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# B.M.S. College of Engineering, Bengaluru-560019

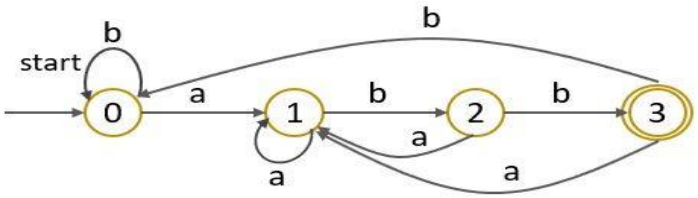
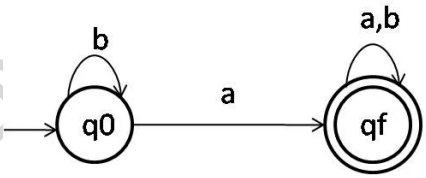
**Autonomous Institute Affiliated to VTU**

## October 2024 Supplementary Examinations

**Programme: B.E.** **Semester: IV**
**Branch: Information Science and Engineering** **Duration: 3 hrs.**
**Course Code: 23IS4ESTFC** **Max Marks: 100**
**Course: Theoretical Foundations of Computation**

**Instructions**: 1. Answer any FIVE full questions, choosing one full question from each unit.
2. Missing data, if any, may be suitably assumed.

**Important Note:** Completing your answers, compulsorily draw diagonal cross lines on the remaining blank pages. Revealing of identification, appeal to evaluator will be treated as malpractice.

| | | UNIT - I | CO | PO | Marks |
|---|---|---|---|---|---|
| 1 | a) | Identify the languages accepted by the following DFAs.<br>i.<br>  <br><br>ii.<br>  <br> | CO2 | PO2 | 4 |
| | b) | Construct DFA for the following languages:<br>i.) L= {1w0 \| w is the set of strings with 0's and 1's}<br>ii.) L = {w \| w is the set of binary strings divisible by 5<br>Show the acceptance and rejection with sample strings. | CO3 | PO2 | 8 |
| | c) | Obtain equivalent DFA for the following **Ɛ** -NFA.<br><br>**δ** \| **Ɛ** \| **a** \| **b**<br>**→1** \| **2** \| **ϕ** \| **ϕ**<br>**2** \| **ϕ** \| **3,4** \| **ϕ**<br>**3** \| **2** \| **ϕ** \| **4**<br>**4** \| **3,5** \| **5** \| **ϕ**<br>***5** \| **ϕ** \| **ϕ** \| **ϕ** | CO1 | PO1 | 8 |
| | | **OR** | | | |

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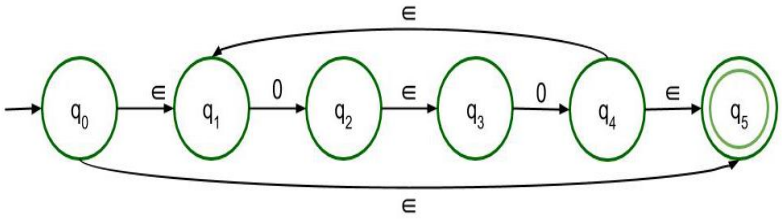
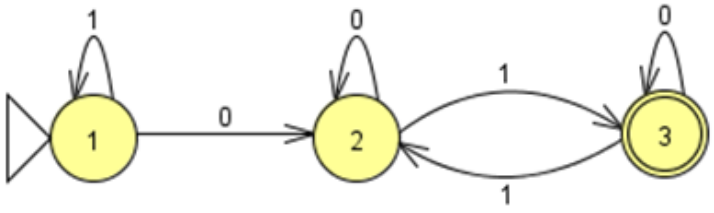
| | 2 | a) | Define **Ɛ** -Closure. Determine the **Ɛ** -Closures for all states in the **Ɛ**-NFA.<br>  <br> | ***CO1*** | ***PO1*** | **6** |
| | | b) | Construct NFA for the language accepting all strings ending with "aab" for Σ = {a,b} and convert it to equivalent DFA. | ***CO2*** | ***PO1*** | **6** |
| | | c) | Minimize the following DFA:<br>**δ** \| **a** \| **b**<br>**→A** \| **B** \| **F**<br>**B** \| **G** \| **C**<br>***C** \| **A** \| **C**<br>**D** \| **C** \| **G**<br>**E** \| **H** \| **F**<br>**F** \| **C** \| **G**<br>**G** \| **G** \| **E**<br>**H** \| **G** \| **C** | ***CO1*** | ***PO1*** | **8** |
| | | | **UNIT - II** | | | |
| | 3 | a) | Provide English description to identify the language for the following:<br>(i) aa (a+b)*(bb+ a)<br>(ii) (ε+a+b) (ε+a+b) (ε+a+b) (ε+a+b)<br>(iii) $(0+1)^*1(0+1)^4$ | ***CO2*** | ***PO2*** | **6** |
| | | b) | Obtain regular expression for the following FA by eliminating states.<br>  <br> | ***CO1*** | ***PO1*** | **8** |
| | | c) | Using Pumping Lemma, prove that the given language is not regular.<br>L = { $0^n1^n$ \| where n >= 1} | ***CO1*** | ***PO1*** | **6** |
| | | | **UNIT - III** | | | |
| | 4 | a) | Write Grammars for the following languages:<br>i.) $L(G) = \{a^m b^n \mid m \geq 0 \text{ and } n > 0\}$<br>ii.) $L(G) = \{w \mid w \in \{0, 1, 2\}* \text{ and is a palindrome}\}$<br>iii.) $L(G) = \{a^n b^{2n} \mid n>=1\}$ | ***CO3*** | ***PO2*** | **6** |

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| | | b) | Determine whether the given grammars G1 and G2 is ambiguous or not<br>G1= { S->aS \| aSbS \| Ɛ }<br>G2= {S-> SS \| (S) \| a } | *CO1* | *PO1* | **10** |
| | | c) | Eliminating Useless Symbols in the grammar given below:<br>S → aaB \| abA \| aaS<br>A → aA<br>B → ab \| b<br>C → ad | *CO1* | *PO1* | **4** |
| | | | **OR** | | | |
| | 5 | a) | Write the LMD and RMD and respective Parse trees for the string "ibtibtaeibta" from the CFG:<br>S→ iCtS \| iCtSeS \| a<br>C→ b | *CO1* | *PO1* | **7** |
| | | b) | For the given grammar:<br>S → ABC \| BaB<br>A → aA \| BaC \|aaa<br>B → bBb \| a \|D<br>C → CA \|AC<br>D →ε<br>(i) Eliminate ε-productions.<br>(ii) Eliminate any unit productions in the resulting grammar.<br>(iii) Eliminate any useless symbols in the resulting grammar.<br>(iv) Convert the resulting grammar into Chomsky Normal Form. | *CO1* | *PO1* | **8** |
| | | c) | Summarize on the different types of grammar. | *CO1* | *PO1* | **5** |
| | | | **UNIT - IV** | | | |
| | 6 | a) | Define Deterministic push down automate. Write the conditions to show whether a PDA is deterministic or not. | *CO1* | *PO1* | **5** |
| | | b) | Design a PDA to accept the language<br>L={w \| $n_a$ (w) = $n_b$ (w)}by final state<br>Write the instantaneous description for the string "abbabbaa" | *CO2* | *PO1* | **10** |
| | | c) | Convert the following CFG to PDA.<br>S→ aABB\| aAA<br>A→ aBB\| a<br>B→ bBB\| aA<br>C→ a | *CO1* | *PO1* | **5** |
| | | | **UNIT - V** | | | |
| | 7 | a) | Design Turing Machine to accept the language L= {$0^n1^n2^n$ \| n>=1}. Provide instantaneous description for acceptance of the string ,"001122". | *CO3* | *PO2* | **12** |
| | | b) | Design a Turing machine to accept a palindrome containing 0's and 1's of any length. Write the instantaneous description for the string "0110" | *CO3* | *PO2* | **8** |

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