

Exam Date & Time: 09-Jun-2022 (02:00 PM - 05:00 PM)



**MANIPAL INSTITUTE OF TECHNOLOGY**  
MANIPAL  
(A constituent unit of MAHE, Manipal)

FOURTH SEMESTER B.TECH END SEMESTER EXAMINATIONS, JUNE 2022

**FORMAL LANGUAGES & AUTOMATA THEORY [CSE 2254]**

**Marks: 50**

**Duration: 180 mins.**

**A**

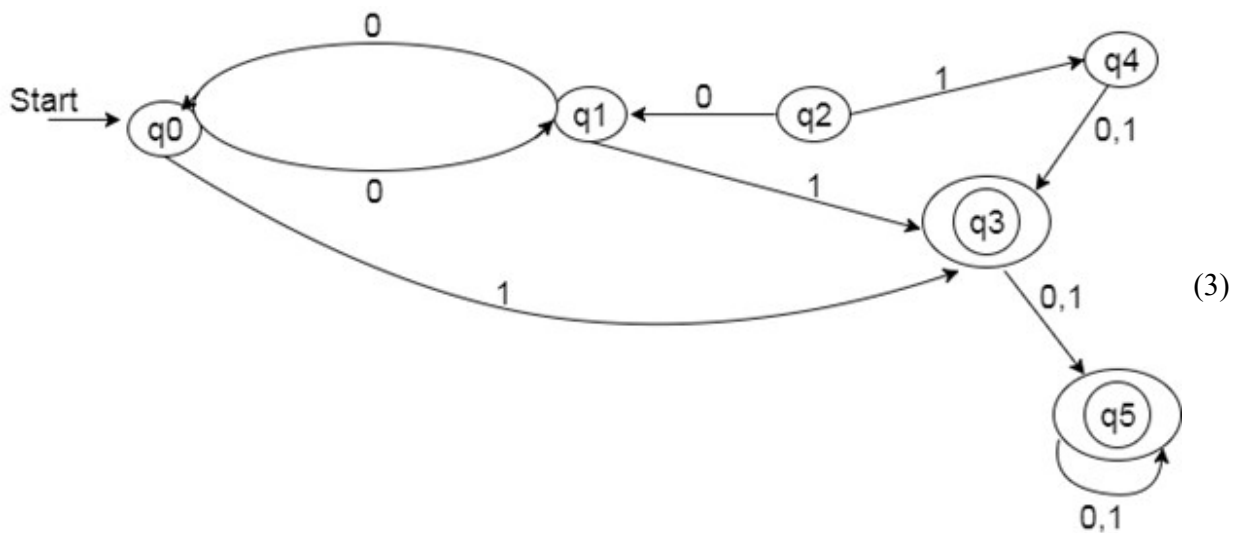
**Answer all the questions.**

Instructions to Candidates: Answer ALL questions Missing data may be suitably assumed

- 1) Find grammar for  $L = \{w : |w| \bmod 3 \geq |w| \bmod 2\}$ . (3)

A)

B) Minimize the given DFA using Mark and Reduce Procedure



- C) Find right quotient ( $L_1 / L_2$ ) for  $L_1 = \{b^*abb^*\}$  and  $L_2 = \{ba^*\}$  by drawing DFA and giving all necessary steps required. (4)

- 2) Prove that the language  $L = \{a^n b^m c^{n+m} : n, m \geq 0\}$  is not regular. (3)

A)

- B) Construct an NPDA for the language  $L = \{w \in \{a,b\}^* : n_a(w) = n_b(w)\}$ . (3)

- C) Simplify the following grammar and convert the grammar to Chomsky Normal Form.

$S \rightarrow aBcDE \mid CBD \mid ad$

$B \rightarrow cDE \mid bc \mid CD$

$C \rightarrow dd \mid ee \mid aC$

$D \rightarrow aCd \mid bC \mid d$

(4)

$$E \rightarrow CD \mid e$$

- 3) Design a Turing machine  $M=(Q, \Sigma, \Gamma, \partial, q_0, \square, F)$  using transition diagram to accept the language  $L=\{a^n b^m c^m d^{n+m} : n, m > 0\}$ . (5)
- A)
- B) What is ambiguous grammar? Check whether the grammar  $E \rightarrow E+E \mid E * E \mid (E) \mid 2$  where  $E$  is the start variable and 2 is the terminal symbol, is ambiguous or not. Give derivation tree for  $2 + 2 * 2$  using above productions. (3)
- C) Differentiate between the Types of languages classified in Chomsky Hierarchy. (2)
- 4) Design a Transducer using transition diagram to compute the difference between two positive integers, A and B where  $A > B$  with minimum states. The integers are represented in the Turing machine with corresponding number of 1's separated by a 0. (5)
- A)
- B) Give Regular Expressions for the following:
- String of a's and b's of even length
  - String of a's and b's with odd number of b's. (3)
  - String of length 3 of a's and b's whose 2<sup>nd</sup> element from RHS is a.
- C) Check whether the language  $L=\{w \mid w \in \{a,b\}^* \text{ accepted by PDA is NPDA or DPDA.}$  (2)
- 5) Construct an NPDA that accepts the language generated by the grammar  $G=(\{A,B\}, \{0,1\}, S, P)$  where set of productions are given as  $S \rightarrow 0ABB \mid 0AA$ ,  $A \rightarrow 0BB \mid 0$ ,  $B \rightarrow bBB \mid A$ . Using instantaneous description, show that, the string '0000' is accepted by the NPDA constructed by you. (5)
- A)
- B) Show that the  $L = \{WW \mid W \in \{a,b\}^*\}$  is not context free. (3)
- C) Design a DPDA to accept the language  $L=\{0^n 1^{2n} \mid n \geq 1\}$ . (2)

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