

# CBCS Scheme

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15CS/IS54

**Fifth Semester B.E. Degree Examination, Dec.2017/Jan.2018**

## Automata Theory & Compatibility

Time: 3 hrs.

Max. Marks: 80

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

### Module-1

- 1 a. Define the following terms with examples: (i) Alphabet (ii) Power of an alphabet  
(iii) Concatenation (iv) Languages (04 Marks)
- b. Draw a DFA to accept strings of a's and b's ending with 'bab'. (03 Marks)
- c. Convert the following NDFSM Fig. Q1 (c) to its equivalent DFSM. (09 Marks)

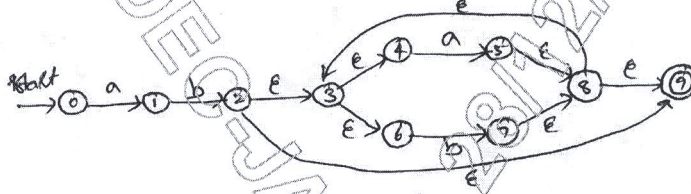


Fig. Q1 (c)

OR

- 2 a. Draw a DFSM to accept the language,  
 $L = \{\omega \in \{a, b\}^* : \forall x, y \in \{a, b\}^* ((\omega = x abbaay) \vee (\omega = x babay))\}$  (03 Marks)
- b. Define distinguishable and indistinguishable states. Minimize the following DFSM,

S	0	1
A	B	A
B	A	C
C	D	B
*D	D	A
E	D	F
F	G	E
G	F	G
H	G	D

- (i) Draw the table of distinguishable and indistinguishable state for the automata.
- (ii) Construct minimum state equivalent of automata. (09 Marks)
- c. Write differences between DFA, NFA and  $\epsilon$ -NFA. (04 Marks)

### Module-2

- 3 a. Consider the DFA shown below:

States	0	1
$\rightarrow q_1$	q <sub>2</sub>	q <sub>1</sub>
q <sub>2</sub>	q <sub>3</sub>	q <sub>1</sub>
*q <sub>3</sub>	q <sub>3</sub>	q <sub>2</sub>

Obtain the regular expressions  $R_{ij}^{(0)}$ ,  $R_{ij}^{(1)}$  and simplify the regular expressions as much as possible. (09 Marks)

- b. Give Regular expressions for the following languages on  $\Sigma = \{a, b, c\}$

- (i) all strings containing exactly one a
- (ii) all strings containing no more than 3 a's.
- (iii) all strings that contain at least one occurrence of each symbol in  $\Sigma$ . (03 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.

- 3 c. Let L be the language accepted by the following finite state machine. (04 Marks)

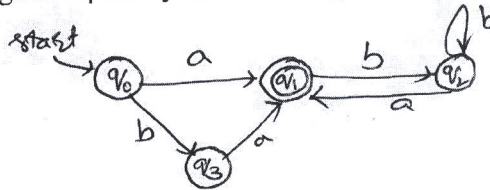


Fig. Q3 (c)

Indicate for each of the following regular expressions, whether it correctly describes L:

- $(a \cup ba)bb^*a$
- $(\epsilon \cup b)a(bb^*a)^*$
- $ba \cup ab^*a$
- $(a \cup ba)(bb^*a)^*$

OR

- Prove that the following language is not regular :  $L = \{0^n1^n \mid n > 0\}$ . (05 Marks)
- If  $L_1$  and  $L_2$  are regular languages then prove that  $L_1 \cup L_2$ ,  $L_1.L_2$  and  $L_1^*$  are regular languages. (05 Marks)
- Is the following grammar ambiguous? (06 Marks)  
 $S \rightarrow iC + S \mid iC + SeS \mid a$   
 $C \rightarrow b$

**Module-3**

- Define Grammar, Derivation, Sentential forms and give one example for each. (03 Marks)
- What is CNF? Obtain the following grammar in CNF  
 $S \rightarrow ASB \mid \epsilon$   
 $A \rightarrow aAS \mid a$   
 $B \rightarrow SbS \mid A \mid bb$  (09 Marks)
- Let G be the grammar,  
 $S \rightarrow aB \mid bA$   
 $A \rightarrow a \mid aS \mid bAA$   
 $B \rightarrow b \mid bS \mid aBB$   
 For the string aaabbabbba find a  
  - Left most derivation.
  - Right most derivation.
  - Parse tree. (04 Marks)

OR

- Explain the following terms: (03 Marks)
  - Pushdown automata (PDA).
  - Languages of a PDA.
  - Instantaneous description of a PDA.
- Construct a PDA to accept the language  $L = \{\omega\omega^R \mid \omega \in \{a, b\}^*\}$ . Draw the graphical representation of this PDA. Show the moves made by this PDA for the string aabbaa. (10 Marks)
- Convert the following CFG to PDA (03 Marks)  
 $S \rightarrow aABB \mid aAA$   
 $A \rightarrow aBB \mid a$   
 $B \rightarrow bBB \mid A$   
 $C \rightarrow a$

Module-4

- 7 a. If  $L_1$  and  $L_2$  are context free languages then prove that  $L_1 \cup L_2$ ,  $L_1 \cdot L_2$  and  $L_1^*$  are context free languages. (04 Marks)
- b. Give a decision procedure to answer each of the following questions:
- Given a regular expression  $\alpha$  and a PDA  $M$ , the language accepted by  $M$  a subset of the language generated by  $\alpha$ ?
  - Given a context-free Grammar  $G$  and two strings  $S_1$  and  $S_2$ , does  $G$  generate  $S_1 S_2$ ?
  - Given a context free Grammar  $G$ , does  $G$  generate any even length strings.
  - Given a Regular Grammar  $G$ , is  $L(G)$  context-free? (12 Marks)

OR

- 8 a. Explain with neat diagram, the working of a Turing Machine model. (05 Marks)
- b. Design a Turing machine to accept the language  $L = \{a^n b^n c^n \mid n \geq 1\}$ . Draw the transition diagram. Show the moves made by this turing machine for the string aabbcc. (11 Marks)

Module-5

- 9 Write short notes on:
- Multi-tape turing machine.
  - Non-deterministic turing machine.
  - Linear Bounded automata. (16 Marks)

OR

- 10 Write short notes on:
- Undecidable languages.
  - Halting problem of turing machine.
  - The post correspondence problem. (16 Marks)

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