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

**Autonomous Institute Affiliated to VTU**

## June 2025 Semester End Main Examinations

**Programme: B.E.** **Semester: IV**

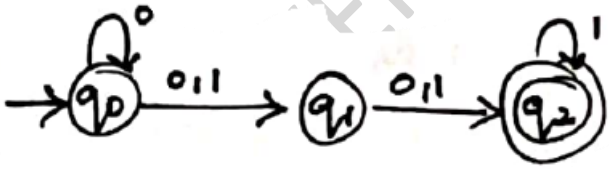
**Branch: CS(ICB)/CS(AIDS)/CS(DS)** **Duration: 3 hrs.**

**Course Code: 23DC4ESTOC** **Max Marks: 100**

**Course: Theory 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) | Enumerate on<br>i) Strings ii) Language iii) Alphabet iv) Power of an alphabet. | CO1 | PO1 | **04** |
| | b) | Design a DFA with strings of a's and b's ending with 'ab' or 'ba'. | CO3 | PO3 | **08** |
| | c) | Convert the following NFA to equivalent DFA.<br>  | CO2 | PO2 | **08** |
| | | **OR** | | | |
| 2 | a) | Distinguish between DFA, NFA and ϵ-NFA. | CO1 | PO1 | **04** |
| | b) | Construct a DFA which accepts strings of 0's and 1's where the value of each string is represented as a binary number. Only the strings representing zero modulo five should be accepted. | CO3 | PO3 | **08** |
| | c) | You are developing a part of a network protocol verifier that checks packet IDs encoded as binary strings. A packet ID is valid if it:<br>• Contains an even number of 0s<br>• AND ends with a 1<br>Construct a DFA. | CO3 | PO3 | **08** |
| | | **UNIT - II** | | | |
| 3 | a) | Minimize the following DFA. | CO1 | PO1 | **10** |

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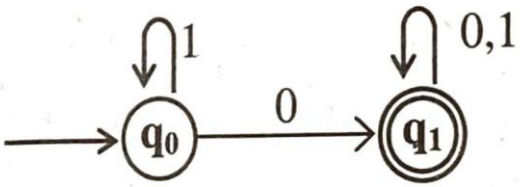
| | | | <table><tr><th>δ</th><th>0</th><th>1</th></tr><tr><td>→A</td><td>B</td><td>E</td></tr><tr><td>B</td><td>C</td><td>F</td></tr><tr><td>*C</td><td>D</td><td>H</td></tr><tr><td>D</td><td>E</td><td>H</td></tr><tr><td>E</td><td>F</td><td>I</td></tr><tr><td>*F</td><td>G</td><td>B</td></tr><tr><td>G</td><td>H</td><td>B</td></tr><tr><td>H</td><td>I</td><td>C</td></tr><tr><td>*I</td><td>A</td><td>E</td></tr></table> | | | |
| | b) | i. State and prove Pumping Lemma for regular languages.<br>ii. Show that L={ww$^R$\|w ∈(0+1)*} is not regular. | *CO1* | *PO1* | **10** |
| | | **OR** | | | |
| 4 | a) | Solve to obtain a Regular Expression from the given Finite State Machine.<br>  | *CO1* | *PO1* | **10** |
| | b) | Obtain Regular Expressions for the following languages:<br>i. L ={a$^n$b$^m$ \| m≥ 1, n ≥ 1, nm ≥ 3 }<br>ii. L ={w : \|w\| mod 3 = 0 where w ∈ (a,b)*} | *CO3* | *PO3* | **06** |
| | c) | Prove that(1+00*1)+(1+00*1)(0+10*1)* (0+10*1) is equal to 0*1(0+10*1)* | *CO2* | *PO2* | **04** |
| | | **UNIT - III** | | | |
| 5 | a) | Solve to obtain grammar to generate the language<br>L={a$^n$b$^m$ \| n≥ 0, m>n } | *CO3* | *PO3* | **05** |
| | b) | Is the following grammar ambiguous?<br>S→aB\|bA<br>A→ aS\|bAA\|a<br>B→bS\|aBB\|b<br>Consider the string "aaabbabbba" | *CO2* | *PO2* | **07** |
| | c) | Convert Context-Free Grammar to Chomsky Normal Form<br>S->0A\|1B<br>A->0AA\|1S\|1<br>B->1BB\|0S\|0 | *CO1* | *PO1* | **08** |
| | | **OR** | | | |
| 6 | a) | Obtain a grammar to generate the language<br>L={0$^m$1$^m$2$^n$ \| m≥ 1, n≥0 } | *CO3* | *PO3* | **05** |
| | b) | In programming constructs, an identifier can be a variable name or a function name etc. An identifier is defined as that which starts | *CO2* | *PO2* | **05** |

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| | | | with a letter and that letter can be followed by any combinations of letters or digits.<br>Design a Context Free Grammar to accept an identifier. | | | |
| | | c) | Convert Context Free Grammar to Greibach Normal Form.<br>S→ASA\|aB<br>A→B\|S\|a<br>B→b\|ϵ | *CO1* | *PO1* | **10** |
| | | | **UNIT - IV** | | | |
| | 7 | a) | i. Design a PDA for L={$a^n$, $b^{2n}$\|n ≥1}<br>ii. Write the instantaneous description for the string "aabbbb"<br>Is the PDA of (i) deterministic? | *CO3* | *PO3* | **10** |
| | | b) | For the given grammar obtain PDA<br>• S->aABB\|aAA<br>• A->aBB\|a<br>• B->bBB\|aBB\|a<br>• C->a | *CO2* | *PO2* | **10** |
| | | | **OR** | | | |
| | 8 | a) | Obtain a PDA to accept the language L(M)={w$Cw^R$\| w ∈ (a+b)*} where $w^R$ is reverse of w. | *CO1* | *PO1* | **10** |
| | | b) | Obtain a CFG from given PDA.<br>• $\delta(q_0, a, Z)=(q_0,AZ)$<br>• $\delta(q_0, b, A)=(q_0,AA)$<br>• $\delta(q_0, a, A)=(q_1, \varepsilon)$ | *CO1* | *PO1* | **06** |
| | | c) | Show that Context Free Languages are not closed under Intersection | *CO2* | *PO2* | **04** |
| | | | **UNIT - V** | | | |
| | 9 | a) | Obtain a TM to accept a string w of a's and b's such that $N_a(w)$ is equal to $N_b(w)$. | *CO3* | *PO3* | **12** |
| | | b) | Deduce how multi-tape and single-tape multi-track Turing Machines are identical. | *CO2* | *PO2* | **04** |
| | | c) | Determine whether a Post Correspondence Solution exists for the following data.<br>$A_1$=1, $A_2$ =10111, $A_3$=10<br><br>$B_1$=111, $B_2$=10, $B_3$=0 | *CO1* | *PO1* | **04** |
| | | | **OR** | | | |
| | 10 | a) | Obtain a TM to multiply two unary numbers separated by a delimiter 1. | *CO3* | *PO3* | **12** |
| | | b) | Design a TM that computes the function<br>• f (x, y)= x+y if x≥y<br>• f (x, y)=xx if x < y | *CO3* | *PO3* | **08** |

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