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RAMAIAH
Institute of Technology

(Autonomous Institute, Affiliated to VTU)
(Approved by AICTE, New Delhi & Govt. of Karnataka)
Accredited by NBA & NAAC with 'A+' Grade

SEMESTER END EXAMINATIONS – AUGUST / SEPTEMBER 2023

Program	:	**B.E. - Computer Science and Engineering**	Semester	:	**IV**
Course Name	:	**Finite Automata and Formal Languages**	Max. Marks	:	100
Course Code	:	**CS45**	Duration	:	3 Hrs

Instructions to the Candidates:

- Answer one full question from each unit.

UNIT - I

1. a) Define the following terms with suitable examples: CO1 (05)
i) Alphabets ii)Strings iii)Empty String iv) Length of the String
v) Language.

b) i.Design a DFA that accept strings over Σ= {a,b} having exactly three a's. CO1 (08)
ii.Obtain a dfa to accept the language ending with L={wbab | w∈ {a,b}*}

c) Convert the following NFA to DFA. CO1 (07)

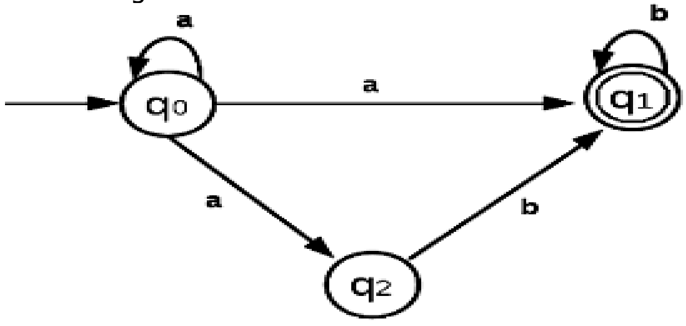

Fig.1(c)

2. a) Prove that if D=(QD,Σ,δD,{q0},FD) is a DFA constructed from NFA N=(QN,Σ,δN,q0,FN) by the subset construction, then L(D)=L(N). CO1 (07)

b) Convert the following ε-NFA to DFA: CO1 (07)

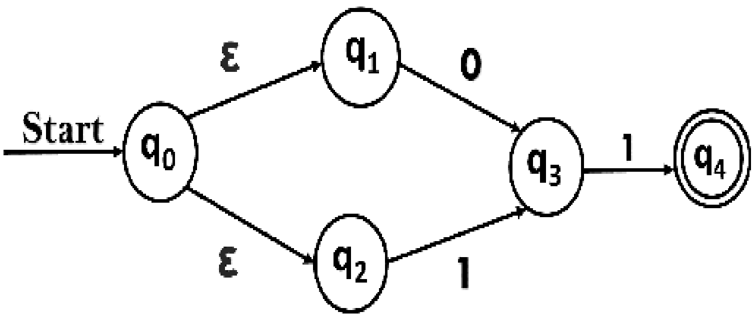

Fig.2(b)

c) Design an NFA with Σ = {a, b} such that it accepts all strings except those which end with abb. CO1 (06)

UNIT - II

3. a) Write Regular Expression for the following language CO2 (04)
i) L={uvw|u,w belong to Σ* and |v|=2} where Σ={a,b}.
ii) Language consisting of strings of 0's and 1's ,starting with zero and ending with 1

b) Consider the following DFA : CO2 (09)

States	0	1
→ q1	q2	q1
q2	q3	q1
*q3	q3	q2

Find $R^{(3)}_{13}$.

c) Prove that if L is a regular language ,so is L^R. CO2 (07)

4. a) Convert DFA to Regular expressions by eliminating states. CO1 (07)

State	a	b
→*qo	q1	q3
q1	qo	q2
q2	q3	q1
q3	q2	qo

b) States and Prove Pumping Lemma for Regular Expression. CO2 (05)

c) Minimize the following DFA by applying table filling algorithm. CO2 (08)

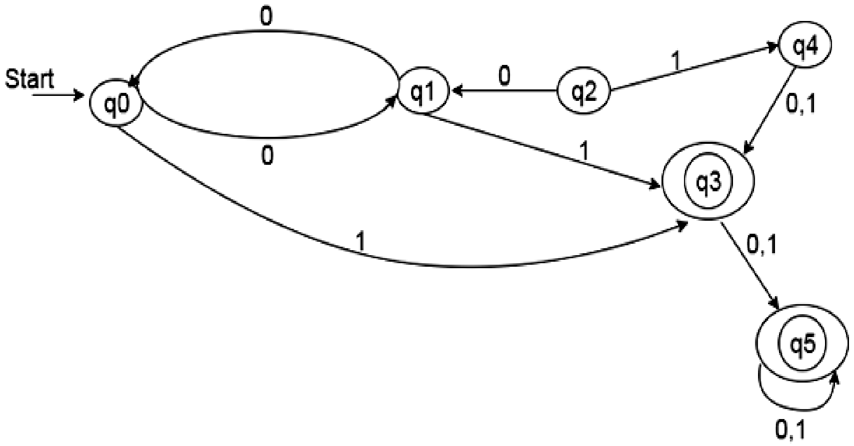

Fig.4(c)

UNIT - III

5. a) Construct CFG for the following language: CO3 (06)
i) $L=\{a^nb^ma^n \mid m, n>=1\}$ ii) $L=\{a^ib^jc^k \mid i\neq j \text{ or } j\neq k\}$

b) Let G=(V,T,P,S) be a CFG. Prove that if the recursive inference procedure tell us that terminal string w is in the language of variable A, then there is a parse tree with root A and yield w. CO3 (07)

c) Define ambiguous grammar. Show the following grammar is Ambiguous CO3 (07)
$S \rightarrow S+S \mid S-S \mid S*S \mid (S)/S \mid a$ for the string a+(a*a)/a-a.

6. a) Obtain the Leftmost and rightmost derivation and parse tree for the string aaabbabbba using the following grammar: CO3 (06)
$S \rightarrow aB \mid bA$
$A \rightarrow aS \mid bAA \mid a$
$B \rightarrow bS \mid aBB \mid b$

b) Construct PDA to accept strings with $L=\{a^nb^nc^n \mid n>=1\}$ and show moves For the strings aabbcc. CO3 (08)

c) Define the following : CO3 (06)
i)Language of CFG ii)Sentential form iii) yield of a parse tree

UNIT- IV

7. a) Define Chomsky Normal Form. State the rules to put a given CFG into CNF. CO4 (06)

b) Show that $a^nb^nc^n$ is not context free language using pumping lemma of CFL. CO4 (05)

c) For the given grammar: CO4 (09)
S->ABC|BaB
A->aA|BaC|aaa
B->bBb|a|D
C->CA|AC
D->ε
   i) Eliminate ε-productions
   ii) Eliminate unit productions in the resulting grammar.
   iii) Eliminate any useless symbols in the resulting grammar.

8. a) Define the following: CO4 (04)
   i. Unit production.
   ii. Null production.
   iii. Null-able production.
   iv. Reachable Symbol.

b) Obtain the following grammar in CNF: CO4 (10)
S->0A0 | 1B1 | BB
A-> C
B-> S | A C->S| ε

c) Prove that context free languages are closed under union and concatenation. CO4 (06)

UNIT- V

9. a) Define Turing machines. Design a Turing machine to accept $a^nb^nc^n$. CO5 (10)
b) Prove that if L is a recursive language, so is complement of L. CO5 (05)
c) Define post correspondence problem and also give suitable example. CO5 (05)

10. a) Explain with neat diagram, general structure of multi-tape Turing machine. CO5 (04)
b) Discuss : CO5 (06)
   i) Halting problem of Turing Machine
   ii) Language of a Turing Machine
   iii) Instantaneous descriptions for Turing Machines.
c) Design a Turing machine to implement the function for multiplication. Show the moves for 0010001. CO5 (10)

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