PAPER ID-411426

Subject Code: KCS402

Roll No: | | | | | | | | | | | | | |

**BTECH**

**(SEM IV) THEORY EXAMINATION 2023-24**

**THEORY OF AUTOMATA AND FORMAL LANGUAGES**

**TIME: 3 HRS** **M.MARKS: 100**

Note: 1. Attempt all Sections. If require any missing data; then choose suitably.

**SECTION A**

**1. Attempt *all* questions in brief.** **2 x 10 = 20**

| Q no. | Question | Marks | CO |
|---|---|---|---|
| a. | Design a FA to accept the string that always ends with 010. | 02 | 1 |
| b. | With example defines "Automata". | 02 | 1 |
| c. | Explain Chomsky Hierarchy | 02 | 2 |
| d. | Write a regular expression for set of all strings such that number of a's divisible by 3 over ∑ = {a,b} | 02 | 2 |
| e. | Construct the CFG for the Language = $\{a^{3n} b^{n} \mid n>=3\}$ | 02 | 3 |
| f. | Explain "Pumping Lemma" for Regular Languages. | 02 | 3 |
| g. | What is PDA? Also write its transition function. | 02 | 4 |
| h. | Draw the graphical representation two stack PDA. | 02 | 4 |
| i. | Differentiate between Recursive & Recursive Enumerable Languages. | 02 | 5 |
| j. | Explain Post Correspondence Problem with suitable example. | 02 | 5 |

**SECTION B**

**2. Attempt any *three* of the following:** **3 x 10 = 30**

| | | | |
|---|---|---|---|
| a. | State and Prove Klein's Theorem. Also, explain its purpose with a suitable example | 10 | 2 |
| b. | Write the procedure to convert a given CFG into equivalent grammar in CNF. Apply the procedure and convert the grammar with following production into CNF:<br>S→ABD\|AC<br>A→aA\|bAa\|a<br>B→bbA\|aB\|AB<br>C→aCa\|aD<br>D→ aD\| bC | 10 | 3 |
| c. | Design a Turing machine for the language L=wcw/ {w ∈ {a, b}*. | 10 | 5 |
| d. | Construct a PDA "M" equivalent to grammar with following productions:<br>S → AA, A → aS / bS/ a<br>Also, check whether the string 'abaaaa' is in M or not | 10 | 4 |
| e. | What are various points of difference between Moore & Mealy Machine? Explain the procedure to convert a moore machine into Mealy machine | 10 | 1 |

**SECTION C**

**3. Attempt any *one* part of the following:** **1 x 10 = 10**

| | | | |
|---|---|---|---|
| a. | Construct a minimum state automata equivalent to a DFA whose transition table is as follows where Q3 and Q4 are final state | 10 | 1 |

| State/∑ | Input | |
|---|---|---|
| | A | B |
| Q0 | Q1 | Q2 |
| Q1 | Q4 | Q3 |
| Q2 | Q4 | Q3 |
| Q3 | Q5 | Q6 |
| Q4 | Q7 | Q6 |
| Q5 | Q3 | Q6 |
| Q6 | Q6 | Q6 |
| Q7 | Q4 | Q6 |

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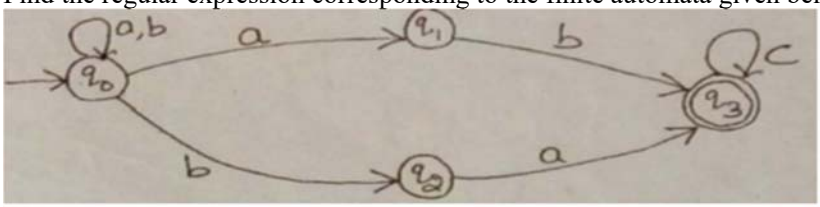
| | | | |
|---|---|---|---|
| b. | Design FA for the following languages containing binary strings:<br>(i) Every String accepted must end with "aa" or "bb".<br>(ii) Accepts all the strings with "ab" and \|w\| = 3(mod4). | 10 | 1 |

**4. Attempt any *one* part of the following: 1 x 10 = 10**

| | | | |
|---|---|---|---|
| a. | Find the regular expression corresponding to the finite automata given below<br>  | 10 | 2 |
| b. | Prove that for all sets<br>i) ( $((S^+))^+$ ii) (S+)* =S* | 10 | 2 |

**5. Attempt any *one* part of the following: 1 x 10 = 10**

| | | | |
|---|---|---|---|
| a. | Define Greibach normal form for a CFG. Reduce the following CFG into GNF:<br>S → AB, A→ BS \|a, B → SA\| b | 10 | 3 |
| b. | State pumping lemma for context free language. Prove that the language L= {a^nb^nc^n \| n>=0} is not context free. | 10 | 3 |

**6. Attempt any *one* part of the following: 1 x 10 = 10**

| | | | |
|---|---|---|---|
| a. | Generate CFG for the given PDA M is defined as M = ({q0, q1}, {0,1} {x, z0}, δ, q0, z0, q1) where δ is given as follows:<br>δ (q0,1, z0) = (q0, xz0)<br>δ (q0,1, x) = (q0, xx)<br>δ (q0,0, x) = (q0, x)<br>δ (q0, ε, x) = (q1, ε)<br>δ (q1, ε, x) = (q1, ε)<br>δ (q1,0, x) = (q1, xx)<br>δ (q1,0, z0) = ( q1, ε) | 10 | 4 |
| b. | Construct a PDA from the following CFG. G = ({S, X}, {a, b}, P, S) where the productions are<br>S → XS \| ε , A → aXb \| Ab \| ab | 10 | 4 |

**7. Attempt any *one* part of the following: 1 x 10 = 10**

| | | | |
|---|---|---|---|
| a. | Design a Turing Machine for the language: L={$a^n b^n c^n$ \| n>=1} | 10 | 5 |
| b. | Write short notes on:<br>(i) Multidiamentional and Multitape Turing Machine<br>(ii) Halting Problem | 10 | 5 |