| U.S.N. | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|

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

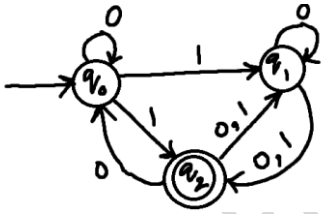
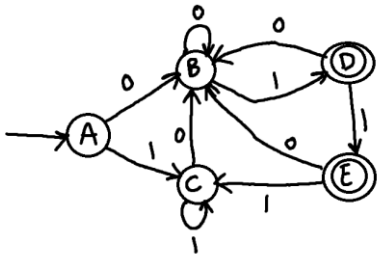
**Autonomous Institute Affiliated to VTU**

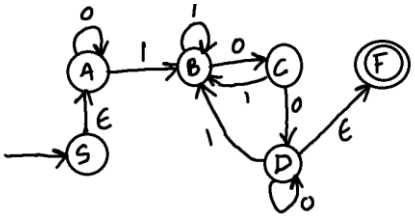
## October 2024 Supplementary Examinations

**Programme: B.E.** **Semester: III**
**Branch: Artificial Intelligence and Machine Learning** **Duration: 3 hrs.**
**Course Code: 23AM3AETFC** **Max Marks: 100**
**Course: Theoretical Foundations of Computations**

**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) | | i. Design a Deterministic Finite Automaton (DFA) to accept the strings of the language L(M) = {$a^n$b, n>=0}<br>ii. Illustrate the acceptance and rejection of the strings "aaab" and "aba" by the resultant DFA using the instantaneous descriptions. | *CO1* | *PO1* | **08** |
| | b) | | Convert the given Non-Deterministic Finite Automaton (NFA) to DFA<br>  | *CO1* | *PO1* | **06** |
| | c) | | Differentiate between DFA, NFA and ϵ-NFA | *CO2* | *PO2* | **06** |
| | | | **OR** | | | |
| 2 | a) | | Design NFA for the language L(M) = 01*0*1 | *CO3* | *PO3* | **06** |
| | b) | | Minimize the DFA<br>  | *CO1* | *PO1* | **06** |
| | c) | | Construct an ϵ-NFA that accepts decimal numbers consisting of<br>i. An optional +/- sign<br>ii. A string of digits<br>iii. A decimal Point<br>iv. Another string of digits followed by (iii) [Note: either this string or the string in (ii) can be empty, but not both]<br>and convert the same to its equivalent DFA representation. | *CO3* | *PO3* | **08** |

| | | | | | | |
|---|---|---|---|---|---|---|
| | | | **UNIT - II** | | | |
| | 3 | a) | Convert the given regular expressions to equivalent NFA<br>i. (a\|b)*ab<br>ii. (ab\|ba)* | *CO2* | *PO2* | **06** |
| | | b) | Construct the regular expression of the automaton using state elimination technique.<br>  <br> | *CO1* | *PO1* | **10** |
| | | c) | Show that the language L = {$WW^R$ \| W (0+1)*} is not regular | *CO2* | *PO2* | **04** |
| | | | **UNIT - III** | | | |
| | 4 | a) | Derive a sample string accepted by the given grammar and verify whether the grammar is ambiguous or not.<br>S → a \| abSb \| aAb<br>A → bS \| aAAb | *CO2* | *PO2* | **04** |
| | | b) | Define Chomsky Normal Form (CNF) and convert the given grammar to CNF. Verify the grammar suitability for CNF representation before starting the conversion process.<br><br>S → AB \| DDA \| CB \| DD<br>A → CCD<br>B → DDA \| DD<br>C → a<br>D → b | *CO3* | *PO3* | **08** |
| | | c) | i. Outline the procedure for eliminating unit productions from CFG.<br>ii. Apply the stated procedure to the CFG<br>S → Aa \| B<br>B → A \| bb<br>A → a \| bc \| B | *CO3* | *PO3* | **08** |
| | | | **OR** | | | |
| | 5 | a) | Show that the language L={$0^P$ \| P is prime} is not Context Free. | *CO2* | *PO2* | **04** |
| | | b) | Define Greibach Normal Form (GNF) and convert the given grammar to GNF after verifying all the necessary pre-requisite conditions.<br>S → aY \| XX<br>X → aZ \| aYXZ \| a \| aYX<br>Z → XXZ \| XX<br>Y → b<br>A → a | *CO3* | *PO3* | **08** |
| | | c) | Eliminate useless symbols from the CFG by justifying the eliminations with proper reasoning.<br>S → AB \| AC | *CO3* | *PO3* | **08** |

| | | | | | | |
|---|---|---|---|---|---|---|
| | | | A → aAb \| bAa \| a<br>B → bbA \| aaB \| AB \| b<br>E → d<br>C → abCA \| aDb<br>D →bD \| aC | | | |
| | | | **UNIT - IV** | | | |
| | 6 | a) | Design a Push Down Automata (PDA) to accept the language $L=\{a^n b^{2n} \mid n\geq 0\}$ | *CO3* | *PO3* | **08** |
| | | b) | Obtain CFG for the PDA: P = ({p,q}, {0,1}, {X,Z}, δ, q, Z) with the transitions<br>δ(q, 1, Z) = {(q, XZ)}<br>δ(q, 1, X) = {(q, XX)}<br>δ(q, ε, X) = {(q, ε)}<br>δ(q, 0, X) = {(p, X)}<br>δ(p, 1, X) = {(p, ε)}<br>δ(p, 0, Z) = {(q, Z)} | *CO3* | *PO3* | **08** |
| | | c) | Elaborate on the instantaneous description of a PDA. | *CO2* | *PO2* | **04** |
| | | | **UNIT - V** | | | |
| | 7 | a) | Determine a Turing Machine (TM) to represent the addition function of a unary number system. | *CO3* | *PO3* | **08** |
| | | b) | Does Post Correspondence Problem with two lists W = (b, $bab^3$, ba) and X = ($b^3$, ba, a) have a solution? | *CO2* | *PO2* | **06** |
| | | c) | Explain how TM can be combined to solve the complicated tasks. | *CO2* | *PO2* | **06** |

**********