Registration No : | | | | | | | | | | |

Total Number of Pages : 03p

Course: B.TECH
Sub_Code: RCS5C001

5th Semester Regular/Back Examination: 2022-23
SUBJECT: Formal Languages and Automata Theory
BRANCH(S): CSE,CSEAIME,CSIT,CST,ELECTRICAL & C.E,IT
Time : 3 Hour
Max Marks : 100
Q.Code : L185

Answer Question No.1 (Part-1) which is compulsory, any eight from Part-II and any two from Part-III.
The figures in the right hand margin indicate marks.

Part-I

Q1 **Answer the following questions :** **(2 x 10)**

a) Construct a Deterministic Finite Automata (DFA) for L = {set of all strings where the number of 'a' and the number of 'b' in the string is even} over $\sum$ = { a, b} }.

b) State Mealy and Moore machines with suitable examples. Find the output string length of Mealy and Moore machines if the input string length is 'n'.

c) Construct the grammar to derive the language L = {wcw^r |w ϵ {a,b}* and w^r is reverse of string w.}

d) Construct finite automaton equivalent to the regular expression

$R = (p \mid q)^*(pp + qq)(p \mid q)^*$

e) Consider the grammar G, where the productions are

$E \rightarrow F - E \mid E - F \mid F$

$F \rightarrow a \mid b$

Prove that the Grammar is ambiguous for the string a – b

f) Construct the grammar to derive the language L = {wcw^r |w ϵ {a,b}* and w^r is reverse of string w.}

g) Differentiate between Chomsky Normal Form (CNF) and Greibach Normal Form (GNF).

h) State the halting problem of Turing machine.

i) Define K-Clique problem. State whether the problem belongs to Class P or Class NP

j) Compute A (3, 3) using Ackermann function

Part-II

Q2 **Only Focused-Short Answer Type Questions- (Answer Any Eight out of Twelve)** **(6 × 8)**

a) Construct the grammar to derive the language L = {wcw^r |w ϵ {a,b}* and w^r is reverse of string w.}

b) Construct a minimum state automaton equivalent to given automaton whose transition table is given below:

States/Input	a	b
→q0	q1	q3
q1	q2	q4
q2	q1	q4
q3	q2	q4
*q4	q4	q4

c) Use pumping lemma to prove that the language L= {a^p|p is a prime} is not regular.

d) Apply the identities of regular expressions to prove the following: (1+00*1)+(1+00*1)(0+10*1)*(0+10*1) = 0*1(0+10*1)*.

e) Consider the grammar G given in CNF.

S→AB | BC

A→BA | a

B→CC | b

C→AB | a

Use Cook-Younger-Kasami (CYK) algorithm to determine whether the string 'baaba' is in L(G).

f) Construct ϵ - NFA for the regular expression R = (cd | c)*. Construct the equivalent DFA by ϵ-closure method for the given regular expression

g) State and prove Greibach Nomal Form

h) Are there any languages which are not recursively enumerable, but accepted by a multi-tape Turing machine? Justify your answer.

i) Compare tractable and untractable problem

j) Compare context sensitive grammar and context free grammar. Can we design a PDA for context sensitive languages? Justify your answer.

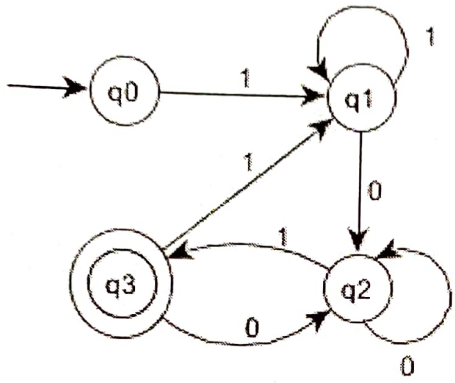
k) State and prove pumping lemma for context free languages. Mention the application of pumping lemma.

Part-III

Only Long Answer Type Questions (Answer Any Two out of Four)

Q3 **a)** Differentiate between Nondeterministic Finite Automata (NFA) and Deterministic Finite Automata (DFA). Construct DFA over $\sum = \{0, 1\}$ for strings having substrings either 101 or 110. **(8)**

b) Find the regular expression corresponding to the automaton given below: **(8)**



Q4 **a)** Design a Push Down Automata (PDA) accepting the language $L = \{0^n1^m0^n1^m | m, n \geq 1\}$. **(8)**

b) Reduce the following grammar G into Chomsky Normal Form (CNF). The productions are P: {S → aAD, A → aB | bAB, B → b, D → d} **(8)**

Q5 **a)** Define Turing Machine (TM) with its tuples. Design a TM for the language $L=\{a^nb^n | n \geq 1\}$. **(8)**

b) Differentiate between recursive language and recursive enumerable language. Prove that recursive languages are closed under Union, Complement **(8)**

Q6 **a)** Explain the meaning of polynomial time reduction. Prove that if B is in P and $A \leq_P B$, then A is in P **(8)**

b) Show the relationship between NP-Complete and NP-Hard problems. Prove that Class P problems are closed under Union, Complement **(8)**