KATHMANDU UNIVERSITY
End Semester Examination [C]
December, 2024

Marks Scored:

Level : B.Sc.
Year : III

Course : COMP 316
Semester : I

Exam Roll No. :

Time: 30 mins.

F. M. : 20

Registration No.:

Date 23 DEC 2024

SECTION "A"

[20 Q. × 0.5 = 10 marks]

Choose and encircle the most appropriate option:

1. The problems that can be solved by computers are called
   a. Hamilton-Circuit Problem
   b. Intractable
   c. NP-complete
   d. Decidable

2. Which of the following is true?
   a. NFA is more powerful than DFA
   b. DFA is more powerful than NFA
   c. NFA and DFA have same power
   d. All of these

3. How many strings of length less than 4 contains the language described by the regular expression (x+y)*y(a+ab)*?
   a. 7 b. 10 c. 11 d. 12

4. A language is regular if and only if
   a. accepted by finite automata
   b. accepted by PDA
   c. accepted by TM
   d. accepted by DPDA

5. Regular expression for all strings starts with ab and ends with bab is....
   a. aba*b*bab b. ab (a+b)*bab c. ab(ab)*bab d. ab(a* + b*)bab

6. Production rule: aSb →acb belongs to which of the following category?
   a. context free language
   b. regular language
   c. Context sensitive language
   d. Recursively ennumerable language

7. Which sentence can be generated by the following grammar

   S → 0S | 1A
   A→ 3|22A

   a. 122333 b. 01113 c. 001223 d. 0101223

8. Find the answer for the regular expression Φ*=
   a. Φ b. { Φ} c. ε d. { ε}

9. Which of the following is false about regular expression r and s ?
   a. r* is a regular expression
   b. r-s is a regular expression
   c. r+s is a regular expression
   d. r.s is a regular expression

10. Which of the following string can be obtained by the language L = {ai b2i / i≥ 1}
    a. aaabbbbbb b. aabbb c. abbabbba d. aaaabbbabb

11. Which of the following cannot be accepted by a regular grammar?
    a. L is a set of 0^n1^n
    b. L isa set of string with odd number of 0
    c. L is a binary complement
    d. L is a set of number divisible by 2

12. Consider the production of the grammar
    $S \rightarrow TT$
    $T \rightarrow aa$
    $T \rightarrow bb$
    Which of the following language is produced by the above grammar
    a. L ={ aaaa,aabb,bbaa,bbba}
    b. L ={ aaaa,aabb,bbaa,bbbb}
    c. L ={ aaaa,abab,bbaa,bbba}
    d. L ={ aaaa,aabb,bbaa,baba}

13. CFG are more powerful than
    a. DFA
    b. NFA
    c. Mealy Machine
    d. All of the above

14. The language which is generated by the grammar $S \rightarrow aSa \mid bSb \mid a \mid b$ over the alphabet {a,b} is the set of
    a. All odd length palindromes
    b. All even length palindrome
    c. String that begins and end with the different symbol
    d. All odd and even length palindromes

15. Which of the following grammars are in Chomsky Normal Form:
    a. $S \rightarrow AB \mid BC \mid CD \quad A \rightarrow 0 \quad B \rightarrow 1 \; C \rightarrow 2 \; D \rightarrow 3$
    b. $S \rightarrow ABa \quad A \rightarrow aab \quad B \rightarrow Ac$
    c. $S \rightarrow AB \quad S \rightarrow BCA \mid 0 \mid 1 \mid 2 \mid 3$
    d. $S \rightarrow AAa \quad A \rightarrow a \; B \rightarrow b$

16. Which of the following is the tuple for Turing Machine
    a. $M = (Q, \sum, \delta, q0, F)$
    b. $M = (Q, \sum, \Gamma, \delta, q0, Z0, F)$
    c. $G = (V, T, P, S)$
    d. $M = (Q, \sum, \Gamma, \delta, q0, B, F)$

17. The transition a Push down automaton makes is depends upon:
    a. Input tape
    b. Stack
    c. Terminals
    d. Stack symbol and input symbol

18. If the PDA does not stop on an accepting state and the stack is not empty the string is……
    a. accepted
    b. rejected
    c. goes into loop forever
    d. accepted in some cases

19. Which of the following a Turing Machine does not consist of
    a. Input tape
    b. Stack
    c. Head
    d. Blank symbol

20. Problems that can be solved in polynomial time are known as_____
    a. complete
    b. decision
    c. tractable
    d. intractable

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SECTION "B"
[6 Q. × 4 = 24 marks]

Attempt ANY SIX questions.

1. Formally define deterministic finite automata with example.

2. Construct a ε-NFA accepting string over {0} which is multiple of 2 or 3.

3. State and prove Arden's theorem.

4. What is regular expression? Convert the following regular expression into finite state automata: (1+110)*0

5. What is Chomsky Normal Form? Convert the following grammar into CNF:
   $S \rightarrow ASB \mid \varepsilon$
   $A \rightarrow aAS \mid a$
   $B \rightarrow SbS \mid A \mid bb$

6. Write a PDA accepting a string over {a, b} such that $L=\{ww^R \mid w \in \{a, b\}^*$ and w^R is reversal of w}

7. Write short notes on:
   a. Universal Turing Machine
   b. Class P and NP

SECTION "C"
[2 Q. × 8 = 16 marks]

Attempt ANY TWO questions.

8. State pumping lemma for regular expression. Prove that $L=\{0^n 1^n \mid n \geq 0\}$ is not a regular language using pumping lemma.

9. Give the formal definition of Turing Machine. Design a Turing Machine to accept language $L = \{0^n 1^n : n>0\}$

10. Illustrate the importance of DFA minimization. Minimize the following DFA.