B.Tech DEGREE EXAMINATION, MAY 2024

Third Semester

18CSC261T - FORMAL LANGUAGE AND AUTOMATA THEORY

(For the candidates admitted during the academic year 2018-2019 to 2021-2022)

Note:
i. **Part - A** should be answered in OMR sheet within first 40 minutes and OMR sheet should be handed over to hall invigilator at the end of 40th minute.
ii. **Part - B** and **Part - C** should be answered in answer booklet.

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

PART - A (20 × 1 = 20 Marks)
Answer **all** Questions

		Marks	BL	CO

1. Choose the RE for a language of any combination of 0's and 1's containing 1001 as a sub string.   (1, 2, 1)
   (A) L=(01)*1001(01)*
   (B) L=(0+1)*1001(0+1)*
   (C) L=(01)*1001(0+1)*
   (D) L=(0+1)*1001(01)*

2. _____ is the maximum number of states that an ε-NFA can have on ε moves.   (1, 2, 1)
   (A) n
   (B) 0
   (C) 1
   (D) n+!

3. I: DFA's can be constructed for all the languages
   II: The strings accepted by DFA will be accepted by NFA
   What can be said about these two statements?   (1, 1, 1)
   (A) Only II is false
   (B) Only I is false
   (C) I is false and II is false
   (D) Neither I nor II is false

4. Regular expression for all strings starts with ab and ends with bba is _____   (1, 1, 1)
   (A) aba*b*bba
   (B) ab(ab)*bba
   (C) ab(a+b)*bba
   (D) ab(ab)b*bba

5. Which of the following is not considered as an application of CFG?   (1, 2, 2)
   (A) Natural Language processing
   (B) Syntax checking in programming languages
   (C) Speech recognition
   (D) Mathematical induction

6. The grammar A-->ε is allowed in   (1, 1, 2)
   (A) CNF
   (B) GNF
   (C) CNF and GNF
   (D) Not allowed in both GNF and CNF

7. The language generated by context-free grammar can be recognized by   (1, 2, 2)
   (A) Finite state automation
   (B) 2-way linear bounded automata
   (C) Push down automata
   (D) Both option (B) and (C)

8. Which of the following statements do not describe the leaves of the parse tree?   (1, 1, 2)
   (A) A--> XY...Z , where X, Y and Z are productions with only terminals
   (B) A--> XY...Z , where X, Y and Z are epsilon productions
   (C) The node A after a sequence of derivations, will reach a string of terminals
   (D) The node A after a sequence of derivations will not reach a string of terminals

9. What can be said about the stack capacity in a PDA? 1 1 3
(A) The size of stack should be equal to number of states in PDA
(B) The size of stack should be one less than the number of states in PDA
(C) Infinite size
(D) The size of stack should be equal to number of non-terminals in the PDA

10. Consider let LangA describes the languages accepted by PDA by final state and LangB is the languages accepted by empty stack. Then 1 2 3
(A) Both languages are equal
(B) LangA is subset of LangB
(C) LangB is subset of LangA
(D) Nothing can be inferred from both languages

11. The transition rule $\delta(q, b,Z)=(p,bZ)$ represents _____ operation 1 1 3
(A) Push
(B) Pop
(C) No change in stack
(D) Input not read

12. Let R be regular language and C be context free language. Then what can be told about R and C? 1 2 3
(A) C is a subset of R
(B) R is a subset of C
(C) Both are same
(D) No relation can be established

13. Which of the following Turing machine type can recognize multiple components simultaneously? 1 1 4
(A) Multi tape
(B) Bidirectional
(C) Multi track
(D) Non deterministic

14. Which of the following conversion is algorithmically impossible? 1 2 4
(A) Regular grammar to CFG
(B) NFA to DFA
(C) Non deterministic PDA to deterministic PDA
(D) Non deterministic Turing machine to deterministic Turing machine

15. Which of the following is not an outcome of a Turing machine? 1 1 4
(A) Never halt
(B) Halt and accept the input
(C) Halt and reject the input
(D) Halt without accepting or rejecting

16. Turing machine are more powerful than finite state machines because _____. 1 1 4
(A) It can remember long input sequence
(B) it has a tape
(C) it can write on the tape
(D) it is bidirectional

17. Which of the following is false? 1 1 5
(A) NP is class of searching problems
(B) P is quickly solvable problems
(C) NP is the hardest class of problem
(D) NP complete is a set of P problems

18. Which of the following is true in the context of universal Turing machine? 1 1 5
(A) All the problems are solvable but all are not decidable
(B) All the problems are solvable and all are decidable
(C) The unsolvable problems are undecidable
(D) The unsolvable problems are decidable

19. When does "P=NP=NP complete" holds true? 1 1 5
(A) At P=NP Complete
(B) When any NP complete problem can be solved in Polynomial time
(C) When any NP hard problem can be solved in Polynomial time
(D) NP=NP hard

20. Consider the following statements about Turing machines:

A: No algorithm exists to decide whether Two turing machines accept same language.

B: The problem of determining whether a turing machine halts of any input is undecidable. Which is more appropriate answer?

(A) A is correct

(B) B is correct

(C) Both A and B are wrong

(D) Both A and B are correct

PART - B (5 × 4 = 20 Marks)
Answer any 5 Questions

	Marks	BL	CO

21. Construct a DFA that accepts the numbers that are multiples of five in its binary form. — 4, 3, 1

22. Construct a NFA for the Regular expression R1=a(a+b)* ab using Thompson's method. — 4, 3, 1

23. Check whether the following grammar is ambiguous
S-->iCtS | iCtSeS |b; C-->d — 4, 4, 2

24. Convert the given CFG to PDA
S→aA
A→aABC|bB|a
B→b, C→c — 4, 3, 3

25. Rewrite the given CFG without null symbol:
A-->0B1 | 1B1; B-->0B| 1B| ε — 4, 3, 2

26. Describe the following Turing machine and their working
I) Multi-tape (Multiple Track) Turing Machine
ii) Multi-Dimensional Turing Machine — 4, 2, 4

27. Give the codes for the below mentioned Turing machine:
δ (A, 0) |-- (B, 1, L)
δ (A,1) |--(C, 1, R)
δ (B,0) |--(B, 0, L) — 4, 3, 5

PART - C (5 × 12 = 60 Marks)
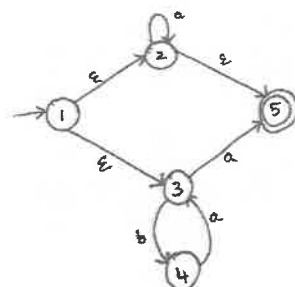### Answer all Questions

	Marks	BL	CO

28. (a) Construct regular expression for the following Finite State Automata — 12, 3, 1
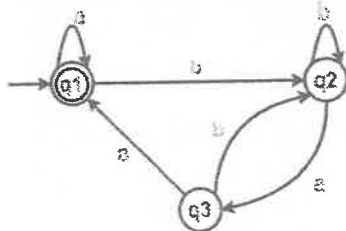
(OR)

(b) Find the DFA accepted by the following FSA.

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29. (a) Normalize the given CFG according to Chomsky's format: 12   4   2
    S-->0A0 | 1B1 | BB; A-->C; B-->S | A; C-->S |ε

    (OR)

    (b) Rewrite the CFG to GNF:
    A-->BC; B-->CA| 1; C-->AB| 0

30. (a) Convert the PDA to CFG.   12   3   3
    $P = (\{p,q\}, \{0,1\}, \{x,z\}, \delta, q, z, F)$ where δ is given by $\delta(q,1,z) = (q,xz)$
    $\delta(q,1,x) = (q,xx)$
    $\delta(q,\varepsilon,x) = (q,\varepsilon)$
    $\delta(q,0,x) = (p,x)$
    $\delta(p,1,x) = (p,\varepsilon)$
    $\delta(p,0,z) = (q,z)$

    (OR)

    (b) Construct a nondeterministic PDA for the language $L=\{ww^R$, w is any word formed from binary numbers 0 and 1\}.
    Elucidate its non determinism.

31. (a) Construct a TM to accept $\{0^n1^n / n>=1\}$. Also check whether the input   12   4   4
    string w=00111 is accepted by the constructed Turing machine.

    (OR)

    (b) i) Construct a Turing machine to add two numbers. Give its transition diagram.
    ii) Construct a Turing machine that computes the complement of a number. Give its transition diagram

32. (a) In a Hackathon activity, the aim is to arrange blocks of two categories in   12   4   5
    such an order that string framed by concatenation of these blocks in some sequence yield same result.

S.No	List A	List B
1	1	111
2	10111	10
3	10	0

    (OR)

    (b) Consider a TM M =$(\{q0,q1,qA\}, \{a,b\}.\{a,b,B\}, \delta, q0, B, \{qA\})$ where, δ given in the following table.
    Find the MPCP instance of the given TM when the input string is w=ab

qi	a	b	B
q0	(q1, b, R)	(q1, a, L)	(q1 ,b, L)
q1	(qA, a, L)	(q0, a, R)	(q1, a, R)
qA	--	--	--

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