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**B.Tech/ M.Tech (Integrated) DEGREE EXAMINATION, NOVEMBER 2023**  
Fifth Semester

**21CSC301T – FORMAL LANGUAGE AND AUTOMATA**  
(For the candidates admitted from the academic year 2022-2023 onwards)

**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 40<sup>th</sup> minute.
- (ii) **Part - B** and **Part - C** should be answered in answer booklet.

Time: 3 Hours

Max. Marks: 75

**PART – A (20 × 1 = 20Marks)**

Marks    BL    CO    PO

Answer ALL Questions

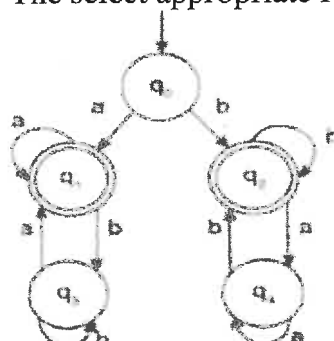
- Write the regular expression for the following language. Set of all strings over alphabet {1} having odd length of strings.
 

(A) $1^*$	(B) $1(11)^*$	1	2	1	1
(C) $(111)^*$	(D) $1+$				
- Which one will be true for the DFA and NFA
 

(A) DFA will be having one transition each alphabet	(B) NFA will have finite states for each alphabet	1	1	1	1
(C) DFA will have epsilon moves	(D) DFA can have many transition for each alphabet				
- What does the below language represent :  $L = \{w|w \text{ is of the form } x01y \text{ where } x \text{ and } y \text{ consisting of 0's and 1's only}\} = \{x01y | x \text{ and } y \text{ are any strings 0's and 1's}\}$ 

(A) The Language that can read the input $(0+1)^+$	(B) The Language that accepts all the strings of 0's and 1 's and may not have the sequence 01 somewhere in the string	1	2	1	1
(C) The language that accepts all and only the strings of 0's and 1's that must have the sequence 01 somewhere in the string	(D) The language that accepts only 0's and 1's separately				
- The select appropriate Regular Expression for the following diagram?
 

		1	2	1	1
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- |                 |               |
|-----------------|---------------|
| (A) $aa^*+bb^*$ | (B) $a^*+b^*$ |
| (C) $a-kb$      | (D) $aba^*$   |

5. A context free grammar  $G$  is in Chomsky normal form if every production is of the form  
 (A)  $A \rightarrow BC$  or  $A \rightarrow a$  (B)  $A \rightarrow BC$  or  $A \rightarrow a$   
 (C)  $A \rightarrow BCa$  or  $B \rightarrow b$  (D)  $A \rightarrow BC$  or  $A \rightarrow B$
6. A context free language is called ambiguous if  
 (A) It has two or more leftmost derivations for some terminal string  $w \in L(G)$   
 (B) It has two or more rightmost derivations for some terminal string  $w \in L(G)$   
 (C) Both (A) and (B) (D) It has one leftmost derivation for some terminal string  $w \in L(G)$
7. Which of the following statement is false?  
 (A) The context free language can be converted into Chomsky normal form  
 (B) The context free language can be converted into Greibach normal form  
 (C) The context free language is accepted by pushdown automata  
 (D) Above all the statements are false
8. The context free grammar  $S \rightarrow A111 | S1, A \rightarrow A0 | 00$  is equivalent to  
 (A)  $\{0^n 1^m | n=2, m=3\}$  (B)  $\{0^n 1^m | n=1, m=5\}$   
 (C)  $\{0^n 1^m | n \text{ should be greater than two and } m \text{ should be greater than four}\}$   
 (D)  $\{0^n 1^m | n \text{ should be greater than two and } m \text{ should be lesser than four}\}$
9. Which one of the following pairs have different expressive power?  
 (A) Deterministic finite automata AND non deterministic finite automata  
 (B) Deterministic push down automata AND non deterministic push down automata  
 (C) Deterministic single tape turing machine and non-deterministic single tape turing machine  
 (D) Single tape turing machine and multiple tape turing machine
10. The lexical analysis for a modern computer language such as java needs the power of which one of the following models in a necessary and sufficient sense?  
 (A) Finite state automata (B) Deterministic pushdown automata  
 (C) Non-deterministic pushdown automata (D) Turing machine
11. The recognizing capability of Non Deterministic Finite State Machine and Deterministic Finite State Machine  
 (A) is different (B) sometimes different  
 (C) is the same (D) sometimes same
12. Finite State Machine can recognize  
 (A) any grammar (B) only CFG  
 (C) any unambiguous grammar (D) only regular grammar
13. Which one of the following is statement is FALSE?  
 (A) Context-free grammar can be used to specify both lexical and syntax rules  
 (B) Type checking is done before parsing

- (C) High-level language programs can be translated to different intermediate representations (D) Arguments to a function can be passed using the program stack

14. Which of the statement is valid for the language 1 1 4 1  
 (A) It is not accepted by a turing machine (B) It is regular but not context-free machine  
 (C) It is context-free but not regular (D) It is neither regular nor context-free, but accepted by a turing machine
15. Which of the following isn't right regarding potential results while executing a Turing Machine for a given input? 1 1 4 1  
 (A) it may halt and accept the input (B) it may halt by changing the input  
 (C) it may halt and reject the input (D) It may never halt
16. What is the purpose of a Turing machine is more impressive than FSM 1 1 4 1  
 (A) Turing machine head movement is continued in one direction (B) Turing machine head moment is in both directions i.e. left moment and right moment as well  
 (C) Turing machine head movement is continued in both directions (D) The turing machine has the capability to remember arbitrary long sequences by the input string
17. If a problem has an algorithm to answer, we call it \_\_\_\_\_. 1 1 5 1  
 (A) Decidable (B) Solved  
 (C) Recognizable (D) Decidable and solvable
18. Which of the following is true for The Halting problem? 1 1 5 1  
 (A) It is recursively enumerable (B) It is undecidable  
 (C) Both (a) and (b) (D) It is enumerable
19. A language L is said to be \_\_\_\_\_ if there is a turing machine M such that  $L(M)=L$  and M halts at every point 1 1 5 1  
 (A) Turing acceptable (B) Decidable  
 (C) Undecidable (D) Turing unacceptable
20. The problems which have no algorithm, regardless of whether or not they are accepted by a Turing machine that fails to halt on some input are referred to as: 1 1 5 1  
 (A) Decidable (B) Undecidable  
 (C) Computable (D) Decidable and Computable

**PART – B (5 × 8 = 40 Marks)**

Answer ALL Questions

21. a. Construct a DFA equivalent to the NFA  $M = (\{a, b, c, d\}, \{0, 1\}, d, a, \{b, d\})$  8 3 1 1  
 where d is a defined as:

$\delta$	0	1
a	{b, d}	{b}
b	c	{b, c}
c	d	a
d	-	a

(OR)

- b. Design a minimized DFA by converting the following regular expression for the RE =  $a(a+b+c)^*(a+b+c)$ . 8 3 1 1
22. a.i. If  $S \rightarrow aSb \mid aAb, A \rightarrow bAa, A \rightarrow ba$ . Find out the CFL. 4 3 2 1
- ii. Generate a context-free grammar for the positive and negative integers. 4 3 2 1
- (OR)**
- b.i. Simplify the following context-free grammar 4 3 2 1  
 $G = \{N, T, P, S\}$   
 $P = \{S \rightarrow AB\}$   
 $A \rightarrow a$   
 $B \rightarrow b$   
 $B \rightarrow C$   
 $E \rightarrow C \mid \epsilon$
- ii. Check whether the following is in Chomsky Normal Form or not 4 3 2 1  
 $S \rightarrow bA \mid aB$   
 $A \rightarrow bAA \mid aS \mid a$   
 $B \rightarrow bBB \mid bS \mid b$
23. a. Construct a PDA to accept the following language L on  $\Sigma = \{a, b\}$  empty stack.  $L = \{wcw^R \mid w \in E^+\}$ . 8 4 3 1
- (OR)**
- b. Construct a PDA to accept the language  $L = \{a^n b^n c^{n+m} \mid n, m \geq 1\}$  empty stack and by final state. 8 4 3 1
24. a. Design a Turing Machine to reorganization the language  $L = \{0^n 1^n \mid n \text{ also specify the ID to trace the string } 0011\}$ . 8 3 4 1
- (OR)**
- b. Construct turning machine for the 2's complement of the binary number. 8 3 4 1
25. a. Define PCP. Let  $\sigma = \{0, 1\}$ . Let A and B be the lists of three strings each defined as: 8 2 5 1
- |   | List A | List B |
|---|--------|--------|
| i | wi     | xi     |
| 1 | 1      | 111    |
| 2 | 10111  | 10     |
| 3 | 10     | 0      |
- (OR)**
- b. Define diagonalization language. Show that the language  $L_d$  is not a recursively enumerable language. 8 2 5 1
- PART – C (1 × 15 = 15 Marks)**
- Answer ANY ONE Question
26. A bus stops in each stop in a pattern that it covers the stops around the shop area repeatedly and the it stops the other areas once. 15 5 1 1

The stops around the shopping zone are grocery shop ('a'), Meat shop ('b'), dress shop('c') and the others are another grocery stop ('a'), another dress shop ('c')

- i. Write a Regular Expression for the above scenario (1 mark)
- ii. Draw a DFA for the Regular Expression (3 marks)
- iii. What are the input strings accepted by the R.E (3 marks)
- iv. Design a  $\epsilon$ - NFA using Thompson's construction (3 marks)
- v. Design a NFA for the Regular Expression and convert it to the DFA (5 marks)

27.i. Convert PDA to CFG. PDA is given by  $P = (\{p, q\}, \{0, 1\}, \{X, Z\}, d, q, Z)$  8    4    3    1

where d is a transition function give by

$$\begin{aligned} d(p, 1, Z) &= \{(p, XZ)\} \\ d(p, \epsilon, Z) &= \{(p, \epsilon)\} \\ d(p, 1, X) &= \{(p, XX)\} \\ d(q, 1, Z) &= \{(q, \epsilon)\} \\ d(p, 0, X) &= \{(q, X)\} \\ d(q, 0, Z) &= \{(p, Z)\} \end{aligned}$$

ii. Consider the following grammar for list structures: 7    4    3    1

$$\begin{aligned} S &\rightarrow a \mid ^ \mid (T) \\ T &\rightarrow T, S \mid S \end{aligned}$$

Find the left most derivation, right most derivation and parse tree for  $((a, a), ^{(a)})a, )$ .

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