Roll Number:_____

Thapar Institute of Engineering & Technology, Patiala

Department of Computer Science and Engineering

Auxiliary Examination

B.E (Third Year)	Course Code: UCS 701 Course Name: Theory of Computation
Date: 09-03-2022 Duration : 2 Hours	Max. Marks: 50 Name of Faculty: NS

Note: Attempt any five questions. Assume missing data, if any, suitably

<table>
<tr><th>S. No.</th><th>Question</th><th>Marks</th></tr>
<tr><td>Q. 1</td><td>a) Design a Regular expression and Deterministic finite automata for the language over $\sum$ = { a, b}, such that it accepts all strings that contain odd occurrence of the substring ab.
b) Design a moore machine to compute 1's complement of a binary input where $\sum$ = {a, b}. Also give the transition table for the same.</td><td>5

5</td></tr>
<tr><td>Q. 2</td><td>Formally define Deterministic finite automata. Convert the following NFA to equivalent DFA using subset construction algorithm. Also describe the language it accepts. The NFA is defined as ({P, Q, R, S, T}, {0,1}, δ, P, {S, T}) and δ is given as follows:
<table>
<tr><th></th><th>0</th><th>1</th></tr>
<tr><td>P</td><td>{P, Q}</td><td>{P}</td></tr>
<tr><td>Q</td><td>{R, S}</td><td>{T}</td></tr>
<tr><td>R</td><td>{P, R}</td><td>{T}</td></tr>
<tr><td>S</td><td>-</td><td>-</td></tr>
<tr><td>T</td><td>-</td><td>-</td></tr>
</table></td><td>10</td></tr>
<tr><td>Q. 3</td><td>Design a Push down automata for the Language L= {$p^n q^m r^n$ | m, n $\geq$ 1}. Give the transition function for the same. Explain the designed pushdown automata with accepted and rejected string.</td><td>10</td></tr>
<tr><td>Q. 4</td><td>a) Explain with examples the Chomsky hierarchy of formal grammar.
b) Explain with example the different types of redundant productions present in Context free grammar. Remove the unit production from the following context free grammar
S $\rightarrow$ Aa, A $\rightarrow$ a | B, B $\rightarrow$ d</td><td>5

5</td></tr>
</table>

P.T.O

Q. 5	**a)** Let G be the grammar $S \longrightarrow aB \mid bA,\ A \longrightarrow a \mid aS \mid bAA,\ B \longrightarrow b \mid bS \mid aBB$ For the string aabbaabbba find **i)** leftmost derivation, **ii)** parse tree, and **iii)** Is the grammar ambiguous? **b)** Convert the following grammar to Greibach Normal form. $\{S \rightarrow AB,\ A \rightarrow SA \mid AA \mid a,\ B \rightarrow SB \mid b\}$	5 5
Q. 6	Define formally Turing machine. Design a Turing machine to compute sum of two binary numbers. Give trace of the designed turing machine for an example	10
Q. 7	**a)** Give the Regular expressions for following languages over alphabet {0, 1} **i)** Set of all strings with 2^{nd} symbol from right is 1. **ii)** Set of all strings starting with 00 or 11 and ending with 10 or 01. **iii)** Set of strings contatining 000 as substring. **iv)** Set of strings not ending with 111. **v)** Set of strings beginning and ending with same alphabet. **b)** Construct a CFG for the following languages **i)** $L = \{wcw^R \mid \text{where } w \in (a, b)^*\}$. **ii)** $L = a^n b^{2n}$ where $n>=1$	5 5