POKHARA UNIVERSITY

Level: Bachelor | Semester: Fall | Year : 2024
Programme: BE | Full Marks : 100
Course: Theory of Computation (New) | Pass Marks : 45
Time : 3 hrs.

Candidates are required to give their answers in their own words as far as practicable.

The figures in the margin indicate full marks.

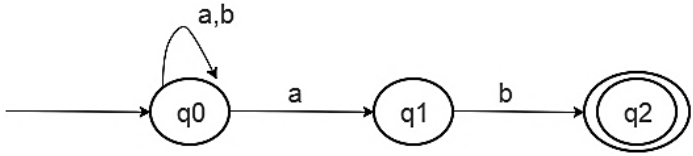
Attempt all the questions.

1. a) State and prove the pigeonhole principle. Prove by mathematical induction $1^2 + 3^2 + 5^2 + \ldots\ldots\ldots + (2n-1)^2 = \frac{n(2n+1)(2n-1)}{3}$. 7

   b) Define Finite Automata. Design a DFA that accepts strings ending with "01" over the alphabet Σ= {0,1}. 8

2. a) What are Regular Expressions (RE)? Construct an NFA for the regex (ab)*.ac.(a|b). 7

   b) Convert the following NFA to its equivalent DFA. 8



3. a) What is Pumping lemma for regular language? Construct a counter-example using the pumping lemma to show that L={w ϵ(a,b)*|w starts and ends with the same letter.} 7

   b) Convert the given grammar CFG into CNF 8
   S→ bA|aB
   A→bAA|aS|a
   B→aBB|bS|a

4. a) Define ambiguous grammar. Show that the given grammar is ambiguous. 7
   S->aB|ab A-> aAB|a B->Abb|b

   b) Why is PDA better than Finite Automata? Design a PDA to accept the Language $\{0^n 1^n | n \geq 0\}$ over alphabets∑= {0,1}. 8

OR

Prove CFL is closed under union and concatenation. Design a string s from the language. L={$a^n b^n c^{n+1} \geq 0$ }to demonstrate a violation of the CFL Pumping Lemma.

5. a) Design a TM which computes the function f(p)=p+2 for each p that belongs to a set of natural numbers. 7

   b) Briefly explain the idea of designing the Turing Machine that accepts the language L ={$a^n b^n$: n>0}. Show the state transition diagram for it. 8

6. a) What is reducibility? Differentiate between recursive and recursively enumerable language. Explain any 2 properties of recursive language. 7

   b) Define computability, P, and NP class problems with an example. How do P and NP class problems reflect the notion of deterministic and non-deterministic algorithms? Is P=NP Explain. 8

OR

What are tractable problems? Explain NP-complete problem with suitable example.

7. Write short notes on: (**Any two**) 2×5

   a) Church Turing Thesis

   b) Set and relation

   c) Extension of Turing Machine