Name: **Enrolment No:**	UPES UNIVERSITY OF TOMORROW

UPES

End Semester Examination, December 2024

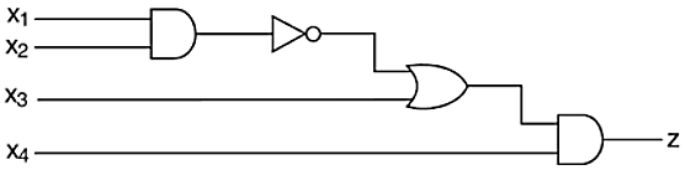
Course: Boolean Algebra & Automata Theory — **Semester: V**

Program: B.Sc. (Hons.) Mathematics — **Time: 03 hrs.**

Course Code: MATH3040P — **Max. Marks: 100**

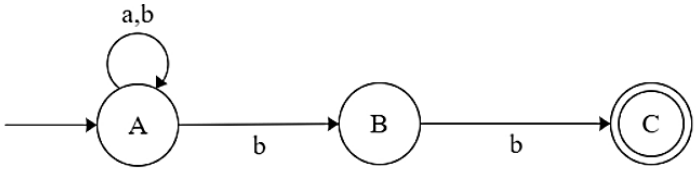
Instructions: Answer all the questions.

SECTION A
(5Qx4M=20Marks)

S. No.		Marks	CO
Q1.	Define AND, OR and NOT gates. Write the Boolean expression corresponding to the following logic circuit. 	**4**	**CO1**
Q2.	Define (a) Complete lattice (b) Bounded lattice (c) Complemented lattice (d) Distributive lattice	**4**	**CO2**
Q3.	Define Deterministic finite automata (DFA). Design a DFA that accepts all strings over $\Sigma = \{a, b\}$ where every accepted string must contain exactly two $a's$ i.e. $\|w\|_a = 2$.	**4**	**CO3**
Q4.	Define Context free grammar (CFG) and write the CFG for the following languages. (a) $\{a^n b^n \mid n \geq 1\}$ (b) $\{a^{2n} b^n \mid n \geq 0\}$	**4**	**CO4**
Q5.	Discuss Greibach Normal form (GNF) and check whether the grammar given by $G = \{S \to aAB \mid aB,\ \ A \to aA \mid \epsilon,\ \ B \to bB \mid \epsilon\}$ is in GNF or not.	**4**	**CO5**

SECTION B
(4Qx10M= 40 Marks)

Q6.	Find the product of sum expansion of the following functions. (a) $f(x, y, z) = (x + z)y$. (b) $f(x, y, z) = xy'$.	**10**	**CO2**

<table>
<tr><td>Q7.</td><td>Convert the following NFA into its equivalent DFA using the subset construction method.
 
</td><td>10</td><td>CO3</td></tr>
<tr><td>Q8.</td><td>Consider the following transition table of a Moore machine and obtain the state-transition diagram of the corresponding Mealy machine.
<table>
<tr><td>Present State</td><td colspan="2">Next State</td><td>Output</td></tr>
<tr><td></td><td>$a=0$</td><td>$a=1$</td><td></td></tr>
<tr><td>$\rightarrow a$</td><td>d</td><td>b</td><td>1</td></tr>
<tr><td>b</td><td>a</td><td>d</td><td>0</td></tr>
<tr><td>c</td><td>c</td><td>c</td><td>0</td></tr>
<tr><td>d</td><td>b</td><td>a</td><td>1</td></tr>
</table></td><td>10</td><td>CO5</td></tr>
<tr><td>Q9.</td><td>Convert the following context free grammar into Chomsky normal form by documenting all the steps in detail.
$S \rightarrow a \mid aA \mid B$
$A \rightarrow aBB \mid \epsilon$
$B \rightarrow Aa \mid b$
OR
State Pumping Lemma for regular languages and show that the language $L = \{ww^R \mid w\epsilon\{0,1\}^*\}$ is not regular.</td><td>10</td><td>CO4</td></tr>
<tr><td colspan="4">SECTION-C
(2Qx20M=40 Marks)</td></tr>
<tr><td>Q10.</td><td>(a) Discuss in detail the Noam Chomsky classification of grammar explaining the production rules in each case with relevant examples.
(b) Define pushdown automata (PDA). Design a PDA for the context free language $L = \{a^n b^{2n} \mid n \geq 1\}$.</td><td>20</td><td>CO4</td></tr>
<tr><td>Q11.</td><td>Define Turing machine and design a Turing machine for the language $L = \{wcw \mid w\epsilon\{a,b\}^*\}$.
OR
Discuss various types of Turing machines and Post’s correspondence problem. Show that PCP problem with 2 lists given by $x = (b, ba^3, ba)$ and $y = (b^3, ba, a)$ has a solution.</td><td>20</td><td>CO5</td></tr>
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