

KATHMANDU UNIVERSITY  
End Semester Examination  
July/August, 2024

Marks Scored:

Level : B.Sc.  
Year : III

Course : COMP 316  
Semester : I

Exam Roll No. :

Time: 30 mins.

F. M. : 10

Registration No.:

Date : 05 AUG 2024

SECTION "A"

[10 Q.  $\times$  0.5 = 5 marks]

Choose and encircle the most appropriate option:

- Which of the following statement defines the automata theory?
  - Study of abstract machine and their properties, providing a mathematical notion of computer.
  - Study of designing and checking behavior of digital circuits.
  - Study of computation.
  - Study of problems.
- If  $\Sigma = \{a, b\}$  then the value of  $\Sigma^2 = ?$ 
  - $\{aa, ab, ba, bb\}$
  - $\{aaa, aab, aba, abb, baa, bab, bba, bbb\}$
  - $\{aaa, aba, bab, bbb\}$
  - $\{aab, aba, abb, bbb\}$
- If  $A = \{0\}$ , which of the following statement is true?
  - $A^* = \{0^n \mid n=1, 2, 3, \dots\}$
  - $A^* = \{0^+ \mid n=1, 2, 3, \dots\}$
  - $A^* = A^+$
  - $A^* = A^+ \cup A$
- NFA differs from DFA with its distinct features of transition function, which is .....
  - $\delta : Q \times \Sigma = 2^Q$
  - $\delta : Q \times \Sigma = Q$
  - $\delta : Q \times \epsilon = Q$
  - $\delta : Q \times \Sigma = Q^2$
- Which of the following condition must be satisfied to accept a string  $w$  by DFA  $D = \{Q, \Sigma, \delta, q_0, F\}$ ?
  - $\hat{\delta}(q_0, w) = p \in Q$
  - $\hat{\delta}(q_0, w) = p \cap F \neq \emptyset$
  - $\hat{\delta}(q_0, w) = p \in F$
  - $\hat{\delta}(q_0, w) = p \neq \emptyset$
- What is the purpose of subset Construction method?
  - Show the equivalence between two DFAs.
  - Convert the DFA into NFA.
  - Show the difference between DFA and NFA.
  - Convert the NFA into equivalent DFA.
- What is the basic step of extended transition function ( $\hat{\delta}$ ) of  $\epsilon$ -NFA?
  - $\hat{\delta}(q, \epsilon) = \epsilon$
  - $\hat{\delta}(q, \epsilon) = \epsilon\text{-closure}(\emptyset)$
  - $\hat{\delta}(q, \epsilon) = q$
  - $\hat{\delta}(q, \epsilon) = \epsilon\text{-closure}(q)$
- Which of the following represents the language of CFG  $G = \{V, T, P, S\}$ ?
  - $L(G) = \{x \in T^* \mid S \xrightarrow{*} x\}$
  - $L(G) = \{x \in V^* \mid S \xrightarrow{*} x\}$
  - $L(G) = \{x \in T^* \mid S \xrightarrow{*} \epsilon\}$
  - $L(G) = \{x \in V^* \mid S \xrightarrow{*} \epsilon\}$

9. Which of the following condition is true for a grammar  $G = (V, T, P, S)$  to be an ambiguous grammar?
- If there is two or more distinct derivation tree rooted at  $S$  and yielding variables.
  - If there is two or more distinct derivation tree rooted at  $S$  and yielding string  $w$ .
  - If there is one left most and one right most derivation for string  $w$ .
  - If there is more than one leftmost derivation for string  $w$  rooted at any  $V$ .
10. Which of the following is useless symbol?
- Generating symbol
  - non-generating symbol
  - Non-reachable symbol
  - both b and c
11. Sentential form of the CFG is
- Any string from  $(V \cup T)^*$  that can be derived from any variable.
  - Any string from  $(V \cup T)^+$  that can be derived from any variable.
  - Any string from  $(V \cup T)^*$  that can be derived from start variable.
  - Any string from  $(V \cup T)^+$  that can be derived from start variable.
12. An ID of Turing Machine consists of
- present state and entire input to be processed
  - present input only
  - present state and input to be processed
  - input to be processed
13. Which of the following grammar is in CNF?
- $A \rightarrow BC \mid a$
  - $A \rightarrow BCD \mid a$
  - $A \rightarrow Ba \mid a$
  - $A \rightarrow AD$
14. Turing machine (TM) is more powerful than FMS (Finite State Machine) because
- tape movement is confined to one direction.
  - it has the capability to remember arbitrarily long sequences of input symbols.
  - it has no finite state.
  - it has infinite state.
15. Which conditions must be satisfied for a grammar to be in GNF?
- must be in CNF
  - must be left recursion free
  - both a and b
  - must have empty productions
16. What is the equivalence between Regular Grammar and Finite Automata (FA)?
- We can obtain an equivalent finite automaton of right-linear grammar that accepts the same language.
  - We can convert into DFA from given CFG.
  - CFG and FA are of same strength.
  - We can obtain an equivalent FA of left recursion grammar.
17. Which of the following represents the  $\delta$  of PDA?
- $\delta(q, a) = (p, x)$
  - $\delta(q, a, x) = p$
  - $\delta(q, a, x) = (p, \alpha)$
  - $\delta(q, a, x) = \alpha$
18. Equivalence of CFG and PDA is \_\_\_\_\_
- we can construct a PDA that accepts same language generated by CFG.
  - We can obtain CFG from PDA.
  - both a and b.
  - PDA and CFG are of same strength.

19. Which of the following is left recursive grammar?

- a.  $S \rightarrow AA' \mid 0, A \rightarrow 0SA' \mid 1A, A' \rightarrow ASA' \mid \epsilon$
- b.  $S \rightarrow AA \mid 0, A \rightarrow AAS \mid 0S \mid 1$
- c.  $S \rightarrow AA \mid 0, A' \rightarrow ASA' \mid \epsilon$
- d.  $S \rightarrow AA \mid 0, A \rightarrow 0SA', A' \rightarrow ASA'$

20. Which of the following is true for  $A \rightarrow A\beta \mid \alpha$

- a.  $A \rightarrow \beta A'$   
 $A' \rightarrow \alpha A' \mid \epsilon$
- b.  $A \rightarrow \alpha A'$   
 $A' \rightarrow \beta A' \mid \epsilon$
- c.  $A \rightarrow \alpha \beta$   
 $A' \rightarrow \beta A' \mid \alpha$
- d.  $A \rightarrow \beta A' \mid \alpha A'$   
 $A' \rightarrow \epsilon$



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SECTION "B"

[6 Q. × 4 = 24 marks]

Attempt ANY SIX questions.

1. Design a DFA with its transition diagram and transition table that accepts the language  $L = \{w \mid w \text{ is string with substring } abb\}$  over alphabet  $\Sigma = \{a, b\}$ . [4]
2. Why do we need pumping lemma theory? Verify the theory with suitable example. [4]
3. What is Arden's rule? Consider any DFA and convert it into Regular Expression using Arden's rule. [1+3]
4. Minimize the following DFA. [4]

$\delta$	0	1
$\rightarrow q_1$	$q_2$	$q_6$
$q_2$	$q_1$	$q_3$
$* q_3$	$q_2$	$q_4$
$q_4$	$q_4$	$q_2$
$q_5$	$q_4$	$q_5$
$* q_6$	$q_5$	$q_4$

5. Construct a PDA accepting a language  $L = \{w \mid w \in \{a, b\}^* \text{ and } w \text{ has equal number of } a \text{ and } b\}$  [4]
6. How do you remove the left recursion from the grammar? Illustrate with example. [1+3]
7. Check the acceptance of string  $w = abbaab$  by Turing Machine with following given transitions table. [4]

$\delta$	a	b	B
$\rightarrow q_0$	$(q_1, a, R)$	$(q_1, b, R)$	$(q_3, B, R)$
$q_1$	$(q_0, a, R)$	$(q_0, b, R)$	
$* q_3$			

P.T.O.

SECTION "C"

[2 Q.  $\times$  8 = 16 marks]

*Attempt ANY TWO questions.*

9. Prove the theorem "A language L is accepted by some DFA D iff L is accepted by some NFA N." [8]
10. Define CNF with suitable example. Convert the following grammar into CNF. [2+6]  
 $S \rightarrow ASB \mid \epsilon$   
 $A \rightarrow aAS \mid a$   
 $B \rightarrow SBS \mid A \mid bb$
11. Write short notes with example. [4+4]  
a. Instantaneous Description (ID) of PDA  
b. Parse Tree