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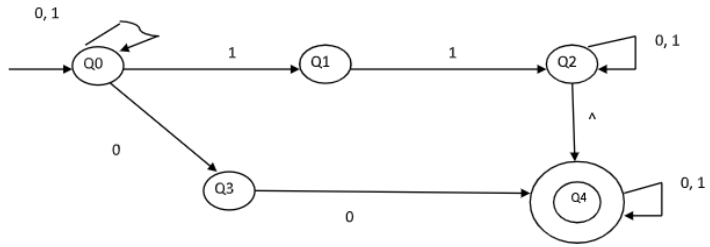
**BTECH**  
**(SEM IV) THEORY EXAMINATION 2021-22**  
**THEORY OF AUTOMATA AND FORMAL LANGUAGES**

**Time: 3 Hours****Total Marks: 100****Notes:**

- Attempt all Sections and Assume any missing data.
- Appropriate marks are allotted to each question, answer accordingly.

SECTION-A	Attempt All of the following Questions in brief	Marks (10X2=20)	CO
Q1(a)	What do you understand by $\epsilon$ - closure in FA?		1
Q1(b)	What are the applications of Finite automata?		1
Q1(c)	State Kleen theorem.		2
Q1(d)	Give the regular expression for set of all strings such that number of a's divisible by 3 over $\Sigma = (a,b)$		2
Q1(e)	Remove null production from the grammar S $\rightarrow$ aS/AB A $\rightarrow$ ^ B $\rightarrow$ ^ D $\rightarrow$ b		3
Q1(f)	What is Greibach Normal Form?		3
Q1(g)	Define Deterministic PDA.		4
Q1(h)	Explain two stack PDA.		4
Q1(i)	Explain Church Thesis.		5
Q1(j)	What are the tuples of a Turing Machine?		5

SECTION-B	Attempt ANY THREE of the following Questions	Marks (3X10=30)	CO
Q2(a)	Construct a DFA accepting all strings w over $\{0, 1\}$ such that the number of 1's in w is $3 \pmod 4$ .		1
Q2(b)	Design a mealy machine that accepts binary string divisible by 3.		2
Q2(c)	Explain Chomsky hierarchy of languages.		3
Q2(d)	Obtain a CFG that generates the language accepted (by final state) by the NPDA with following transitions: $\delta(q_0, a, z) = \{(q_0, Az)\}$ $\delta(q_0, a, A) = \{(q_0, A)\}$ $\delta(q_0, b, A) = \{(q_1, \epsilon)\}$ $\delta(q_1, \epsilon, z) = \{(q_1, \epsilon)\}$ q <sub>0</sub> is the initial state and q <sub>1</sub> is the final state.		4
Q2(e)	What are the ways of representations of Turing Machines?		5

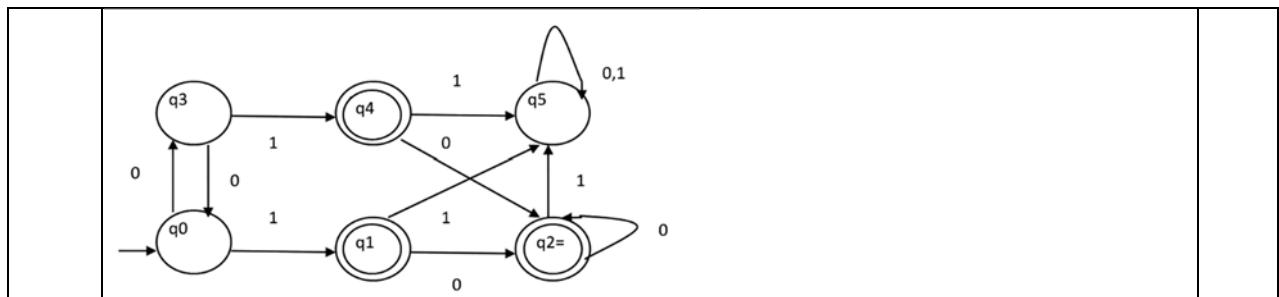
SECTION-C	Attempt ANY ONE following Question	Marks (1X10=10)	CO
Q3(a)	Construct a DFA equivalent to the NFA 		1
Q3(b)	Obtain DFA with minimum number of states which accepts the same language which is accepted by the following DFA		1



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SECTION-C	Attempt ANY ONE following Question	Marks (1X10=10)	CO
Q4(a)	Prove that $L = \{ a^p : p \text{ is prime} \}$ is not regular?		2
Q4(b)	State and prove Arden's theorem.		2

SECTION-C	Attempt ANY ONE following Question	Marks (1X10=10)	CO
Q5(a)	Let G be a grammar $S \rightarrow aB \mid bA$ $A \rightarrow a \mid aS \mid bAA$ $B \rightarrow b \mid bS \mid aBB$ For string aaabbabbba find (a) Left Most Derivation (b) Right Most Derivation (c) Parse Tree (d) Is the grammar unambiguous?		3
Q5(b)	Explain Closure properties of Context free language.		3

SECTION-C	Attempt ANY ONE following Question	Marks (1X10=10)	CO
Q6(a)	Construct Pushdown automata for the language $L = \{ wcw^R \mid w \text{ is in } (a + b)^* \}$ . Give instantaneous description of the input abcba.		4
Q6(b)	Define and Design 2-stack PDA for language $L = \{ \{ a^n b^n c^n \mid n \geq 1 \}$		4

SECTION-C	Attempt ANY ONE following Question	Marks (1X10=10)	CO
Q7(a)	Design transition diagram for the language $L = \{ a^n b^n c^n \mid n \geq 1 \}$ using Turing Machine. Give instantaneous description of the input aabbcc.		5
Q7(b)	Write Short note on the following i) Universal Turing Machine ii) Post Correspondence problem iii) Halting problem of Turing machine		5