

Pokhara Engineering College
Internal Assessment

Program : Computer

Level : Bachelor

Year : 2024

Subject : Theory of Computation (New)

FM: 100

PM: 45

Semester: IV

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. Neat and clean writing are extra credited.

Attempt all the questions.

1. a) What is the fundamental difference between DFA and NFA? 8
Design a FA which starts with either 01 or end with 01 over the given alphabet $\Sigma = \{0,1\}$.

OR

Construct a finite automata for the following regular expression $a(a+b)^*bb$

- b) Convert the following NFA to its equivalent DFA: 7
NFA:
• States: $\{q_0, q_1, q_2\}$
• Alphabet: $\{a, b\}$
• Transition function: $\delta(q_0, a) = \{q_0, q_1\}$, $\delta(q_0, b) = \{q_0\}$,
 $\delta(q_1, a) = \{q_2\}$, $\delta(q_1, b) = \{q_2\}$, $\delta(q_2, a) = \{\}$, $\delta(q_2, b) = \{q_2\}$
• Start state: q_0
• Accept states: $\{q_2\}$

2. a) What are the applications of CFG? Write the context free grammar for the language given by $L = \{a^n b^n : n \geq 0\}$ 8

- b) What is ambiguous grammar? Show that given grammar is ambiguous: 7

$S \rightarrow mCnS \mid mCnSeS \mid a$
 $C \rightarrow b$

3. a) What is CNF? Convert below context-free grammar $G = (V, \Sigma, R, S)$ to Chomsky Normal Form, where $V = \{S, A, B\}$ 8

$\Sigma = \{a, b\}$

$R = \{ S \rightarrow ASA \mid aB$

$A \rightarrow B \mid S$

$B \rightarrow b \mid \epsilon \}$

- b) Design a PDA that accepts the language $L = \{a^n b^m : n \geq m\}$. 7
4. a) State pumping lemma for CFL. Show that $L = \{a^n b^n c^n : n > 0\}$ is not a CFL. 8
b) Explain and illustrate with an example why the Halting Problem is undecidable. 7
5 a) Explain the basic model of a Turing machine. Design Turing machine that accepts the language $L = \{x^n y^n \mid n \geq 1\}$. 8

OR

Define a UTM. Explain about encoding for a UTM with a suitable example.

- b) Show, with a suitable example, that TM can be constructed as a transducer. 7
6. a) What are Tractable and Intractable problem? Explain the NP complete and NP hard problems with suitable examples. 8
b) Differentiate between Recursive Language and Recursive Enumerable language. Also, write the properties of these languages. 7
7. Write short notes on: (any two) 10
a) Relation and function
b) State minimization of DFA.
c) TM Extensions
d) Induction proof theory

All the Best