CBCS SCHEME

USN | | | | | | | | | | | 15CS/IS54

Fifth Semester B.E. Degree Examination, June/July 2018
Automata Theory and Computability

Time: 3 hrs. Max. Marks: 80

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

Module-1

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

b. Define deterministic FSM. Draw a DFSM to accept decimal strings which are divisible by 3. **(06 Marks)**

c. Convert the following NDFSM to its equivalent DFSM. (Refer Fig.Q.1(c)).

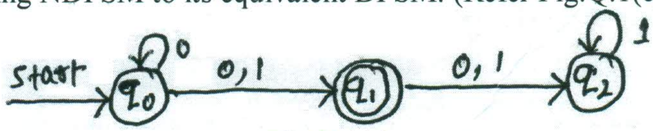

Fig.Q.1(c)

Also write transition table for DFSM. **(06 Marks)**

OR

2 a. Minimize the following finite automata, (Refer Fig.Q.2(a)). **(06 Marks)**

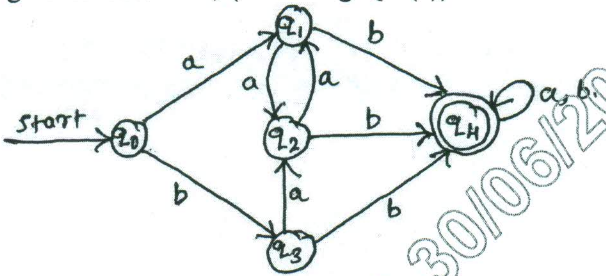

Fig.Q.2(a)

b. Construct a mealy machine for the following:

i) Design a mealy machine for a binary input sequence. Such that, if it has a substring 101, the machine outputs A. If input has substring 110, the machine outputs B. Otherwise it outputs C.

ii) Design a mealy machine that takes binary number as input and produces 2's complement of that number as output. Assume the string is read from LSB to MSB and end carry is discarded. **(06 Marks)**

c. Convert the following mealy machine to Moore machine. (Refer Fig.Q.2(c)). **(04 Marks)**

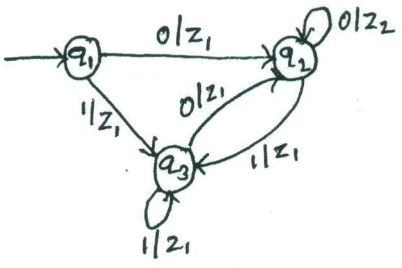

Fig.Q.2(c)

Module-2

3 a. Define regular expression. Obtain a regular expression for the following languages:

i) $L = \{a^n b^m \mid m + n \text{ is even}\}$.

ii) $L = \{a^n b^m \mid m \geq 1, n \geq 1, nm \geq 3\}$

iii) $L = \{w : |w| \bmod 3 = 0 \text{ where } w \in (a, b)^*\}$. **(08 Marks)**

b. Design an NDFSM that accept the language $L(aa^*(a+b))$. **(04 Marks)**

c. Convert the regular expression $(0+1)^* 1(0+1)$ to NDFSM. **(04 Marks)**

OR

4 a. If the regular grammars define exactly the regular language, then prove that the class of languages that can be defined with regular grammars is exactly the regular languages. **(04 Marks)**

b. Prove that the regular languages are closed under complement, intersection, difference, reverse and letter substitution. **(08 Marks)**

c. State and prove pumping theorem for regular language. **(04 Marks)**

Module-3

5 a. Define a context-free grammar. Obtain the grammar to generate the language $L = \{w \mid n_a(w) = n_b(w)\}$. **(04 Marks)**

b. For the regular expression $(011+1)^*(01)^*$ obtain the context free grammar. **(04 Marks)**

c. What is ambiguity? Show that the following grammar is ambiguous.

$S \rightarrow aB \mid bA$

$A \rightarrow aS \mid bAA \mid a$

$B \rightarrow bS \mid aBB \mid b$. **(08 Marks)**

OR

6 a. Define PDA (Push Down automata). Obtain a PDA to accept the language $L(M) = \{wCw^R \mid wt(a+b)^*\}$, where WR is reverse of W by a final state. **(08 Marks)**

b. For the grammar:

$S \rightarrow aABB \mid aAA$

$A \rightarrow aBB \mid a$

$B \rightarrow bBB \mid A$

$C \rightarrow a$

Obtain the corresponding PDA. **(04 Marks)**

c. Obtain a CFG for the PDA shown below:

$f(q_0, a, Z) = (q_0, AZ)$

$f(q_0, a, A) = (q_0, A)$

$f(q_0, b, A) = (q_1, \varepsilon)$

$f(q_1, \varepsilon, Z) = (q_2, \varepsilon)$. **(04 Marks)**

Module-4

7 a. Consider the grammar

$S \rightarrow 0A \mid 1B$

$A \rightarrow 0AA \mid 1S \mid 1$

$B \rightarrow 1BB \mid 0S \mid 0$

Obtain the grammar in CNF. **(08 Marks)**

b. Show that $L = \{a^n b^n c^n \mid n \geq 0\}$ is not context free. **(08 Marks)**

OR

8 a. With a neat diagram, explain the working of a basic Turing machine. **(04 Marks)**

b. Obtain a Turing machine to accept the language $L = \{0^n 1^n \mid n \geq 1\}$. **(08 Marks)**

c. Briefly explain the techniques for TM construction. **(04 Marks)**

Module-5

9 a. Obtain a Turing machine to recognize the language $L = \{0^n 1^n 2^n \mid n \geq 1\}$. **(08 Marks)**

b. Prove that $HALT_{TM} = \{(M, W) \mid$ the Turing machine M halts on input W$\}$ is undecidable. **(04 Marks)**

c. With example, explain the quantum computation. **(04 Marks)**

OR

10 Write a short note on:

a. Multiple Turing machine

b. Non deterministic Turing machine

c. The model of linear bounded automaton

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

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