



# CBCS SCHEME

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15CS54

## Fifth Semester B.E. Degree Examination, Jan./Feb. 2021 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. Define the following terms with example:
  - (i) Length of a string
  - (ii) Reversal
  - (iii) Proper substring
  - (iv) Language
  - (v) Power of an alphabet

(05 Marks)
- b. Design a FSM to accept set of all strings that either begins or ends or both with substring ab. (05 Marks)
- c. Convert the given NDFSM to DFSM. (Refer Fig.Q1(c))

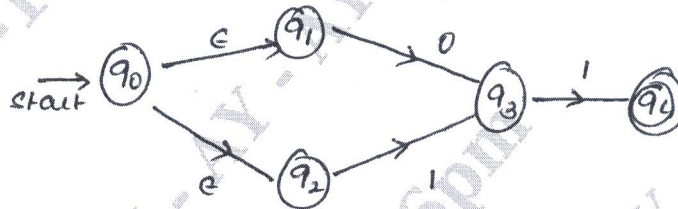


Fig.Q1(c)

(06 Marks)

OR

- 2 a. Construct a minimized DFSM for the following: (08 Marks)
 

	A	B	C	D	E	F	G	H	I
0	B	C	D	E	F	G	H	I	A
1	E	F	H	H	I	B	B	C	E
- b. Define NDFSM and construct NDFSM for the following languages:
  - (i) To recognize the following set of strings abc, abd and aacd
  - (ii)  $L = \{w | w \in abab^n \text{ or } aba^n \text{ where } n \geq 0\}$
  - (iii)  $L = \{w | w = aba \text{ or } |w| \text{ is even}\}$

(08 Marks)

### Module-2

- 3 a. Define Regular expression. Obtain a regular expression for the following languages:
  - (i)  $L = \{w : |w| \text{ is even}\}$
  - (ii)  $L = \{w : \text{in } w \text{ the } 5^{\text{th}} \text{ character from right is a and either character is b}\}$
  - (iii)  $L = \{w : w \text{ contains both aa and aba as sub string}\}$

(06 Marks)
- b. Construct FSM for the following RE:
  - (i) ab
  - (ii)  $b + (ab)$
  - (iii)  $(b + (ab))^*$
  - (iv)  $(babb^* + a)^*$
  - (v)  $(b + \epsilon)(ab)^*(a + \epsilon)$

(10 Marks)

OR

- 4 a. Show that for every RE there is an equivalent FSM. (05 Marks)
- b. Prove that the regular languages are closed under intersection and difference. (06 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. Obtain RE from the following FSM. (Refer Fig.Q4(c))

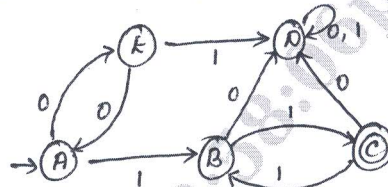


Fig.Q4(c)

(05 Marks)

**Module-3**

- 5 a. Define context free grammar and write CFG for the following languages:

(i)  $L = \{a^i b^j c^k : i + j = k, i \geq 0, j \geq 0\}$

(ii)  $L = \{a^n b^m c^k : n + 2m = k\}$

(06 Marks)

- b. Consider the grammar G, with productions:

$$S \rightarrow AbB$$

$$A \rightarrow aA | \epsilon$$

$$B \rightarrow aB | bB | \epsilon$$

Give the left most derivation, rightmost derivation and parse tree for the string aaabab.

(06 Marks)

- c. What is ambiguous grammar? Prove that the following grammar is ambiguous on the string aab.

$$G: S \rightarrow aS | aSbS | \epsilon$$

(04 Marks)

**OR**

- 6 a. Build a PDA to accept delimiters or balanced parenthesis having parenthesis  $\{ ( , ) , \}$ .

(08 Marks)

- b. Explain the following terms: (i) Pushdown Automata (PDA) (ii) Languages of a PDA

(04 Marks)

- c. Obtain a CFG for PDA M with the transitions:

$$\delta(q_0, a, Z) = (q_0, AZ)$$

$$\delta(q_0, b, A) = (q_0, AA)$$

$$\delta(q_0, a, A) = (q_1, \epsilon)$$

(04 Marks)

**Module-4**

- 7 a. State and prove pumping Lemma for context free languages. (06 Marks)  
 b. Prove that  $L = \{w \in \{a, b, c\}^* \text{ where } n_a(w) = n_b(w) = n_c(w)\}$  is not context free. (04 Marks)  
 c. Prove that the Context Free Languages are closed under, union and concatenation. (06 Marks)

**OR**

- 8 a. With a neat diagram, explain the working of a basic TM. (06 Marks)  
 b. Design a TM to accept the following language  $L = \{0^n 1^n 2^n \mid n \geq 1\}$  (10 Marks)

**Module-5**

- 9 Write short notes on:

a. Multi Tape TM

b. Non Deterministic TM

c. Post Correspondence Problem

(16 Marks)

**OR**

- 10 a. Prove that every Language accepted by a multitape TM is accepted by standard TM with single tape. (06 Marks)  
 b. Write note on: (i) Linear Bounded Automata (ii) Recursive Language (10 Marks)

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