Register No.: ..... Name: .....

SAINTGITS COLLEGE OF ENGINEERING (AUTONOMOUS)

(AFFILIATED TO APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY, THIRUVANANTHAPURAM)

FIFTH SEMESTER B.TECH DEGREE EXAMINATION (R,S), DECEMBER 2023

COMPUTER SCIENCE AND ENGINEERING

(2020 SCHEME)

CourseCode: **20CST301**

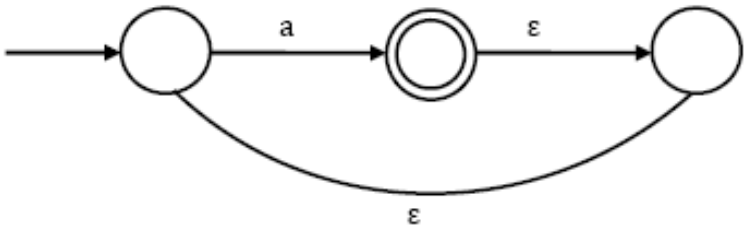
CourseName: **Formal Languages and Automata Theory**

Max. Marks : **100** **Duration: 3 Hours**

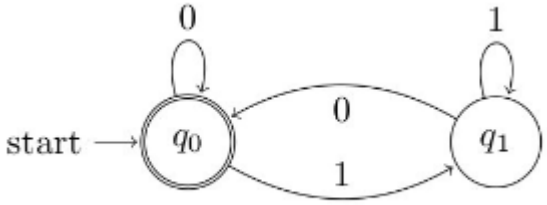
PART A

(Answer all questions. Each question carries 3 marks)

1. Consider X and Y are two languages over alphabet {0, 1} represented by regular expression 0*(10*)* and (0* + 1*)* respectively. Is X =Y? Justify your answer with proper proof.
2. What is the complement of the language accepted by the NFA shown below? Assume ∑ = {a} and ε is the empty string



3. Identify the language accepted by the following DFA?



4. Obtain the regular expression for the following set: $\{b^2, b^5, b^8, \ldots\ldots\}$
5. Write the equivalent Context Free grammar for the following regular expression: (00 + 11 + 10 + 01)*
6. Assume that you are asked to design a comment statement for a C programming language. Comments appear between the delimiters such as **/*and */.** For simplicity, assume the alphabet Σ={a,b,/,*}. Give an NFA that recognises the language.
7. Consider the following grammar (the start symbol is S; the alphabets are implicit in the rules):

S-->SS|AAA|ε
A -->aA|Aa|b
Is the grammar ambiguous? Prove.

8. Distinguish between decidable and undecidable problems.

9. Eliminate left recursion from the following grammar:

$A \rightarrow Ba / Aa / c$

$B \rightarrow Bb / Ab / d$

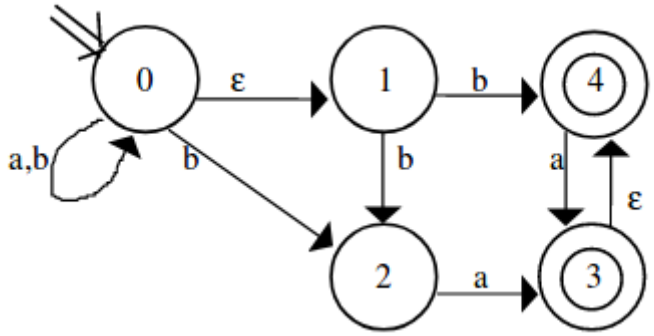
10. Give a deterministic PDA to accept the language L = { $0^n1^m0^n$ | n, m > 0}

PART B

(Answer one full question from each module, each question carries 14 marks)

MODULE I

11. a) Convert the Ɛ-NFA to DFA.



(10)

b) What is dead or trap state? Explain with an example. (4)

OR

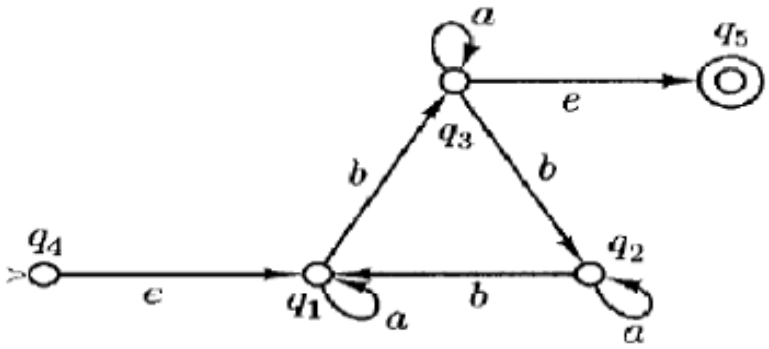
12. a) Design a DFA for the language aba*. Also show that the DFA works fine while tracing the instance abaa. (7)

b) Design a DFA for language
L={w ϵ {a, b} | each a in w is immediately preceded and immediately followed by b} (7)

MODULE II

13. a)
Write regular expressions for the following language
i) All strings that contain an even number of b's.
ii) L = {w|w contains at least two 0's and at most one 1 }.
iii) The set of strings of 0's and 1's with at most one pair of consecutive 1's. (6)

b) Find the Regular Expression from the NFA given below: (8)



OR

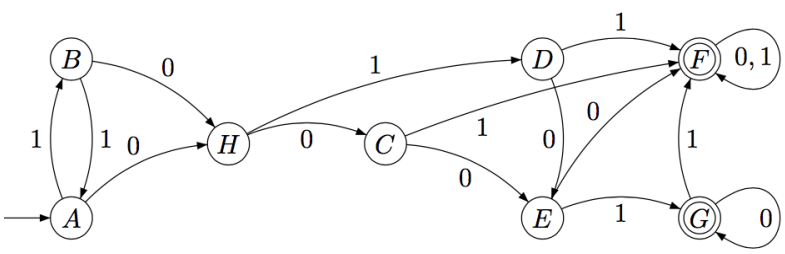
14. a) Find the minimal DFA for the following automata. (12)

Current State	a	b
→q0	q5	q1
q1	q2	q6
*q2	q2	q0
q3	q6	q2
q4	q5	q7
q5	q6	q2
q6	q4	q6
q7	q2	q6

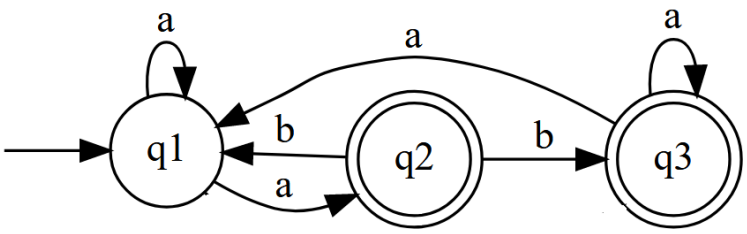
b) What will be the maximum number of states in a DFA whose equivalent NFA has k-states. Justify your answer. (2)

MODULE III

15. a) Using Myhill Nerode theorem , minimize the following DFA. (10)



b) Consider the following machine M. Does the machine accept the string ***'abaaba'***? Prove your answer.



(4)

OR

16. a) Convert the given Context Free grammar to Greibach Normal Form (GNF):

P→ RT|QQ
Q→d|PQ
R→d
T→b

(10)

b) Differentiate between Null and Unit production (4)

MODULE IV

17. a) Construct a Pushdown Automata that recognizes the language (7)

L={ w ∈ {0, 1}* | w = w^R and the length of w is odd }

b) Using the PDA constructed, check if the string **abbc is** accepted**.** (7)

OR

18. a) Give pushdown automata that recognize the following languages. (5)

A = { w ∈ {0, 1}* | w contains at least three 1s }

b) Let M be the PDA defined by

Q = {q0, q1, q2}
Σ = {a, b}
Γ = {A}
F = {q1, q2}

δ(q0, a, λ) = {[q0, A]}
δ(q0, λ, λ) = {[q1, λ]}
δ(q0, b, A) = {[q2, λ]}
δ(q1, λ, A) = {[q1, λ]}
δ(q2, b, A) = {[q2, λ]}
δ(q2, λ, A) = {[q2, λ]}

(9)

a) Describe the language accepted by M.
b) Give the state diagram of M.

MODULE V

19. a) Design a Turing machine that recognizes the languages:
All strings in the Language $0^n 1^n 2^n$, where n>=0: (8)

b) Elucidate different types of Turing Machines. (6)

OR

20. a) Let M be the Turing machine defined by δ:

δ	B	a	b	c
q_0	q_1,B,R			
q_1	q_2,B,L	q_1,a,R	q_1,c,R	q_1,c,R
q_2		q_2,c,L		q_2,b,L

(8)

Trace the computation for the input string ***aabca*** Give the state diagram of M.

b) Construct a Turing machine with input alphabet {a, b} to accept each of the following language by final state: (6)
L $\{a^i b^j \mid i \geq 0, j \geq i\}$

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