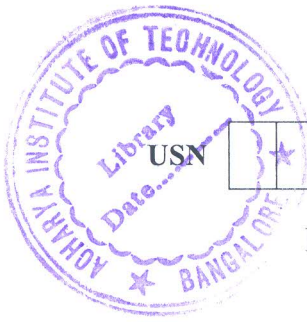


# CBCS SCHEME



15CS/IS54

## Fifth Semester B.E. Degree Examination, Aug./Sept. 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

- Define the following with examples :
    - String
    - Language(04 Marks)
  - Explain various functions on languages. (02 Marks)
  - Draw the deterministic Finite State Machine for the following :
    - To accept decimal string divisible by 3 over the alphabet  $\Sigma = \{0, 1, 2, 3, 4, 5, 6, 7, 8, 9\}$
    - To accept odd number of a's and even number of b's over alphabet.  $\Sigma = \{a, b\}$(10 Marks)

OR

- Write an algorithm for deterministic FSM simulator. (04 Marks)
  - Convert the following Non - deterministic FSM to Deterministic FSM using subset construction method. (Ref. Fig Q2(b)) (08 Marks)

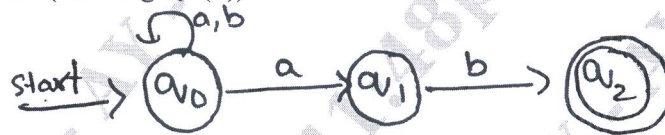


Fig Q2(b)

- Describe standard bar code reader and write its Finite State Machine diagram. (04 Marks)

### Module-2

- What is Regular expression? And mention the applications of regular expression. (03 Marks)
  - Find the regular expression for the following Languages :
    - To accept strings of 0's and 1's having no two consecutive 0's
    - $L = \{a^n b^m \mid m \geq 1, n \geq 1, nm \geq 3\}$(06 Marks)
  - Obtain a regular expression using Kleene's theorem for the finite automata shown below in Fig Q3(c)

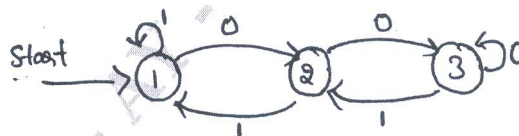


Fig Q3(c)

(07 Marks)

OR

- State and prove pumping lemma theorem for Regular language. (07 Marks)
  - Prove that the regular languages are closed under complement, intersection, difference, reverse and letter substitution. (05 Marks)
  - State and prove : "The Regular languages are closure under union, concatenation and Kleene's Star". (04 Marks)

**Module-3**

- 5 a. Define Context – Free Grammar (CFG). Design CFG for the following language.
- To generate the strings of balanced parentheses
  - $L = \{0^m 1^m 2^n \mid m \geq 1 \text{ and } n \geq 0\}$  (08 Marks)
- b. What is ambiguous grammar? Show that the following grammar is ambiguous.  
 $E \rightarrow E + E \mid E * E \mid (E) \mid id$   
 Write the left most derivation for the string “id + (id \* id)” (08 Marks)

OR

- 6 a. Define Deterministic PDA with example. (04 Marks)
- b. Obtain PDA to accept the language.  
 $L = \{WCW^R \mid W \in (a + b)^*\}$  where  $W^R$  is reverse of  $W$  by a final state. (07 Marks)
- c. Convert the following CFG to an equivalent PDA.  
 $S \rightarrow aABB \mid aAA$   
 $A \rightarrow aBB \mid a$   
 $B \rightarrow bBB \mid A$   
 $C \rightarrow a$  (05 Marks)

**Module-4**

- 7 a. Prove that “The Context – Free Language properly contain the Regular languages”. (04 Marks)
- b. Show that the language  $L = \{a^n b^n c^n \mid n \geq 0\}$  is not context free. (08 Marks)
- c. Prove that “Context – Free Language are non closure under intersection”. (04 Marks)

OR

- 8 a. Define Turing Machine. Explain the working of a Turing machine model. (06 Marks)
- b. Design a turning machine that accepts  $L = \{0^n 1^n \mid n \geq 1\}$ . Write the transition diagram for the same and also indicate the moves made by the turning machine for the input ‘0011’. (10 Marks)

**Module-5**

- 9 a. Write short notes on :
- Multitape Turning Machine
  - Model of Linear Bounded Automation. (10 Marks)
- b. Prove that “ $HALT_{TM} = \{(M, W) \mid \text{The Turning machine } M \text{ halts on input } W \text{ is undecidable}\}$ ”. (06 Marks)

OR

- 10 a. Prove that “The growth rate of any exponential functional is greater than that of any polynomial”. (08 Marks)
- b. Write short note on :
- Quantum Computers
  - Church Turning Thesis. (08 Marks)

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