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

SAINTGITS COLLEGE OF ENGINEERING (AUTONOMOUS)

(AFFILIATED TO APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY, THIRUVANANTHAPURAM)

FIFTH SEMESTER B.TECH DEGREE EXAMINATION (S), FEBRUARY 2023
COMPUTER SCIENCE AND ENGINEERING
(2020 SCHEME)

Course Code : **20CST301**

Course Name: **Formal Languages and Automata Theory**

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

PART A

(Answer all questions. Each question carries 3 marks)

1. Define Non Deterministic Finite Automata? Compare its ability with Deterministic Finite Automata in accepting languages.
2. Design a Finite state automata which accepts all binary strings over {0, 1} that are divisible by 3.
3. Construct regular expression for the language that consists of all strings ending with 00. Assume $\Sigma = \{0, 1\}$
4. Define Ultimate Periodicity.
5. State Myhill-Nerode Theorem and its applications.
6. When do you say a CFG is ambiguous?
7. List any three Closure properties of Context Free Language.
8. Explain 2 types of language acceptance by PDA.
9. Write the formal definition of Context Sensitive Grammar. Write the CSG for the language $L = \{ a^n b^n c^n \mid n >= 1 \}$.
10. Write a note on Recursive Enumerable Languages.

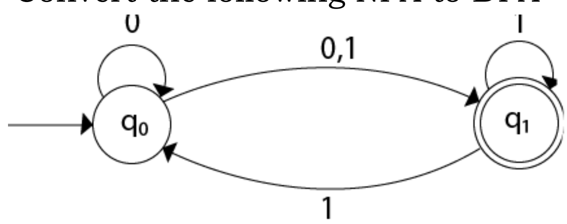
PART B

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

MODULE I

11. a) Prove the equivalence of non deterministic finite automata and deterministic finite automata. (9)

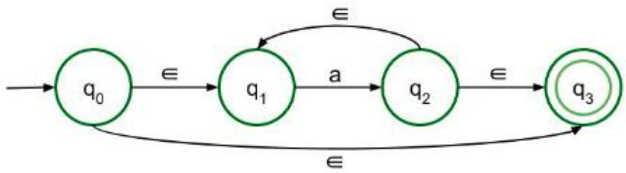
b) Convert the following NFA to DFA (5)



OR

12. a) Design a Finite state automata which accepts all strings over {0,1} with Odd number of 0's or even number of 1's. Show the changes needed to convert the above designed automata to accept, odd number of 0's and even number of 1's. (9)

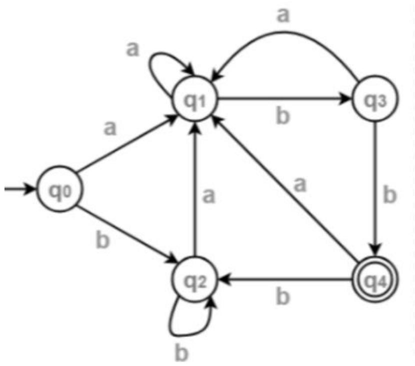
b) What is ε-closure? Find the ε-closure of the following NFA. (5)



MODULE II

13. a) Prove that L=(a^p | p is a prime number} is not regular. (7)

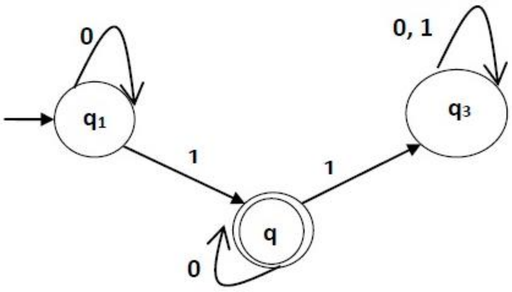
b) Minimize the following DFA using equivalence theorem. (7)



OR

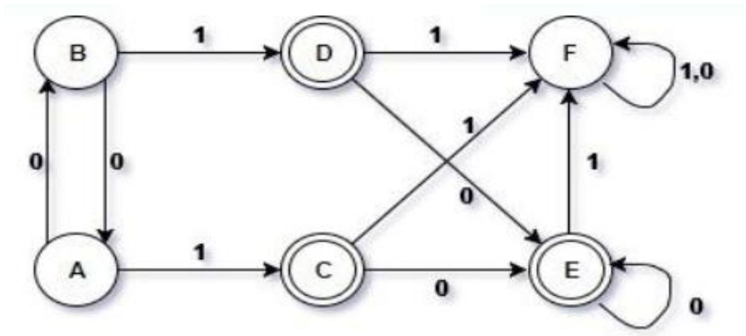
14. a) Design an ε-NFA for the regular expression (0+1)*01. (5)

b) State Arden's Theorem .Convert the following finite automata to regular expression. (9)



MODULE III

15. a) Minimize the following DFA by table filling method using Myhill-Nerode theorem describing the steps in detail. (10)



b) Write regular expression corresponding to following languages (4)

i) $L=\{a^n b^m \mid n>=4, m<=3\}$

ii) $L=\{w \in \sum^* \mid$ Every string in L begins with 00 and ends with 11 over $\sum=(0,1)\}$

OR

16. a) Convert the following CFG to Greibach Normal Form (7)

$S \rightarrow XA \mid BB$

$B \rightarrow b \mid SB$

$X \rightarrow b$

$A \rightarrow a$

b) Convert the following CFG into CNF (7)

$S \rightarrow ASA \mid aB$

$A \rightarrow B \mid S$

$B \rightarrow b \mid \varepsilon$

MODULE IV

17. a) Construct a Deterministic PDA for the language $L=ww^R$ *over* $\sum=\{a,b\}$. Is this a Deterministic PDA. Justify your answer. Otherwise how can we modify this language to make it accepted by DPDA. (10)

b) State pumping lemma for CFL. Write its application. (4)

OR

18. a) Compare context sensitive grammar and context free grammar. Can we design a PDA for context sensitive languages? Justify your answer. (6)

b) Convert the following PDA to equivalent CFG (8)

$\partial(q_0,a,Z_0)=(q_0,aZ_0)$

$\partial(q_0,b,Z_0)=(q_0,bZ_0)$

$\partial(q_0,a,a)=(q_0,aa)$

$\partial(q_0,b,b)=(q_0,bb)$

$\partial(q_0,a,b)=(q_0,\varepsilon)$

$\partial(q_0,b,a)=(q_0,\varepsilon)$

MODULE V

19. a) Design a Turing Machine over $\sum=\{0,1,2\}$ to accept $L=\{0^n1^n2^n \mid n>1\}$ (8)

    b) Explain different type of Turing Machine. (6)

OR

20. a) Prove that halting problem of Turing machine is undecidable. (8)

    b) Explain Chomsky's Hierarchy of Languages. (6)

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