KATHMANDU UNIVERSITY
End Semester Examination
January/February 2024

Level : B.Sc.
Year : III
Time : 2 hrs. 30 mins.

12 FEB 2024

Course : COMP 316
Semester : I
F.M. : 40

SECTION "B"
[6 Q. × 4 = 24 Marks]

Attempt *ANY SIX* questions.

1. Construct a DFA with transition diagram and transition table that accepts the language L= {w| w is set of all strings from ∑={a,b} that starts with a and end with ab}

2. State and prove Arden's theorem. Find the regular expression corresponding to the given transition function. [2+2]

δ	0	1
→q1	q1	q2
q2	q3	q2
q3	q1	q4
*q4	q1	q2

3. What is regular language? What are different algebraic rules for regular expressions? Explain. [1+3]

4. How do you remove the immediate left recursion? Explain with example.

5. Design a PDA for the language L = $\{0^n 1^{2n} \mid n>0\}$ and trace with a string w = 001111

6. Minimize the following DFA.

	0	1
→ P	Q	R
Q	Q	S
R	Q	R
S	Q	T
*T	Q	R

[2+2]

7. Write short notes
   a. Parse Tree
   b. Geribach Normal Form

SECTION "C"
[2 Q. × 8 = 16 Marks]

Attempt *ANY TWO* questions.

8. Prove that a language L accepted by some DFA D if and only if it is accepted by some NFA N.

9. Define CNF with suitable example. Simplify the following grammar [2+6]

$S \rightarrow ABC$
$A \rightarrow BC|a$
$B \rightarrow bAC|\varepsilon$
$C \rightarrow cAB|\varepsilon$

10. Design a Turing Maching for the following language
$L = \{w \mid w$ has equal number of a's, b's and c's and $w \varepsilon \{a,b,c\}\}$

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Time: 30 mins.

F. M. : 10

Registration No.:

Date :

SECTION "A"

[20Q. × 0.5 = 10 marks]

Choose and encircle the most appropriate answer:

1. Let $\sum=\{0, 1\}$, the value of $\sum^2$ is
   a. {0, 1, 01} b. {0, 1, 10} c. {00, 01, 10, 11} d. {ϵ, 00, 10, 01, 11}

2. Which of the following statement is **TRUE**?
   a. $\sum^+=\sum^1 \cup \sum^2 \cup \sum^3 \cup \ldots \cup \sum^n$ b. $\sum^*=\sum^0 \cup \sum^+$
   c. Both a and b d. $\sum^*=\sum^1 \cup \sum^2 \cup \sum^3 \cup \ldots \cup \sum^n$

3. Which of the following statement is true for extended transition function?
   a. $\hat{\delta}(q_0, \epsilon) = q_0$ b. $\hat{\delta}(q_0, \epsilon) = \epsilon$ c. $\hat{\delta}(q_0, \epsilon) = \Phi$ d. $\hat{\delta}(q_0, \epsilon) = \{\}$

4. Language of DFA L(D) is defined as
   a. $L(D)=\{w\epsilon\sum^*|\hat{\delta}(q_0,w)\cap F\neq\Phi\}$ b. $L(D)=\{w\epsilon\sum^+|\hat{\delta}(q_0,w)\cap F\neq\Phi\}$
   c. $L(D)=\{w\epsilon\sum^*|\hat{\delta}(q_0,w)\in F\}$ d. $L(D)=\{w\epsilon\sum^+|\hat{\delta}(q_0,w)\in F\}$

5. The main difference between DFA and NFA is in
   a. The type of input. b. Number of states.
   c. Number of final states. d. The type of value that δ returns.

6. The precedence order of regular operators is
   a. *, . , + b. ., *, + c. +, *, . d. *, +, .

7. Which of the following is RE to represent the set of all strings over $\sum = \{p, q\}$ containing pp or qpq as substring?
   a. $(p + q)^*$(pp+qpq) $(p + q)^*$ b. $(pq)^*$(p+qpq) $(pq)^*$
   c. (p+q)(pp+qpq)(p+q) d. $(p + q)^*$(p.qpq) $(p + q)^*$

8. Which of the following statement is **TRUE**, if P, Q and R are any regular language ?
   a. $P(Q \cup R) = P \cup R$ b. $P \cup Q \cup R = Q \cup R$
   c. $P(Q \cup R) = PQ \cup PR$ d. $P \cup Q) = Q \cup R$

9. Sentential form of the CFG is
   a. Any string from $(V \cup T)^*$ that can be derived from any variable.
   b. Any string from $(V \cup T)^+$ that can be derived from any variable.
   c. Any string from $(V \cup T)^*$ that can be derived from start variable.
   d. Any string from $(V \cup T)^+$ that can be derived from start variable.

10. If A,BϵV and aϵT then A production P is unit production if it is of the form
    a. A→B b. A→a c. A→aB d. A→AB

11. The variable AϵV is generating symbol if
a. $A \overset{*}{\Rightarrow} w$ b. $A \overset{*}{\Rightarrow} V^*$ c. $A \overset{*}{\Rightarrow} T^*V^*$ d. $A \overset{*}{\Rightarrow} WV$

12. Let X, Y,ZϵV and pϵT then which of the following production is allowed in CNF?
a. X→pYZ b. X→YZ or X→p c. A→YZ d. X→YZ or X→pYZ

13. A production grammar for the language L = { $a^m b^n / m,n \geq 1, m \neq n$ } is
a. { S→aS, S→aB, B → ab, A →aaB, B → b }
b. { S→ A,A→ aA,A → aB, B → ab}
c. {S → A, S → C, A → aA, A → aB, B → aBb, B → ab, C → Cb, C → Bb }
d. { S→aS, S→aB, B → ab, A →aaB, B → b }

14. Let the production A→Aα/β with β doesn't start with A, the equivalent grammar without left recursion can be written as
a. A→ $\beta A'/\beta$, $A' \rightarrow \alpha A'/\alpha$ b. A→ $A'\beta/\alpha$, $A' \rightarrow \alpha A'/\beta$
c. A→ $A'\beta$, $A' \rightarrow \alpha A'/\epsilon$ d. A→ $\beta A'/$, $A' \rightarrow \alpha A'/\beta$

15. Which of the following condition must be satisfied before converting the grammar into GNF?
a. The grammar must be simplified.
b. The grammar must be in CNF.
c. The grammar must be without left recursion.
d. Both b and c

16. The transition function of Non-deterministic PDA is
a. δ: Q× {$\sum \cup \epsilon$} × $\tau \rightarrow (Q \times \tau^*)^*$ b. δ: Q× $\sum \times \tau$ →any subset of $(Q \times \tau^*)^*$
c. δ: Q× {$\sum \cup \epsilon$} × τ →Q× τ^* d. δ: Q× {$\sum \cup \epsilon$} × τ →any subset of $(Q \times \tau^*)^*$

17. If q is any state of PDA, w is the remaining string to read and τ is the stack content then the ID of PDA is represented as
a. (q, w, τ) b. (q, τ, w) c. (w, q, τ) d. (τ, w, q)

18. Which of the following can accept even palindrome over $\sum$={a, b}?
a. Push Down Automata b. Turing Machine
c. NDFA d. All of these

19. An ID of Turing Machine consists of
a. present state and input to be processed
b. present input only
c. present state and entire input to be processed
d. input to be processed

20. Turing machine (TM) is more powerful than FMS (Finite State Machine) because
a. tape movement is confined to one direction
b. it has the capability to remember arbitrarily long sequences of input symbols
c. it has no finite state
d. it has infinite state