OBE

REFNO035112

M.Sc. SEMESTER - I EXAMINATION 2020-21

COMPUTER SCIENCE

CS-202 : Theory of Computation

Time : Four hours **Max. Marks : 70**

Instructions

1. **The Question Paper contains 08 questions out of which you are required to answer any 04 questions. The question paper is of 70 marks with each question carrying 17.5 marks.**

2. The total duration of the examination will be **4 hours** (Four hours), which includes the time for downloading the question paper from the Portal, writing the answers by hand and uploading the hand-written answer sheets on the portal.

3. For the students with benchmark disability as per Persons with Disability Act, the total duration of examination shall be **6 hours** (six hours) to complete the examination process, which includes the time for downloading the question paper from the Portal, writing the answers by hand and uploading the hand-written answer sheets on the portal. .

4. Answers should be hand-written on a plain white A4 size paper using black or blue pen. Each question can be answered in upto 350 words on 3 (Three) plain A4 size paper (only one side is to be used).

5. Answers to each question should start from a fresh page. All pages are required to be numbered. You should write your Course Name, Semester, Examination Roll Number, Paper Code, Paper title, Date and Time of Examination on the first sheet used for answers.

Questions

1 (a) Test whether 001100, 001010, 01010 are in the language generated by the grammar G = ({S}, {a,b}, { S →0S1| 0A| 0| 1B|1, A →**0A|0, B→1B|1**}, S}. **[5.5]**

(b) Construct a regular grammar which can generate the set of all strings starting with a letter *(A* to *Z)* followed by a string of letters or digits (0 to 9). **[6.5]**

(c) Show that $\{a^n b^n \ | n>0\}$ is not a regular set without using the pumping lemma. **[5.5]**

2 (a) Construct a Deterministic Finite Automata accepting all strings over {0, 1} ending with 010 or 0010. **[6]**

(b) Construct a deterministic finite automaton equivalent to the grammar $S \rightarrow aS|\ bS|\ aA,\ A \rightarrow bB.\ B \rightarrow aC,\ C \rightarrow \varepsilon$. **[5.5]**

(c) Find all strings of length 5 or less in the regular set represented by the regular expressions a* + (ab + a)*, also draw the transition diagram. **[6]**

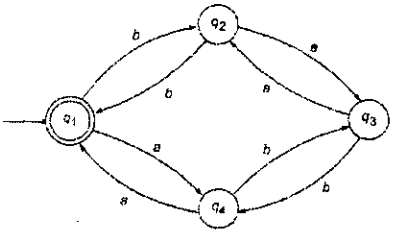
3 (a) Construct an **ε-NFA** for the Language **[10]**

$L=\{0^m1^n: \quad m+n=\text{even}\}$

And convert it to equivalent NFA.

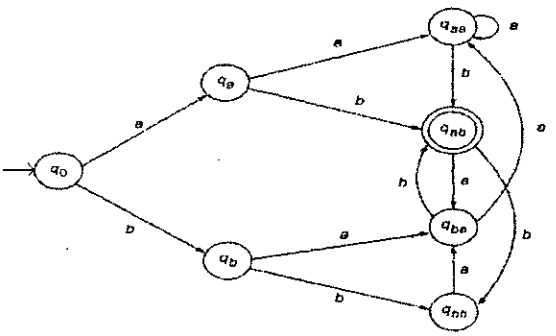
(b) Construct a Mealy machine over {0, 1} which can output even, odd according as the number of 1's encountered is even or odd. Convert it to its equivalent Moore Machine. **[7.5]**

4 (a) Find the regular expression corresponding to the following Automaton: **[6]**



(b) Design a DFA over {a,b}, which accepts the string w where, |w| mod 3=2 **[4]**

(c) Construct the minimum state automata using Myhill-Nerode theorem equivalent to the following DFA. **[7.5]**



5 (a) Consider the grammar G which has the following productions **[6]**
$S \rightarrow aB|bA$, $A \rightarrow aS|bAA|a$, $B \rightarrow bS|aBB|b$ and state whether the following statements are true or false.

i. $aab \notin L(G)$ *ii.* L(G) has some strings of even length

(b) Given the grammar $S \rightarrow AB$, $A \rightarrow a$, $B \rightarrow C|b$, $C \rightarrow D$, $D \rightarrow E$, **[5.5]**
$E \rightarrow a$, find an equivalent grammar which is reduced and has no unit productions.

(c) Reduce the following grammar to Greibach and Chomsky normal form:

$S \rightarrow A0$, $A \rightarrow 0B$, $B \rightarrow A0$, $B \rightarrow 1$ **[6]**

6 (a) Determine whether or not the following language is context free [6]

$L = \{w \in \{a, b\}^* : n_a(w) = n_b(w)$, w does not contain a substring aab.

(b) Construct PDA which accepts the language [5.5]

$L = \{a^{m+n} b^m c^n : m, n \geq 1\}$

(c) Using Pumping Lemma prove that the language $L = \{a^n b^j : n \leq j^2\}$ is not context free. [6]

7 (a) Construct a Turing Machine for L((01(01)*), then find an unrestricted grammar for it. Give a derivation for 0101 using the resulting grammar. [9]

(b) Find Linear Bounded Automata for the following language: [8.5]

$L = \{w^n : w \in \{a, b\}^+, n \geq 1\}$

8 (a) Let A= {00, 00, 11, 101} and B={01, 111, 111, 010}. Does the pair (A, B) have a PC-Solution? If yes, find at least two solutions. [5.5]

(b) Is the halting problem solvable for deterministic push down automata (PDA); that is given a PDA, can we always predict whether or not the automaton will halt on input w? [6]

(c) Determine whether or not the following statement is true: Any problem whose domain is finite is decidable. [6]