'समानो मन्त्रः समितिः समानी'

UNIVERSITY OF NORTH BENGAL
BCA Honours 5th Semester Examination, 2022

CC12-BACHELOR OF COMPUTER APPLICATION (52)

THEORY OF COMPUTATION

Time Allotted: 2 Hours   Full Marks: 60
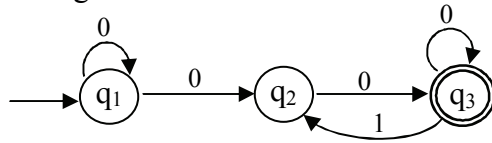
The figures in the margin indicate full marks.

GROUP-A

Answer any *four* questions   3×4 = 12

1. Define nondeterministic finite automata (NFA). Draw the NFA for the language   3
   $L = \{a^n b^m \mid n, m >= 1\}$.

2. Convert the following NFA to DFA   3

3. Write the conditions for a pushdown automaton to be considered as   3
   deterministic.

4. Which are the methods to accept a string in a PDA? Whether both type of PDAs   3
   can define the same language. Justify your answer.

5. Whether the following grammar is ambiguous?   3
   $$E \rightarrow E + E \mid E * E \mid I$$
   $$I \rightarrow 0 \mid 1 \mid a \mid b$$

6. Define context free grammar. Consider the following CFG   3
   $$S \rightarrow aS \mid Sb \mid a \mid b$$
   Prove by induction on the string length that no string in L(G) has *ba* as substring.

GROUP-B

Answer any *four* questions   6×4 = 24

7. Define formally Type 0, Type 1, Type 2 and Type 3 grammar. Show the   6
   corresponding automata for each class.

8. Define a Universal Turing Machine (UTM). With the help of suitable arguments   6
   show the simulation of other Turing machines by a UTM.

9. State pumping lemma for regular languages. Prove that the language $L = \{a^{n^2} \mid n > 0\}$ is not regular.   6
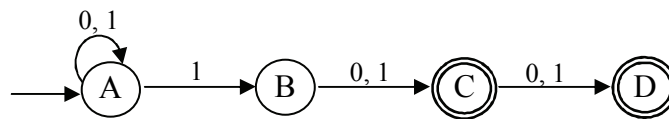
10. Let G be the grammar   6

    $S \to aB \mid bA, \ A \to a \mid aS \mid bAA, \ B \to b \mid bS \mid aBB$

    For the string *aabbaabbba* find

    (i)   leftmost derivation

    (ii)   parse tree

    (iii)   Is the grammar ambiguous?

11. Construct regular expression corresponding to the following state diagram.   6

12. What is recursive and recursively enumerable languages? What is Halting problem?   4+2

GROUP-C

Answer any *two* questions $12 \times 2 = 24$

13. Define Turing Machine. Explain the different type of Turing Machine.   12

14. Explain the block diagram of PDA with its components, specification, language and transition table.   12

15. Write the Chomsky Hierarchy of languages. Prepare a table indicating the automata and grammars for the languages in the Chomsky Hierarchy.   12

16. Define grammars. Convert the given CFG into GNF   12

    $S \to AB, \ A \to BS \mid 1, \ B \to SA \mid 0$

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