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Question Paper Code: 1045166

B.E. / B.Tech. DEGREE EXAMINATIONS, NOV/ DEC 2024

Fifth Semester

Computer Science and Engineering

U20CS502/ U20AI501/U20IT503 - THEORY OF COMPUTATION

(Regulation 2020)

(Common to Artificial Intelligence and Data Science & Information Technology)

Time: Three Hours

Maximum: 100 Marks

Answer ALL questions

PART – A

(10 x 2 = 20 Marks)

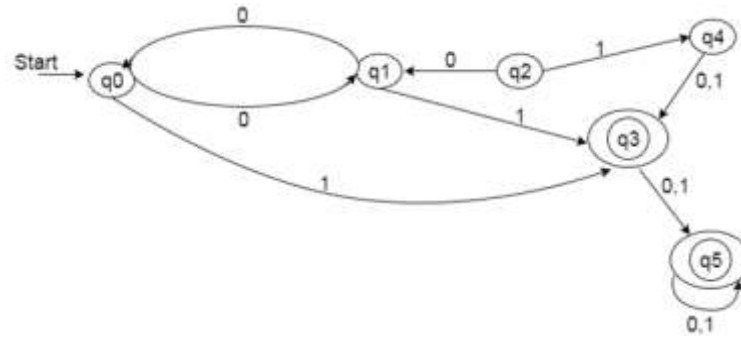
1. Define Finite Automata.
2. Draw a NFA to accept strings containing the substring 0101.
3. What is regular expression?
4. Give the regular expression for the following.  
L1= set of all strings of 0 and 1 ending in 00  
L2= set of all string 0 and 1 beginning with 0 and ending with 1
5. Under what conditions is a grammar considered ambiguous?
6. Generate CFG for  $(011+1)^*$ .
7. How do you covert CFG to PDA.
8. When pushdown automata is said to be deterministic?
9. How do we define a decidable problem, and can you provide an example of a undecidable problem?
10. Compare P and NP problems.

PART – B

(5 x 16 = 80 Marks)

11. (a) i) State and Prove  $1+2+3+\dots+n = n(n+1)/2$  using induction method. (8)  
ii) Construct a NFA accepting binary strings with either two consecutive 0's or two consecutive 1's over  $\Sigma = \{0,1\}$  (8)
- (OR)
- (b) i) Distinguish NFA and DFA with example (8)  
ii) Prove that for every  $\epsilon$ -NFA, there exists an equivalent DFA and provide an example. (8)

12. (a) Explain various steps to minimize the DFA. Construct a minimized DFA from given DFA. (16)



(OR)

- (b) i) Prove that there exists an NFA with  $\epsilon$ -transitions that accepts the regular expression  $\gamma$ . (8)  
 ii) Explain any two closure properties of regular languages. (8)
13. (a) What is the purpose of normalization? Construct the CNF and GNF for the following grammar and explain the steps. (16)  
 $S \rightarrow aAa \mid bBb \mid \epsilon$     $A \rightarrow C \mid a$     $B \rightarrow C \mid b$     $C \rightarrow CDE \mid \epsilon$     $D \rightarrow A \mid B \mid ab$

(OR)

- (b) i) Design a Turing machine to reverse a string consisting of a's and b's. (8)  
 Input1 : aabb  
 Output1 : bbaa  
 Input2 : abab  
 Output2: baba  
 ii) Write briefly about the programming techniques for TM. (8)
14. (a) Design a NPDA and DPDA for the language  $L = \{ww^R \mid w \text{ in } (a+b)^*\}$  (16)

(OR)

- (b) i) Discuss how to convert from PDA to CFG and vice versa. (8)  
 ii) Construct PDA for the given CFG and test whether 010000 is acceptable by this PDA. (8)  
 $\{ S \rightarrow 0BB, B \rightarrow 0S \mid 1S \mid 0 \}$
15. (a) Write brief notes on (8)  
 i) Recursive and Recursively Enumerable languages (8)  
 ii) Halting problem is undecidable. (8)

(OR)

- (b) Analyze the Post Correspondence Problem (PCP) and provide examples to illustrate it. (16)