CBCS SCHEME

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18CS54

Fifth Semester B.E. Degree Examination, June/July 2025
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) String iv) Language v) Kleene star. **(05 Marks)**

b. Design DFSM for each of the following languages :
i) L = {W : W has even number of a's and even number of b's. **(10 Marks)**
ii) L = {W : |W| mod 5 ≠ 0} on Σ = {a, b}.

c. Mention the differences between DFSM , NFSM and ε - NFSM. **(05 Marks)**

OR

2 a. Define Distinguishable and Indistinguishable states. Minimize the following DFSM. **(10 Marks)**

δ	→A	B	*C	D	E	F	G	H
0	B	G	A	C	H	C	G	G
1	F	C	C	G	F	G	E	C

b. Convert the following NDFSM to DFSM. Refer Fig. Q2(b). **(10 Marks)**

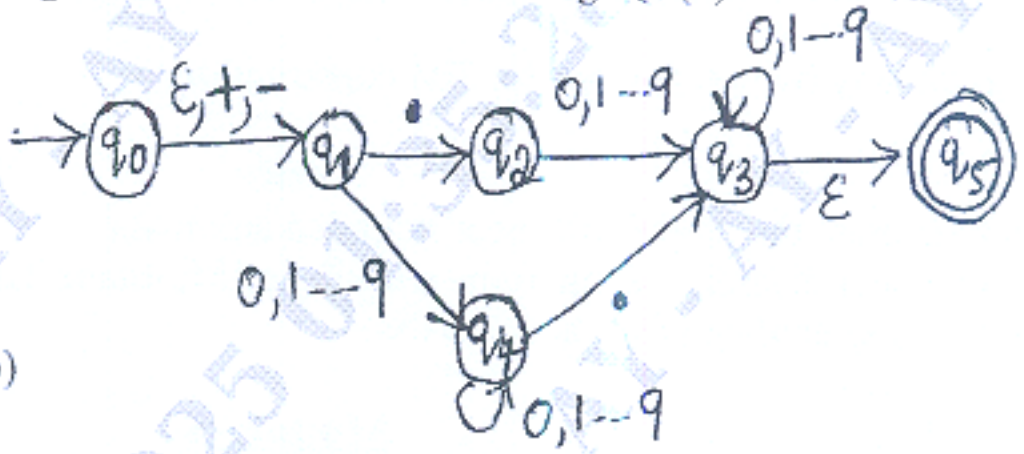

Fig. Q2(b)

Module-2

3 a. Define Regular Expression. Write Regular Expression for the following languages :
i) $L = \{a^{2n} b^{2m} \mid n \geq 0 , m \geq 0\}$ ii) $L = \{a^n b^m \mid n \geq 4 , m \leq 3\}$
iii) L = { W ∈ {a, b}* : strings with alternate a's and b's. **(08 Marks)**

b. Obtain ε – NDFSM for the regular expression a* + b* + c*. **(06 Marks)**

c. Build a Regular expression from an FSM. Refer Fig. Q3(c). **(06 Marks)**

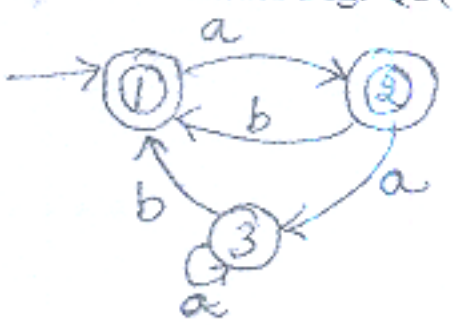

Fig. Q3(c)

OR

4 a. State and prove Pumping lemma theorem for regular languages. Show that $L = \{WW^R \mid W \in (0+1)^*\}$ is not regular. **(10 Marks)**

b. Show that if L_1 and L_2 are regular, then $L_1 \cup L_2$, $L_1 . L_2$ and 4^* are also regular. **(06 Marks)**

c. Write Regular Grammar & FSM for the language

$L = \{W \in \{a, b\}^* : W$ ends with Pattern aaaa$\}$. **(04 Marks)**

Module-3

5 a. Define CFG and design a CFG for the following Languages :

i) $L = \{a^n b^{n+2} : n \geq 0\}$

ii) $L = \{WW^R \mid W \in (a, b)^*\}$

iii) $L = \{O^i 1^j \mid i \neq j \ , \ i \geq 0$ and $j \geq 0\}$. **(10 Marks)**

b. Define CNF. Convert the following CFG into CNF.

$S \rightarrow aACa \quad A \rightarrow B \mid a \quad B \rightarrow C \mid c \quad C \rightarrow c\,C \mid \varepsilon$ **(10 Marks)**

OR

6 a. Design a PDA for the language $L = \{a^n b^n \mid n \geq 0\}$ and show the moves made by PDA for the string aaabbb. **(10 Marks)**

b. Define Leftmost derivation , Rightmost derivation and Parse tree. Consider the grammar.

$E \rightarrow E + E \quad E \rightarrow E * E \quad E \rightarrow E - E \quad E \rightarrow$ id. Obtain LMD , RMD and Parse tree for the string id + id * id. **(10 Marks)**

Module-4

7 a. Design a TM for the language $L = \{1^n 2^n 3^n \mid n \geq 1\}$ Show that 112233 is accepted by ID. **(12 Marks)**

b. Explain any two techniques for TM construction. **(08 Marks)**

OR

8 a. Demonstrate the model of Linear bounded automata. **(08 Marks)**

b. With a neat diagram , explain the working of Multitape Turing M/C. **(08 Marks)**

c. Define and explain DTM and NDTM. **(04 Marks)**

Module-5

9 a. Explain the following with example :

i) Decidability ii) Decidable Languages iii) Undecidable languages. **(12 Marks)**

b. Explain Halting problem in TM. **(08 Marks)**

OR

10 a. Explain Quantum computers. **(07 Marks)**

b. Explain P and NP classes. **(07 Marks)**

c. Write applications of TM **(06 Marks)**

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