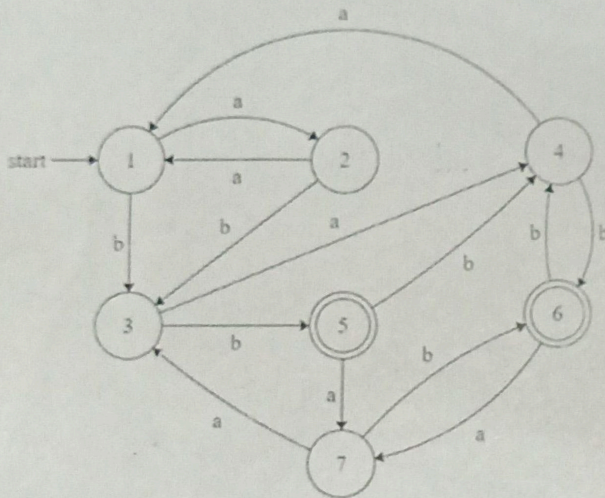
| Programme | B.Tech. | Semester | Fall Semester 2022-23 |
|---|---|---|---|
| Course Title | THEORY OF COMPUTATION | Course Code | BCSE304L |
| Faculty Name | Prof. Karmel A | Slot | C1+TC1 |
| | | Class Nbr | CH2022231001262 |
| Time | 3 Hours | Max. Marks | 100 |

## PART A (10 X 10 Marks)
### Answer All questions

1. Obtain automation, G' with minimal states equivalent to the given automata. . G [10]



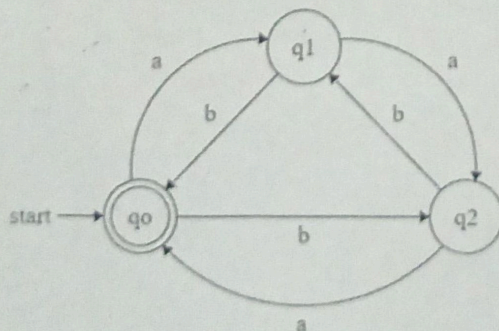2. Given the language, $L= \{w \mid w \in (ab)^i (c)^{2j} (d)^{2i} \mid i, j\geq1\}$ [10]
   a.) Define the Context Free Grammar G for L. [5 marks]
   b.) Identify a sample string with minimum length 7. Write the LMD, and RMD and draw a derivation tree with the constructed CFG. [5 marks]

3. Construct a regular expression corresponding to the DFA. [10]



4. Design a Turing machine that transforms a string containing only 0's, 1's, and 2's by replacing [10] each value preceding a '1' with '2'. For example, 0220 would remain unchanged while 012011 would change to 212221.

5. Let $\Sigma= \{a,b\}$. Write a regular expression, R representing the language having even-length strings [10] that starts with "a" and ends with "b". Design an equivalent Nondeterministic Finite Automaton without any ε moves, equivalent to R.

6. VITAA organizes a "flowers contest" for the kids of alumni members. A basket full of roses, [10] jasmine and lotus flowers will be given to the kid and is instructed to pick one flower at a time from the basket (without replacement). A kid is announced to be the winner if he/she picks up the flowers in the following way: the first two flowers can either be rose flowers or jasmine flowers followed by any number of lotus flowers. The last three flowers would be either two rose flowers and one jasmine flower or two lotus flowers and one rose flower. Design a deterministic finite automaton (DFA) to recognize whether the kid has won the contest or not.

7. Prove the following statement with justification. [10]
   a.) The language $L = \{a^i b^j c^k \mid i>0,\ i<j<k\}$ is not regular. (5 Marks)
   b.) The language $L = \{w \mid$ where $n_0(w) \bmod 3 = 0,\ w \in \{0, 1\}\}$ is regular. (5 Marks)

8. Is the language $L = \{a^m b^n c^m d^{2n} \mid n,m>0\}$ decidable? Justify your answer. [10]

9. Let $L_1 = \{a^n b^n c^n \mid n>0\}$ and $L_2 = \{d^m e^m f^p \mid m,p>0\}$ is $L_1 \cup L_2$ recursive? Justify your answer. [10]

10. State whether the instances of the Post Correspondence Problem (PCP) have a solution. The [10] following are the instances with $\Sigma = \{a,b\}$

| Index | List A | List B |
|-------|--------|--------|
| 1 | ba | ab |
| 2 | bba | abb |
| 3 | bba | ab |
| 4 | aaa | aa |
| 5 | ba | aba |

In case the PCP has a solution, describe the post-correspondence solution with justification.

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