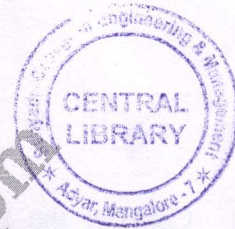


# CBCS SCHEME



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15CS54

Fifth Semester B.E. Degree Examination, Dec.2019/Jan.2020

## Automata Theory and Computability

Time: 3 hrs.

Max. Marks: 80

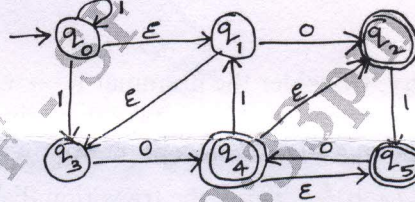
**Note: Answer any FIVE full questions, choosing ONE full question from each module.**

### Module-1

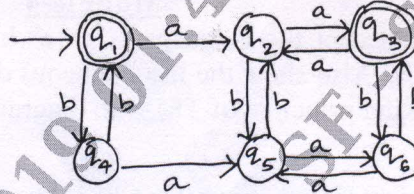
- 1 a. Briefly describe the applications of Theory of computation. (04 Marks)
- b. Define DFSM. Build DFSM for the following languages.
  - i)  $L = \{w \in \{a, b\}^* : \text{every } a \text{ in } w \text{ is immediately followed by } b\}$  (08 Marks)
  - ii)  $L = \{w \in \{a, b\}^* : w \text{ does not contain substring } aab\}$ . (08 Marks)
- c. Describe Machine based hierarchy of language classes. (04 Marks)

OR

- 2 a. For the following NDFSM, use ndfsmto fsm to construct an equivalent DFSM. Begin by showing the value of eps (q) for each state q : (08 Marks)

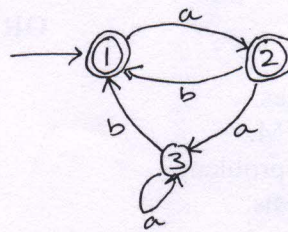


- b. Let M be the following DFSM. Use minDFSM to minimize M. (08 Marks)



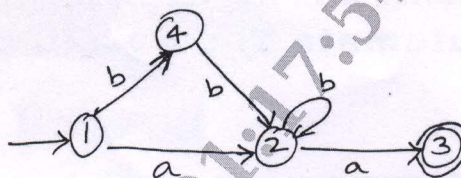
### Module-2

- 3 a. Define Regular Expression. Write regular expression for the following :
  - i)  $L = \{w \in \{a, b\}^* : w \text{ does not end in } ba\}$
  - ii)  $L = \{w \in \{0-9\}^* : w \text{ corresponds to the decimal encoding, without leading } 0\text{'s, of an odd natural number}\}$ . (06 Marks)
- b. Consider the FSM M. Use the fsmto regex heuristic algorithm to construct a regular expression that describes  $L(M)$ . (05 Marks)



Important Note : 1. On completing your answers, compulsorily draw diagonal cross lines on the remaining blank pages.  
2. Any revealing of identification, appeal to evaluator and /or equations written eg, 42+8 = 50, will be treated as malpractice.

- c. Consider the FSM M. Use fsmtoregex algorithm to construct a regular expression that describes  $L(M)$ . (05 Marks)



OR

- 4 a. Show that regular languages are closed under complement and set difference. (06 Marks)  
 b. State and prove pumping lemma theorem for regular languages. And show that the language  $L = \{a^n b^n : n \geq 0\}$  is not regular. (10 Marks)

**Module-3**

- 5 a. Define CFG. Design CFG for the languages.  
 i)  $L = \{a^i b^j \mid 2i = 3j + 1\}$  ii)  $L = \{0^{n+2} 1^n \mid n \geq 1\}$ . (08 Marks)  
 b. Define Chomsky Normal form. Convert the following CFG to CNF.  
 $S \rightarrow aACa$   
 $A \rightarrow a \mid B$   
 $B \rightarrow C \mid c$   
 $C \rightarrow cC \mid E$ . (08 Marks)

OR

- 6 a. Define Ambiguity. Consider the grammar  $E \rightarrow +EE \mid *EE \mid -EE \mid x \mid y$ . Find the leftmost, rightmost derivations and parse trees for the string “+\* -xyxy”. (07 Marks)  
 b. Define PDA. Design a PDA to accept the following language.  
 $L = \{ww^R : w \in \{a, b\}^*\}$ . Draw the transition diagram for the constructed PDA. (09 Marks)

**Module-4**

- 7 a. Design a TM to accept the language  $L = \{a^n b^n \mid n \geq 1\}$ . Obtain the transition table and transition diagram. Also show the instantaneous description for the string “aabb”. (11 Marks)  
 b. Explain the working principle of TM with diagram. (05 Marks)

OR

- 8 a. State and prove pumping theorem for CFL's shown that the language  $L = \{a^n b^n c^n : n \geq 0\}$  is not context free. (10 Marks)  
 b. Explain the hierarchy within the class of CFL's (hierarchy of languages). (03 Marks)  
 c. Show that CFL's are closed under reverse. (03 Marks)

**Module-5**

- 9 a. Explain Multitape TM, with diagram. (05 Marks)  
 b. Prove that every language accepted by a multitape TM is acceptable by some standard TM. (06 Marks)  
 c. Explain the model of Linear Bounded Automata. (05 Marks)

OR

- 10 Write short notes on :  
 a. Undecidable languages.  
 b. Halting problem of TM.  
 c. Post correspondence problem.  
 d. Church – Turing Thesis. (16 Marks)

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