CBCS SCHEME

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17CS54

Fifth Semester B.E. Degree Examination, Feb./Mar. 2022
Automata Theory and Computability

Time: 3 hrs. Max. Marks: 100

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

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.

Module-1

1 a. Define strings language and automata with examples. **(05 Marks)**

b. Define DFSM. Design DFSM to accept each of the following languages:

i) $L = \{w \in \{0, 1\}^* :$ w corresponds to the binary encoding, without leading 0's, of natural numbers that are evenly divisible by 4$\}$.

ii) $L = \{w \in \{a, b\}^* : (\#_a(w) + 2 - \#_b(w)) \equiv_5 0\}$. ($\#_a(w)$ is the number of a's in w). **(12 Marks)**

c. Differentiate Moore machines and Mealy machines. **(03 Marks)**

OR

2 a. Define NDFSM. Convert the following NDFSM to its equivalent DFSM. Refer Fig.Q.2(a). **(12 Marks)**

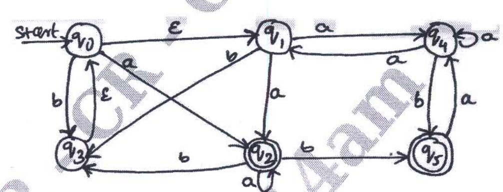

Fig.Q2(a)

b. Let M be the following DFSM. Use min DFSM to minimize M. Refer Fig.Q.2(b). **(08 Marks)**

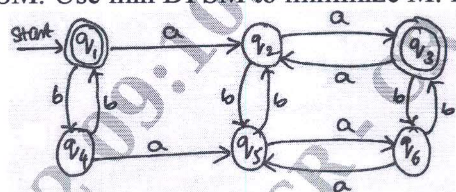

Fig.Q.2(b)

Module-2

3 a. Define regular expression and write regular expressions for the following languages:

i) $L = \{w \in \{a, b\}^* : |w| \text{ is even}\}$

ii) $L = \{w \in \{0, 1\}^* :$ w corresponds to the binary encoding, without leading 0's, of natural numbers that are powers of 4$\}$

iii) $L = \{a^n b^m c^p \mid n \le 4, m \ge 2, p \le 2\}$ **(10 Marks)**

b. Build a regular expression equivalent to DFSM given below. Refer Fig.Q.3(b). **(05 Marks)**

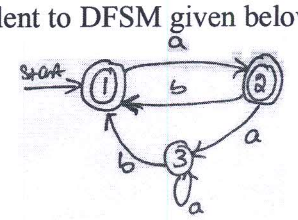

Fig.Q.3(b)

c. Build a FSM that accepts the language defined by regular expression : $(b \cup ab)^*$ **(05 Marks)**

OR

4 a. Define regular grammar, and show a regular grammar for the language: $L = \{w \in \{a, b\}^* : |w| \text{ is even}\}$ **(06 Marks)**

b. State and prove the pumping theorem for regular languages. **(08 Marks)**

c. Show that the language $L = \{a^n b^n | n \geq 0\}$ is not regular. **(06 Marks)**

Module-3

5 a. Define Context Free Grammar. Design a CFG for each of the following languages:

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

ii) $L = \{a^i b^j c^k | j = i + k, \forall i, j, k \geq 0\}$

iii) $L = \{a^n b^m | m \geq n, m - n \text{ is even}\}$ **(10 Marks)**

b. Convert the following grammar to Chomsky normal form:

$S \rightarrow aACa$

$A \rightarrow B|a$

$B \rightarrow C|c$

$C \rightarrow cC|\varepsilon$ **(10 Marks)**

OR

6 a. Define PDA. Obtain a PDA to accept the language $L = \{a^n b^m a^n | n, m \geq 0 \text{ and } m \text{ is even}\}$ **(10 Marks)**

b. Convert the following CFG to PDA:

$E \rightarrow E + T|T$

$T \rightarrow T * F|F$

$F \rightarrow (E)|id$ **(06 Marks)**

c. When a PDA is called as deterministic PDA? **(04 Marks)**

Module-4

7 a. State and prove pumping theorem for CFL. **(08 Marks)**

b. Show that the following language is not context free $L = \{a^n b^n c^n | n \geq 0\}$ **(06 Marks)**

c. Prove that context free languages are closed under Union and concatenation. **(06 Marks)**

OR

8 a. With a neat block diagram, explain the working of basic model for Turing machine. **(06 Marks)**

b. Design a Turing machine that accepts $L = \{0^n 1^n | n \geq 0\}$. Draw the transition diagram and show the moves for the string 0011. **(10 Marks)**

c. Briefly discuss the techniques for Turing machine construction. **(04 Marks)**

Module-5

9 a. With a neat diagram, explain the model of linear bounded automation. **(08 Marks)**

b. Explain working of multitape turning machine. **(06 Marks)**

c. Explain how a post correspondence problem can be treated as a game of dominoes. **(06 Marks)**

OR

10 Write short notes on the following:

a. Quantum computation and quantum computers **(10 Marks)**

b. Church – Turing Thesis **(05 Marks)**

c. The post-correspondence problem. **(05 Marks)**

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