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)**

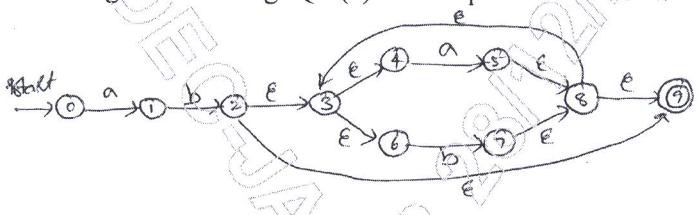

Fig. Q1 (c)

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 ε-NFA. **(04 Marks)**

Module-2

3 a. Consider the DFA shown below:

States	0	1
→q_1	q_2	q_1
q_2	q_3	q_1
*q_3	q_3	q_2

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 $\sum = \{a,b,c\}$

(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 occurance of each symbol in $\sum$. **(03 Marks)**

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

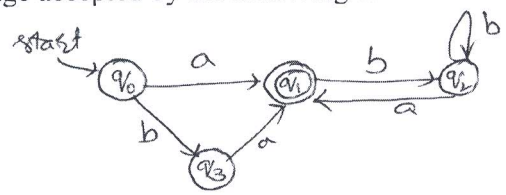

Fig. Q3 (c)

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

(i) $(a \cup ba)bb^*a$

(ii) $(\varepsilon \cup b)a(bb^*a)^*$

(iii) $ba \cup ab^*a$

(iv) $(a \cup ba)(bb^*a)^*$

OR

4 a. Prove that the following language in not regular : $L = \{0^n 1^n \mid n > 0\}$. **(05 Marks)**

b. 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)**

c. Is the following grammar is ambiguous? **(06 Marks)**

$S \rightarrow iC + S \mid iC + SeS \mid a$

$C \rightarrow b$

Module-3

5 a. Define Grammar, Derivation, Sentential forms and give one example for each. **(03 Marks)**

b. What is CNF? Obtain the following grammar in CNF

$S \rightarrow ASB|\varepsilon$

$A \rightarrow aAS \mid a$

$B \rightarrow SbS \mid A \mid bb$ **(09 Marks)**

c. 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

(i) Left most derivation.

(ii) Right most derivation.

(iii) Parse tree. **(04 Marks)**

OR

6 a. Explain the following terms:

(i) Pushdown automata (PDA).

(ii) Languages of a PDA.

(iii) Instantaneous description of a PDA. **(03 Marks)**

b. 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)**

c. Convert the following CFG to PDA

$S \rightarrow aABB \mid aAA$

$A \rightarrow aBB \mid a$

$B \rightarrow bBB \mid A$

$C \rightarrow a$ **(03 Marks)**

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:

(i) Given a regular expression α and a PDA M, the language accepted by M a subset of the language generated by α?

(ii) Given a context-free Grammar G and two strings S_1 and S_2, does G generate S_1S_2?

(iii) Given a context free Grammar G, does G generate any even length strings.

(iv) 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 $L = \{a^n b^n c^n \mid n >= 1\}$. 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:

a. Multi-tape turing machine.

b. Non-deterministic turing machine.

c. Linear Bounded automata. **(16 Marks)**

OR

10 Write short notes on:

a. Undecidable languages.

b. Halting problem of turing machine.

c. The post correspondence problem. **(16 Marks)**

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