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B.Tech DEGREE EXAMINATION, NOVEMBER 2023

Third Semester

18CSC261T - FORMAL LANGUAGE AND AUTOMATA THEORY

(For the candidates admitted during the academic year 2020 - 2021 & 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.	The entity which generates language is termed as: (A) Automata (B) Tokens (C) Grammar (D) Data	1	1	1
2.	The Grammar can be defined as: G=(V, ∑, P, S)In the given definition, what does S represents? (A) Accepting State (B) Starting Variable (C) Sensitive Grammar (D) State Variable	1	1	1
3.	The language generated by the following grammar is A0 -> aA1 A1 -> ab (A) Type 0 (B) Type 1 (C) Type 2 (D) Type 3	1	2	1
4.	Myhill-Nerode Theorem is used for _____ (A) Minimization of DFA (B) Maximization of NFA (C) Conversion of NFA (D) Conversion of DFA	1	1	1
5.	With reference to the process of conversion of a context free grammar to CNF, the number of variables to be introduced for the terminals are: S->ABa A->aab B->Ac (A) 2 (B) 4 (C) 3 (D) 5	1	3	2
6.	Which among the following cannot be accepted by a regular grammar? (A) L is a set of numbers divisible by 2. (B) L is a set of binary complement (C) L is a set of strings with odd number of 0 (D) L is a set of 0^n1^n	1	1	2
7.	If grammar G is unambiguous, G' produced after the removal of Unit production will be: (A) Ambiguous (B) Unambiguous (C) Finite (D) Cannot be said	1	2	2
8.	Answer in accordance to the third and last statement in pumping lemma: For all _____ $xy^iz \in L$ (A) i>0 (B) i<0 (C) i<=0 (D) i>=0	1	2	2
9.	The memory used in push down automata is ____ (A) Stack (B) Queue (C) Circular Queue (D) Tapes	1	1	3

10. The transition a push down automaton makes is additionally dependent upon the: 1 1 3
(A) stack (B) input tape
(C) Terminals (D) Production

11. A push down automata is said to be _____ if it has at most one transition around all configurations. 1 1 3
(A) Finite (B) Non regular
(C) Non-deterministic (D) Deterministic

12. Let G=(V, T, P, S) be a CFG such that _____. Then there exists an equivalent grammar G' having no e productions. 1 1 3
(A) e ∈ L(G) (B) w ∉ L(G)
(C) e ∉ L(G) (D) w ∈ L(G)

13. The value of 'n' if turing machine is defined using n-tuples: 1 1 4
(A) 6 (B) 8
(C) 7 (D) 5

14. The class of recursively enumerable language is known as: 1 1 4
(A) Turing Class (B) Recursive Languages
(C) Universal Languages (D) RE

15. If T1 and T2 are two Turing machines. The composite can be represented using the expression: 1 1 4
(A) T1T2 (B) T1 U T2
(C) T1 X T2 (D) T1 ∩ T2

16. Statement 1: Multi-track Turing machine. 1 1 4
Statement 2: Gamma is Cartesian product of a finite number of finite sets.
Which among the following is the correct option?
(A) Statement 1 is the assertion and Statement 2 is the reason.
(B) Statement 1 is the reason and Statement 2 is the assertion.
(C) Statement 1 and Statement 2 are independent from each other.
(D) Statement 1 is the reason and Statement 2 is the reason.

17. If a problem has an algorithm to answer it, we call it _____ 1 1 5
(A) decidable (B) solved
(C) recognizable (D) non decidable

18. Which among the following are undecidable theories? 1 2 5
(A) The first order theory of boolean algebra
(B) The first order theory of Euclidean geometry
(C) The first order theory of hyperbolic geometry
(D) The first order theory of the natural number with addition, multiplication, and equality

19. Consider three decision problems A, B, C. A is decidable and B is not. Which of the following is a correct option? 1 2 5
(A) C is undecidable if C is reducible to B
(B) C is undecidable if B is reducible to C
(C) C is decidable if A is reducible to C
(D) C is decidable if C is reducible to B's complement.

20. The complexity class P consist of all the decision problems that can be solved by _____using polynomial amount of computation time. 1 1 5
(A) Push Down automata (B) DFA
(C) NDFA (D) Deterministic Turing machine

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

21. Construct a DFA equivalent to the NFA, M=({p,q,r},{0,1},δ,p,{q,s}) where δ is define in the following table. 4 3 1

state	0	1
p	{q,s}	{q}
q	{r}	{q,r}
r	{s}	{p}
s	-	(p}

22. Solve the following grammar. 4 3 2
S->aAa | bBb | BB
A->C
B->S|A
C->S|ε
for the string "abaaba" find the following.
(i) Left most derivation
(ii) Right most derivation

23. Differentiate deterministic PDA and non deterministic PDA. 4 2 3

24. Construct a Turing machine for the language {WW|W∈ {a,b}} 4 3 4

25. Describe about Recursive and Recursive Enumerable language with example? 4 2 5

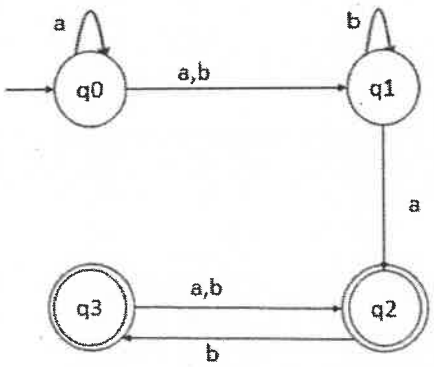
26. Given ∑={a,b}, construct a DFA which recognize the language L={$b^m ab^n$: m,n >0} 4 3 1

27. Describe a Turing Machine 'M' to implement the function "Multiplication" using the subroutine copy. 4 3 4

PART - C (5 × 12 = 60 Marks) **Marks BL CO**

Answer **all** Questions

28. (a) Convert that given NFA into equivalent Deterministic Finite Automata (DFA). 12 3 1



(OR)

(b) Determine DFA from a given NFA:
M=({q_0,q_1},{0,1},δ,q_0,{q_1}) where δ is given by
δ (q_0,0)={q_0,q_1}, δ (q_0,1)={q_1}, δ (q_1,0)=φ, δ (q_1,1)={q_0,q_1}

29. (a) What is the purpose of normalization? Construct the CNF and GNF for the following grammar and explain the steps. 12 3 2

S→aAa | bBb |€
A→C|a
B→C|b
C→CDE | €
D→A|B|ab

(OR)

(b) (i) Convert the following grammar into the CNF

S->bA |aB
A->bAA | aS |a
B-> aBB | bS |b

(ii) Remove the ε production from the following grammar.

S->ASA | aB | b
A->B,
B-> b|ε

30. (a) Construct PDA for L = $\{a^n b^n \mid n>=0\}$ 12 3 3

(OR)

(b) Construct PDA for L = {wϵ(a|b)* | where 'w' is a PALINDROME}

31. (a) Construct a Turing machine that estimate unary multiplication (Say 111 X 11 = 11111) 12 3 4

(OR)

(b) Express a PDA for the language L= $a^n b^m c^{n+m}$ | where n, m >=1 }.

32. (a) Write note on NP complete problems and Polynomial time reduction. 12 2 5

(OR)

(b) (i) Show that Halting problem is undecidable.
(ii) Explain in detail about Rice Theorem

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