B.Tech. DEGREE EXAMINATION, MAY 2024
OPEN BOOK EXAMINATION

Fifth Semester   18CSC301TO

18CSC301T – FORMAL LANGUAGE AND AUTOMATA
(For the candidates admitted during the academic year 2018-2019 to 2021-2022)

- Specific approved THREE text books (Printed or photocopy) recommended for the course
- Handwritten class notes (certified by the faculty handling the course / Head of the Department)

Time: 3 Hours   Max. Marks: 100

Answer **FIVE** questions
(Question: No 6 is compulsory)

			Marks	BL	CO	PO

1.a. A leading firm in India wants to ensure security in the interest of its employees and important records. A secure password scheme was introduced which can accept binary numbers which should start and end with 01. Design a DFA to implement the same. Give its transition table, formal definition and transition diagram. — 10 3 1 6

b. In a certain language there are only four alphabets namely y &, *, % and ε. The pattern of words that is formed in the language always has ε as its third alphabet and no two alphabets can occur consequently. The language has a limitation that the maximum number of allowable alphabets in the word is only 6 (including ε). Create a Finite state automata for generating the words of the language and convert the same to a deterministic machine. — 8 3 1 6

c. What is the minimum number of states to recognise the language $L=\{w/w \in (0+1+2)+\}$? — 1 3 1 6
(A) 1   (B) 3
(C) 2   (D) 4

d. The Minimum number of states required by the DFA that accepts $L=\{x \mid$ length of x is divisible by n$\}$ is _____. — 1 3 1 6
(A) n-1   (B) n+1
(C) 2n   (D) n

2. Mithra has to travel back to his home every day from college. She can use two paths, path A and path B. Each month if she takes path A once she needs to take path B twice that month. In each given duration she needs to take path A first for n number of days sequentially followed by taking up path B as per the given condition.

a. Construct Context Free Grammar and simplify it. — 8 4 2 4

b. Convert the simplified CFG into GNF. — 10 4 2 4

c. Which of the following is true about CFG?   1   4   2   4
  - (A) The number of symbols in LHS of CFG must always be less than or equal to the number of symbols in RHS
  - (B) The RHS of the CFG cannot start with terminals
  - (C) The RHS of the CFG cannot start with nonterminals
  - (D) CFG cannot have epsilon in its RHS

d. I: Context sensitive grammar is a subset of Context Free Grammar   1   4   2   4
   II: Regular grammars are the most restricted type of grammars
  - (A) Both are false
  - (B) Both are true
  - (C) I is false and II is true
  - (D) II is false and I is true

3. The college organized an event for all its employees. One such event is picking the color beads. The employee has to pick the bead in an predefined order. The person is picking the beads in the specified order is declared as winner. There are four different colored beads namely Red, Green, violet and yellow.

   Case (i):

   First, they should pick 'm' number of red beads then 'n' number of green beads then '4n' number of Violet beads and at last '2m' number of yellow beads.

   Case (ii):

   First they should pick 'n' number of red beads then '3n' number of Green beads.

a. Construct PDAs for the cases mentioned.   14   4   3   6

b. Check whether 2 consecutive red beads followed by 4 consecutive green beads can be picked using ID in Case i)'s PDA ?   4   4   3   6

c. What can be inferred from the PDAs constructed for the given scenario?   1   4   3   6
  - (A) The PDA constructed for Case i) is non deterministic
  - (B) The PDAs constructed for Case i) and Case ii) are deterministic
  - (C) The PDA constructed for Case ii) is non deterministic
  - (D) The PDAs constructed for Case i) and Case ii) are non deterministic

d. What can be said about the language accepted by a PDA with 12 stack elements?   1   4   3   6
  - (A) Regular
  - (B) Context Free
  - (C) Recursive
  - (D) Nothing can be inferred

4. The math assignment says you will be given numbers, mostly with unary additions, which means you can consider only zeros, and you need to add them and tell the answer in your answer script. Your friend told you he doesn't know the addition of unary numbers, so you help your friend to solve this problem.

a. Design the transition rules, transition table and transition diagram for the Turing machine for the generated language.   12   4   4   4

ii. Is it a computing device or an acceptor? Justify your answer.   2   4   4   4

b. Use instantaneous description and find out the solution for the two given numbers five and three.   4   4   4   4

c. If there exists a language L, for which there exists a TM, T, that accepts every word in L and either rejects or loops for every word that is not in L, is called   1   4   4   4
   (A) Recursive   (B) Recursively Enumerable
   (C) NP-Hard   (D) Decidable

d. What type of memory is been used by Turing machine?   1   4   4   4
   (A) RAM   (B) Finite Tape
   (C) Restricted Tape   (D) Infinite Tape

5. A leading software company asked the employees to set the password in binary language. The company's policy is to invert the password that the employees set and store it in their database for security reasons.

a. Help the company to automate the solution for the given problem by designing a suitable Turing Machine and write appropriate code for the constructed Turing Machine.   10   4   5   4

b. Convert the above Turing Machine into Modified Post Correspondence Problem (MPCP). Show the ID and MPCP solution for the input string "101".   8   4   5   4

c. Assume that the above given problem (problem_1) can be reduced to problem_2. If problem_2 is undecidable then _____.   1   4   5   1
   (A) Problem_1 is undecidable   (B) Only problem_2 is undecidable
   (C) problem_1 is decidable   (D) problem_2 is decidable

d. NP complete problem is the intersection of ____ and _____.   1   4   5   4
   (A) NP and NP hard   (B) P and NP
   (C) NP hard and P   (D) cannot be determined

6. Consider the grammar given below which denotes Boolean expressions
   Expr → Expr or Term | Term
   Term → Term and Factor | Factor
   Factor → not Factor | (Expr) | true | false

a. Write leftmost derivation, rightmost derivation and parse tree for the string "true and not false or (false and (not true))" . Is the grammar ambiguous?   10   4   2,3   4

b. Convert the given grammar to a Pushdown Automata.   8   4   2,3   4

c. Which of the following lemma/ algorithm is not related to CFG?   1   4   2,3   4
   (A) Substitution rule   (B) Elimination of left recursion
   (C) Pumping lemma for regular languages   (D) Elimination of useless symbols

d. A PDA can behave like a FSM when the stack size is_____ .   1   4   2,3   4
  (A) 1   (B) 0
  (C) n   (D) infinite

7. Ram wants to group the balloons in order to convey a message to his friend Lakshman at a birthday party. Consider there are two colored balloons red and yellow color. He wants to group n number of red balloons first and then group n number of yellow balloons. After grouping the balloons Ram wants to convey a message through encoding using 0s and 1s. Help Ram to encode the message.

a. Design the TM transitions rules and diagram for the above scenario.   10   4   4,5   4

b. Consider the following group (R indicates red, Y indicates yellow) M= (RYY, YYR, RR, YY) and N=(YYYR, YRYR, RRY, YRY). Can a Post correspondence solution be formed? If yes, give the sequence. If no, give reasons.   8   4   4,5   4

c. If L and L' are recursively enumerable then L is _____ .   1   4   4,5   4
  (A) Undecidable   (B) Diagonalization Language
  (C) Recursively Enumerable   (D) Recursive

d. A Language is said to be decidable if   1   4   4,5   4
  (A) TM accepts L   (B) TM rejects L
  (C) L is recursively enumerable (D) L is recursive

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