CBCS SCHEME

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Fifth Semester B.E. Degree Examination, June/July 2023
Automata Theory and Computability

Time: 3 hrs. Max. Marks: 100

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

Module-1

1 a. Define the following terms with example
i) Alphabet ii) Power of an alphabet iii) Language **(06 Marks)**

b. With a neat diagram, explain a hierarchy of language classes in automata theory. **(04 Marks)**

c. Define deterministic finite state machine. Design DFSM
i) To accept strings having odd number of a's and odd number of b's
ii) To accept strings having number of a's divisible by 5 and number of b's divisible by 3. **(10 Marks)**

OR

2 a. Convert the following NDFSM [Refer Fig Q2(a)] to its equivalent DFSM.

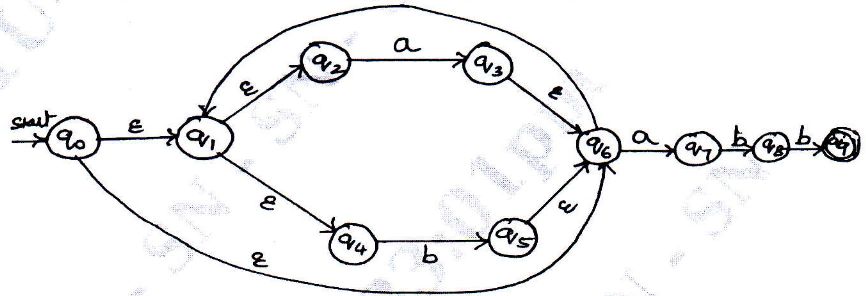

Fig Q2(a) **(10 Marks)**

b. Define distinguishable and indistinguishable states minimize the following DFSM shown in Table Q2(b)

δ	a	b
→ A	B	E
B	C	F
* C	D	H
D	E	H
E	F	I
* F	G	B
G	H	B
H	I	C
* I	A	E

(10 Marks)

Module-2

3 a. Define regular expression. Obtain a regular expression for the following :
i) $L = \{a^n b^m \mid n \geq 4, m \leq 3\}$
ii) $L = \{w : n_a(w) \bmod 3 = 0 \text{ where } w \in (a, b)^*\}$
iii) $L = \{w$: strings ends with ab or ba where $w \in \{a, b\}^*\}$
iv) $L = \{a^{2n} b^{2m} \mid n \geq 0, m \geq 0\}$ **(10 Marks)**

b. Consider the DFSM shown below

States	0	1
$\rightarrow q_1$	q_2	q_1
q_2	q_3	q_1
* q_3	q_3	q_2

Obtain the regular expression $R_{ij}^{(0)}$, $R_{ij}^{(1)}$ and simplify the regular expression as much as possible. **(10 Marks)**

OR

4 a. Using Kleen's theorem, prove that only language that can be defined with a regular expression can be accepted by source FSM. **(10 Marks)**

b. State and prove pumping lemma for regular language and show that the language $L = \{a^i b^j \mid i > j\}$ is not regular. **(10 Marks)**

Module-3

5 a. Define context free grammar. Design CFG for the following language.
i) $L = \{0^i 1^j \mid i \# j, i \geq 0, j \geq 0\}$ ii) $L = \{a^n b^m \mid n \geq 0, m > n\}$ **(10 Marks)**

b. Define Ambiguity consider the grammar
$E \rightarrow E + E \mid E - E \mid E * E \mid E/E \mid a/b$
Find Leftmost and Rightmost derivation and parse tree for the string a + b * a + b, show that the grammar is ambiguous. **(10 Marks)**

OR

6 a. Define Chomsky normal form and Greibach normal form. Convert the following grammar to CNF
$S \rightarrow OA \mid 1B$
$A \rightarrow OAA \mid 1S \mid 1$
$B \rightarrow 1BB \mid 0S \mid 0$ **(10 Marks)**

b. Define a PDA. Obtain PDA to accept the language $L = \{wcw^R \,/\, w \in \{a, b\}^*$ where w^R is reverse of w by a final state. Draw transition diagram. Write sequence of moves made by PDA to accept the string aabcbaa. **(10 Marks)**

Module-4

7 a. Define Turing machine. Explain with neat diagram the working of a Turing machine model. **(06 Marks)**

b. Design turning machine to accept the language $L = \{a^n b^n c^n \mid n \geq 1\}$. Draw the transition diagram and shown the moves made by turing machine for the string aabbcc. **(14 Marks)**

OR

8 a. Explain various technique used for construction of turing machine. **(05 Marks)**

b. Explain the following ;
i) Multitape Turing machine ii) Non-deterministic Turing machine
iii) Linear bounded automata **(15 Marks)**

Module-5

9 a. Explain halting problem in Turing machine prove that
$HALT_{TM} = \{(M, W) \mid$ The Turing machine M halts on input w$\}$ is undecidable. **(10 Marks)**

b. Define decidable language prove that DFA is decidable language (A_{DFA} is decidable) **(10 Marks)**

OR

10 a. Explain quantum computers **(06 Marks)**

b. Explain Church-Turing Thesis **(07 Marks)**

c. Explain post correspondence problem. **(07 Marks)**