CSPC41

Formal Languages & Automata theory

NATIONAL INSTITUTE OF TECHNOLOGY, TIRUCHIRAPPALLI
DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING

END SEMESTER EXAMINATIONS – MAY 2023

Session: January 2023 | Time: 3 hours
Date: 8th May 2023 | Max Marks: 100

Answer ALL Questions

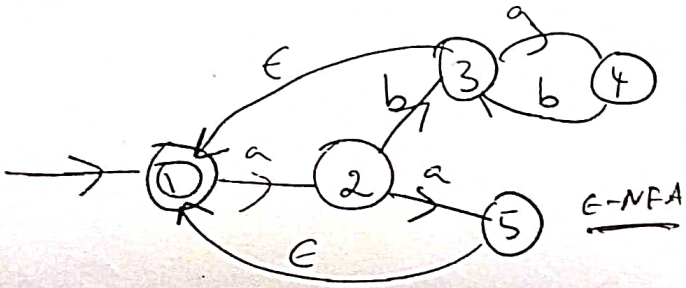
1. a. Prove that if a language is accepted by a NFA then there exists a DFA. (6)

b. Construct a DFA for the following languages: (4)

i. $\{a^i b^j \mid i \geq 0, j \geq 0, i+j \text{ is an even number}\}$

ii. The set of all strings that begin with 'a' but do not contain 'aab' as a substring.

c. Construct a DFA for the following NFA by converting to an intermediate NFA (10)



2. a. Construct a DFA for the language over {0,1}* that contains odd number of 1's and even number of 0's. Using Arden's theorem construct a regular expression for the same. (10)

b. Prove that there exists a ε-NFA for every regular expression (4)

c. Construct a ε-NFA for the following regular expression. (6)

0*(10)* + 1*0*1

3. a. Write a grammar for the 'while' and 'do-while' construct in C language and verify whether your constructed grammar is ambiguous or not. (4)

b. Convert the following grammar to GNF (8)

S → bS | aT | ε
T → aT | bU | ε
U → aT | ε

c. Prove that every CFL without useless symbols and ε productions can be represented with an alternate grammar. (6)

d. Using the properties of CFL show that CFL's are not closed under intersection. (2)

(P.T.O.)

4. a. Construct a PDA for the following language using empty stack
$\{a^i b^j c^k \mid i = j \text{ or } i > k\}$ (7)
b. Construct a PDA using empty stack for the language $\{0^n 1^n \mid n > 0\}$ and convert this PDA to a context free grammar. (10)
c. Prove using pumping lemma that the following is not a context free language: $\{a^n b^m c^n d^m\}$ (3)

5. a. Construct TM to implement the rotate left by one and increment, function where the input string is available on the tape in binary over the language $\{0,1\}^*$ (5)
Example: Input: 01011101 Output: 10111011
b. Given two context free grammars G1 and G2, is the problem of finding $L(G1) = L(G2)$ decidable? (4)
c. Design a TM that accepts the language $\{w\#ww \mid w \in \{a,b\}^*\}$ (7)
d. Define Ld and show that it is not recursively enumerable and not recursive. Comment about its complement. (4)

--- Best Wishes ---