[Total No. of Questions - 9] [Total No. of Printed Pages - 3]

Dec-25-0363

CSPC-512 (Theory of Computation)

B.Tech. 5th (CBCS/NEP) [CSE/CSE (AI&DS)/CSE (AI&ML)]

Time : 3 Hours **Max. Marks : 60**

The candidates shall limit their answers precisely within the answer-book (40 pages) issued to them and no supplementary/continuation sheet will be issued.

Note : Attempt five questions in all, selecting one question each from section A, B, C and D. Section E is compulsory.

SECTION - A

1. (a) (i) Construct a DFA for binary strings ending with '101'. (3)

   (ii) Construct a DFA for binary strings divisible by 5. (3)

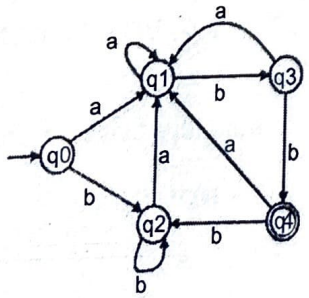
   (b) (i) Prove equivalence of DFA and NFA. (3)

   (ii) Show that two-way finite automata are equivalent in power to one-way Finite automata. (3)

2. (a) (i) Design a Mealy machine that outputs 1 whenever substring "110" appears. (3)

   (ii) Construct a Moore machine that outputs 1 for odd parity of 1's. (3)

   (b) (i) Minimize the given DFA (provide sample table). (3)



(ii) Justify with reasoning why DFA minimization always produces a unique minimal DFA. (3)

SECTION - B

3. (a) Prove or disprove, $L_1 = \{a^n b^m \mid m \neq n\}$ and $L_2 = \{wtw \mid w,t \in \{0,1\}^*\}$ are regular. (3+3=6)

   (b) (i) Construct a regular expression for binary strings with no two consecutive 1's. (3)

   (ii) Construct a regular expression for binary strings where number of 0's is divisible by 3. (3)

4. (a) (i) Show closure of regular languages under union. (3)

   (ii) Show closure of regular languages under reversal. (3)

   (b) Define regular expression. Explain the applications of regular expression. State the pumping lemma for the regular languages. (6)

SECTION - C

5. (a) Convert the grammar $S \rightarrow aSb \mid ab$ into CNF. (6)

   (b) Convert the grammar $S \rightarrow aSa \mid bSb \mid a \mid b$ into GNF. (6)

6. (a) (i) Simplify grammar $S \rightarrow AB \mid a, A \rightarrow aA \mid \varepsilon, B \rightarrow bB \mid C, C \rightarrow c$ by removing null/unit productions. (3)

   (ii) Remove useless symbols from $S \rightarrow AB, A \rightarrow aA \mid a, B \rightarrow b$. (3)

   (b) (i) Differentiate between ambiguous and unambiguous grammars with examples. (3)

   (ii) Construct a CFG in Greibach Normal Form for $L = \{a^n b^n \mid n \geq 1\}$. (3)

[P.T.O.]

SECTION - D

7. (a) (i) Design a Turing Machine to accept $L = \{0^{2^n} | n \geq 0\}$. (3)

(ii) Construct a PDA for $L = \{0^m 1^n 2^p | m,n,p \geq 0, m = n \text{ or } m = p\}$. (3)

(b) (i) Define Universal Turing Machine with proper notations. (3)

(ii) Show that Halting Problem is undecidable. (3)

8. (a) (i) Design a Turing Machine to accept $L=\{0^m 1^m 2^m | m \geq 0\}$. (3)

(ii) Construct a PDA for the Language L that accepts the set of strings over the alphabet {a, b} with more a's than b's. (3)

(b) (i) Differentiate between acceptance by empty stack and acceptance by final state in PDA. (3)

(ii) Write short notes on composite and iterated Turing Machines. (3)

SECTION - E (Compulsory)

9. (a) Define ε-NFA with an example.

(b) List two differences between classification and regression.

(c) Explain the terminal and non-terminal symbols of a grammar.

(d) State any two properties of CFL's.

(e) Explain the mathematical representation of Turing Machine with a suitable example.

(f) State the differences between PDA and DIA. (6×2=12)

Total No.