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B.Tech DEGREE EXAMINATION, NOVEMBER 2023

Fifth Semester

25/11/2023

FN

18CSC301T - FORMAL LANGUAGE AND AUTOMATA

(For the candidates admitted during the academic year 2018-19 to 2021-22)

OPEN BOOK EXAMINATION

18CSC301TO (18)

Note:

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

Time: 3 Hours **Max. Marks: 100**

Answer **FIVE** Questions

Question 2 is the mandatory question

			Marks	BL	CO
1	i.	A software engineer is working on developing a compiler for a programming language. In initial phase the rule for naming an identifier is set. The rules are an identifier must start with a letter (a-z or A-Z). After the initial character, it can have zero or more occurrences of letters or digits (0-9). a) Design a Ɛ- NFA using Thompson's Construction for the identified grammar (5 Marks) b) Convert the Ɛ- NFA to DFA (10 Marks) c) Check whether the string "abc2" is accepted by the language. (3 Marks)	18	3	1
	ii.	Which one is an equivalent regular expression for the identifier? (A) Letter(Letter|digit)* (B) Letter.digit* (C) (letter|digit)* (D) (letter|digit)+	1	1	1
	iii.	Give an example of valid that belongs to the language. (A) ab (B) abc (C) 1 (D) aa	1	1	1
2	i.	Consider the grammar given below: S → NP VP S → Aux NP VP S → VP NP → Det NOM NOM → Noun NOM → Noun NOM VP → Verb VP → Verb NP Det → *that* | *this* | *a* | *the* Noun → *book* | *flight* | *meal* | *man* Verb → *book* | *include* | *read* Aux → *does* 1. List the terminals and non-terminals in the given grammar (4 Marks) 2. Simplify the grammar (6 Marks) 3. Convert the grammar to CNF (6 Marks) 4. Check if the above grammar could generate the string "the flight include meal and the man read a book" (2 Marks)	18	3	2
	ii.	What can be told about the above grammar? (A) Certain terminals in the grammar cannot be derived (B) Few useless symbols are inherently present in the grammar (C) It has 3 unit productions (D) It had 1 useless symbol	1	1	1
	iii.	I: Regular grammars are a subset of Context Free Grammars II: Context free grammars are accepted by FSA (A) I is true and II is false (B) Both I and II are true (C) II is true and I is false (D) Both are false	1	1	1

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i.	Consider following grammar declarationlist → declaration | declarationlist declaration declaration → type idlist T idlist → idlist ',' I | I type →int | float | char T → ; I → ID (a) Simplify the grammar (4 marks) (b) Convert to GNF (6 marks) (c) Construct a PDA for that grammar (6 marks) (d) Identify the String which can be acceptance and Rejection by PDA (2 marks)	18	3	2
ii.	A context free grammar G is in Chomsky normal form if every production is of the form. (A) A->BCa or B-> b (B) A->BC or A->A (C) A->B or B->a (D) A->BC or A->a	1	1	2
iii.	Which of the following statement is false? (A) A context free language is also a regular language (B) A context free language is also recursive enumerable language (C) A recursive language is also a regular language (D) Both recursive and context free language are regular language	1	1	2
4 i.	Consider following push down automata (Hint: i = if, t = then, g = goto) $\delta(q_1,\varepsilon,Z) \rightarrow (q_1, SZ)$ $\delta(q_1,20, N) \rightarrow (q_1, \varepsilon)$ $\delta(q_1,), Y) \rightarrow (q_1, \varepsilon)$ $\delta(q_1,>, X) \rightarrow (q_1, \varepsilon)$ $\delta(q_1,10, W) \rightarrow (q_1, \varepsilon)$ $\delta(q_1, a, V) \rightarrow (q_1, \varepsilon)$ $\delta(q_1, t, T) \rightarrow (q_1, \varepsilon)$ $\delta(q_1, g, G) \rightarrow (q_1, \varepsilon)$ $\delta(q_1,i,S) \rightarrow (q_1, DTGN)$ $\delta(q_1, (,D) \rightarrow (q_1, VXWY)$ (a) Convert the given PDA to CFG (10) (b) Simplify the grammar (4) (c) Identify the string and write the ID for string acceptance (4)	18	4	3
ii.	What kind of Data Structure used in PDA? (A) Stack (B) Queue (C) Tree (D) List	1	1	2
iii.	How many tuples are there in PDA? (A) 6 (B) 8 (C) 7 (D) 4	1	1	2
5 i.	a) Generate the accepting language L for the given scenario. Jay visits a store to buy some gallon of milk and bread. First she buys milk followed by bread, which is twice the quantity of milk. (2 marks) b) Design a TM along with transition table for the generated language. (12 marks) c) Give a sample acceptance and rejection string for the constructed TM (4 mark)	18	4	3
ii.	A: The Machine Halts when there is no possible transition to follow B: The TM final state has an outgoing transition Which of the following is true ? (A) A and B are true (B) A and B are false (C) A is true and B is false (D) A is false and B is true	1	1	3
iii.	Turing Machine (TM) tape head can move in left, right, up or down direction in (A) Multi-tape TM (B) Multi-track TM (C) Multi-head TM (D) Multi-dimensional TM	1	1	3

6	i.	A financial trader made consecutive investments in three stocks. Then, after the market fall, he discovered that he could always earn reasonably by investing in a third stock of quantity n, provided the quantity of the first stock remained the same. a) Provide the investor with a diagrammatic representation of an appropriate Turing machine that would only take investments if they met the previously stated conditions and would therefore provide a respectable profit. (10 marks) b) Check whether the string "aaabbccc" is accepted or not. (8 marks)	18	4	4
	ii.	____ is a special symbol in seven tuple representation of Turing Machine used for blank (A) F (B) B (C) Q (D) ∑	1	1	4
	iii.	Which type of language is recognized by a Turing Machine? (A) Context-Free Language (B) Context-Sensitive Language (C) Recursively Enumerable Language (D) Regular Language	1	1	4
7	i.	Every year a common festival is celebrated between two villages A and B. On an account of this, a local sport is organized by the villagers. The selection of players in this year happens according to the given table (Here 0 indicates women and 1 indicates men). The positioning of the players is made in such a way that at any position, if village A places a set of players from set i, then village B should also place the set of players from set I only. This pattern will repeat for other sets also.	18	4	5

i	A	B
1	11	10110
2	111	000
3	001	0101
4	010	0

a) An audience claims that there are at least two ways in which the men and women of villages A and B can be placed after fulfilling the condition of the game. Is this true? If yes, give the sequence. (10 marks)
b) Assuming the above given table is a MPCP problem, convert it into PCP. (4 marks)
c) Construct a TM, for another game in which if village A places men then village B should place woman and vice versa. Design a TM to help village B in doing so. (4 marks)

	ii.	Consider the statements: S1: All recursively enumerable languages are countable. S2: Set of all non-regular languages over the alphabet {a,b,c} is recursively enumerable. (A) Both S1 and S2 are true (B) Only S1 is true (C) Only S2 is true (D) Both S1 and S2 are false	1	1	5
	iii.	Which type of problems can be included in class NP? (A) Sometimes solvable in polynomial time (B) Always solvable in linear time (C) Always solvable in exponential time (D) Always solvable in polynomial time	1	1	5

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