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

Autonomous Institute Affiliated to VTU

May 2023 Semester End Main Examinations

Programme: B.E. **Semester: III**
Branch: Artificial Intelligence and Machine Learning **Duration: 3 hrs.**
Course Code: 22AM3PCTFC **Max Marks: 100**
Course: Theoretical Foundations of Computations **Date: 12.05.2023**

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

1 a) Design a Deterministic Finite Automaton (DFA) to accept **12**

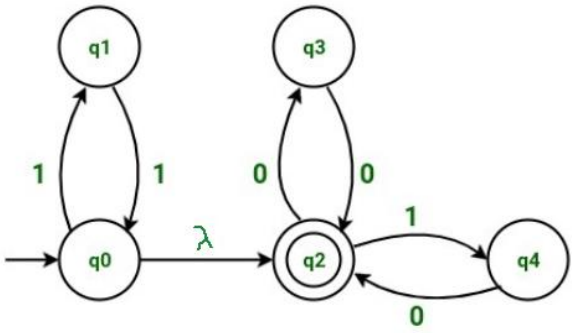
i) strings consisting of even number of 0's and even number of 1's
ii) strings starting with a prefix ab
iii) strings containing 001 as a substring

b) Convert the following NFA to its equivalent DFA. **8**

δ	a	b
→p	{p,q}	{q}
q	{q}	{r}
*r	{r}	{r}

OR

2 a) Convert the given λ -NFA to DFA and explain the conversion steps theoretically. **10**



b) Consider the given language L = {w, w mod 5=0, ∑ = {0, 1} and Construct a DFA which accepts strings of 0's & 1's where each string is represented as binary number. **10**

UNIT – II

3 a) Write the Regular Expression (RE) to accept set of all strings **4**

i) over the alphabet {a,b,c} consisting of atleast one 'a' and atleast one 'b'

ii) over the alphabet {0,1} where every pair of adjacent 0's appear before any pair of adjacent 1's

b) Convert the given RE to its equivalent NFA with λ transitions **6**

i) (0+1)*1(0+1)

ii) (a+bb)*(ba*+ λ)

c) Minimize the given DFA by applying suitable procedure. **10**

δ	q_0	q_1	q_2	$*q_3$	q_4	$*q_5$
0	q_1	q_0	q_1	q_5	q_3	q_5
1	q_3	q_3	q_4	q_5	q_3	q_5

UNIT - III

4 a) Design Context Free Grammar (CFG) to accept the following languages **6**

i. L = { $a^n b^{n-4}$, n >= 4}

ii. L = {$0^i 1^j$, i ≠ j , i >= 0 , j >=0 }

b) Check whether the given grammar is ambiguous or not. If not then, convert it into CNF form by applying the sequence of conversion steps accordingly **10**

S → ASB | λ A → aAS | a B → SbS |A | bb

c) prove that the language is not a Context Free Language (CFL). **4**

L = {$a^i b^i c^i$ | i>=0}

UNIT - IV

5 a) Define Push Down Automata (PDA). Design a PDA which accepts equal number of a's and b's over ∑ = {a,b} **10**

b) Consider the transition functions given below and convert the PDA : **10**

P = ({p,q}, {0,1}, {X,Z}, δ, q, Z) to its equivalent CFG representation.

δ(q, 1, Z) = (q, XZ)

δ(q, 1, X) = (q, XX)

δ(q, λ , X) = (q, λ)

δ(q, 0, X) = (p, X)

δ(p, 1, X) = (p, λ)

δ(p, 0, Z) = (q, Z)

OR

6 a) Obtain PDA for the given CFG by applying suitable conversion procedures. **10**

$S \rightarrow aABC \quad A \rightarrow aB \mid a \quad B \rightarrow bA \mid b \quad C \rightarrow a$

b) Design a Non-Deterministic PDA (NPDA) for accepting balanced parenthesis. Using the Instantaneous Descriptions, show that the resultant NPDA will accept the string ([ ])[ ] **10**

UNIT - V

7 a) Design a Turing Machine to accept the language $L(M) = \{0^n1^n2^n \mid n>=1\}$ **10**

b) Differentiate between **10**

i) Multi-tape and Multi-dimensional Turing Machine
ii) Deterministic and Non-Deterministic Turing Machines

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