

Pre-University Examination Questions

paper collection



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Cosmos (Aasha Thapa)

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Pokhara University
Everest Engineering College
Preboard
Spring

Level: Bachelor
Program : BE CMP(4TH Sem)
Course: Theory of Computation

Year : 2025
Full Marks: 100
Pass Marks: 45
Time : 3 hrs.

Candidates are required to answer in their own words as far as practicable.
The figures in the margin indicate full marks.
Attempt all the questions.

1. a) what is string and alphabet. State and prove mathematical induction for sum of square of N natural numbers. 7

Or

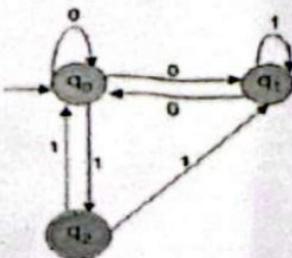
State digonalization Principal with example. Use mathematical induction to prove that $7^{2n} + 2^{3n-3} \cdot 3^{n-1}$ is divisible by 25 for $n \in \mathbb{N}$. 8

- b) Design a DFA to accept string of 0's & 1's when interpreted as binary numbers . 8

15

2. a) Differentiate NFA AND DFA. Convert the following NFA into DFA. 7

5



- b) Create a ϵ -NFA for regular expression: $(a/b)^*a$ and also show the steps while constructing it. 8

Or

What are regular expression. Construct a Nfa for given regular expression:-

$(ab)^* \cdot ac \cdot (a/b)$

5

3 a) Explain the decision algorithm for regular set.7

b) what are the rules for the production of GNF? Convert the following CFG into GNF.8

$$S \rightarrow AY \mid XX$$

$$X \rightarrow x \mid SX$$

$$Y \rightarrow y$$

$$A \rightarrow x$$

4. a) When the grammar is said to be ambiguous? Verify this with an example and derivation of string.7 X 3

b) Why PDA is considered more powerful than Finite state machine. Design a PDA for accepting the language $(a^n b^m c^n \mid n, m > 1)$ over input alphabet {0,1}.8

5 a) Define Turing Machine. That accepts the language: $L = \{ w \in \{a, b\}^* \mid w \text{ is a palindrome} \}$.
Trace the steps of the machine when processing the input string baabbaab.7

Or

Design a Turing machine for a 2's Complement and show each steps and also check a 2's complement for a string 010010010010.

b) Why Turing machine is considered as much powerful machine. Explain in details. Design a turing Machine for $a^n b^m c^n \mid n, m > 1$ over input alphabet {a,b}.8 X

6 a) What does it mean to say that a language is "Turing-recognizable" and how does the UTM relate that.7

b) What do you understand by time and space complexity in algorithm analysis? Illustrate and differentiate between the complexity classes P and NP using examples. Discuss their importance in addressing practical computational challenges.8

7. Write short notes (Any Two)

a) Let $*L = \{ ww \mid w \in \{a, b\}^* \}^*$. Prove that L is not regular using the Pumping Lemma.

b) Halting Problem

c) Recursive and Recursively Enumerable languages

Hall

GANDAKI COLLEGE OF ENGINEERING AND SCIENCE

Level: Bachelor	Semester: Spring	Year : 2025
Programme: BE CE IV		Full Marks: 100
Course: Theory of Computation		Pass Marks: 45

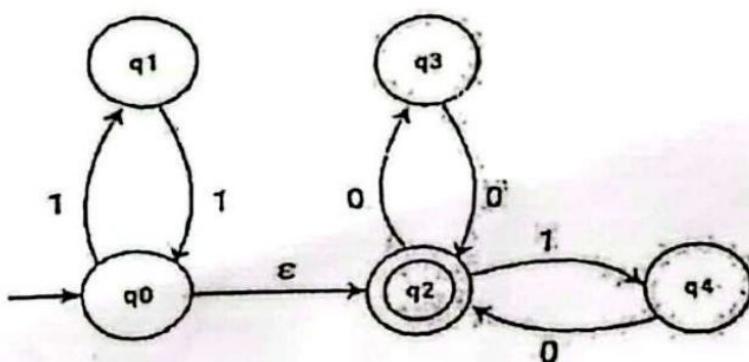
Time : 3hrs.

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 Pigeonhole Principle. Prove by mathematical induction that $n^4 - 4n^2$ is divisible by 3 for $n \geq 0$; 7
 b) Differentiate between DFA and NFA. Construct a DFA that recognizes Languages L that accepts the set of strings that starts and ends with different symbol over $\Sigma = \{a, b\}$ and test your design with a valid string. 8
2. a) Convert the following NFA to its equivalent DFA. 7



- b) Define Pumping Lemma for regular language. Show that $L = \{a^n b^{2n} : n \geq 1\}$ is not regular using pumping lemma for regular language. 8
3. a) What is CFL? Convert the following CFG into CNF. 7
- $S \rightarrow ASA \mid aB$
 $A \rightarrow B \mid S$
 $B \rightarrow b \mid \epsilon$

- b) Design a PDA for the following language $L = \{a^n b^{2n+1} : n > 0\}$ 8
also check it for aabbhhh and aabbb.

OR,

Define PDA with block diagram. Construct a PDA that accepts $L = \{a^n b^n : n > 0\}$. Show by sequence of IDs that aabb is accepted by this PDA,

4. a) Show the language $L = \{a^n b^n c^n : n > 0\}$ is not context free using the concept of pumping lemma. 7
b) What is CFG? Design CFG for language $L = \{a^m b^n : m \geq 1, n \geq 1\}$. Test the grammar for derivation of aaaabbb and also draw equivalent parse tree. 8

OR,

PDA is stronger than FA and for every CFG there is an equivalent PDA. Justify this statement with an example.

5. a) Design a TM for $L = \{WW^R : W^R \text{ is reverse of } W \in (a,b)^*\}$ for both even and odd palindrome. 7

OR,

Define Turing Machine. Design a Turing machine that accepts the language $L = \{a^n b^n c^n : n \geq 0\}$.

- b) Describe the concept of "accepting state" and "halting state" in a Turing Machine. Show that the function $f(n) = 2n$ is Turing computable. 8

6. a) State the halting theorem and give outline of its proof. 7

- b) What is P, NP and NP-complete problems? Explain with examples. 8

7. Write short notes on (Any Two) 2×5

- a) Simplification of CFG.
- b) Universal Turing Machine
- c) Church-Turing Thesis

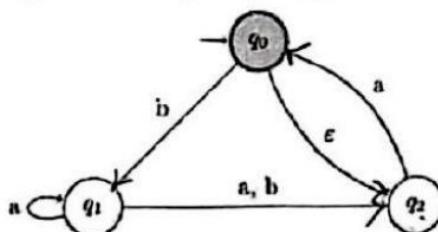
Date: 20/04/07	Level BE	Full Marks 70
Programme BCE		Time
Semester IV		2 hrs

Subject: - Theory of Computation

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ Attempt 70 mark questions.
- ✓ The figures in the margin indicate Full Marks.
- ✓ Assume suitable data if necessary.

1. a) Draw the block diagram of a finite state automata and also formally define DFA. [7]
- b) Define Finite State Automata. Construct a DFA that recognizes language L that accepts the set of strings that contains neither aa nor bb as substring over $\Sigma = \{a, b\}$ and test your design with a valid string. [8]

2. a) Convert the following NFA to its equivalent DFA. [7]



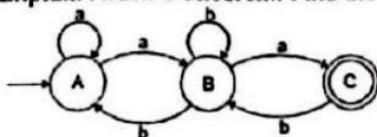
- b) Define pumping Lemma for regular language. Show that $L = \{a^n b^{2n}; n > 1\}$ is not regular using pumping lemma for regular language [8]
3. a) What are the decision properties of regular language? Explain in detail. [7]
- b) Describe Context free grammar with its formal definition. Convert the following grammar into Chomsky Normal form. [8]

$$S \rightarrow bA/aB, A \rightarrow bAA/aS/a, B \rightarrow aBB/bS/b$$

4. a) Show that the language $L = \{a^n b^n c^n; n > 0\}$ is not context free using the concept of pumping lemma. [7]
- b) Design a PDA which accepts the language given by $L = \{w \in \{a, b\}^*: w w^R\}$. Consider Z_0 to be the bottom of the stack. [8]

5. a) Design a Turing machine for computing function: $F(x, y) = x + y$ and show your validation for $x = 2$ and $y = 4$. [7]
- b) Design a Turing machine which replaces each occurrence of a by b and vice versa and validate your design using #aabba#. [8]

6. a) Explain Arden's Theorem. Find the expression for the following FSA. [7]



- b) Explain the Halting Paradox in Turing Machine. What are Space and Time complexity? [8]

7. Write short notes on (Any Two): [2*5=10]
 - a) P class and NP class problems
 - b) Church-Turing Thesis
 - c) Recursive and Recursively Enumerable Language

C - 103

Madan Bhandari College of Engineering
Urlabari-3, Morang
Final Internal Examination

Level: Bachelor

Full Marks: 100

Programme:B.E Computer

Pass Marks: 45

Year/Part:II/II

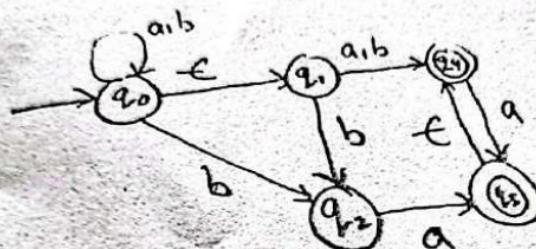
Time: 3 hrs

Subject: - Theory Of Computation

- ✓ Candidates are required to give their answers in their own words as far as possible.
- ✓ Attempt all questions

1) A) Differentiate between DFA and NDFA. Design DFA for language of strings over $\{a,b\}$ in which strings end with "aba". [8]

B) Convert a DFA equivalent to NFA as shown. [7]

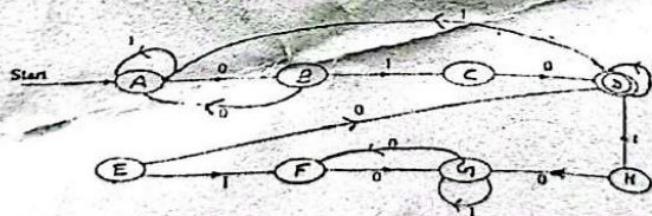


2.A) What is Set? Give the regular expression for the following languages over alphabet {a, b}; [7]

a. Set of all strings starting with substring "ab"

b. Set of all strings with ending with "bb"

B) Convert the following DFA into minimum-state equivalent DFA. [8]



3.A) Define Pumping Lemma. Show that $L=\{1^n 2^{2n} : n \geq 1\}$ is not regular using pumping lemma for regular language. [7]

B) Explain about the closure properties of RL. Show that for any regular languages L₁ and L₂, L₁ ∪ L₂ is also regular. [8]

4. A) Define PDA with block diagram? Design a PDA which accepts the language $L=\{a^n b^{2n} : n \geq 1\}$ and test for strings aabb and aab. [8]

B) Convert following grammar into equivalent PDA [7]

$$S \rightarrow AAC, A \rightarrow aAb \mid \epsilon, C \rightarrow ac \mid b \mid ab$$

5.A) Explain the closure properties of context free languages with example. [7]

B) What do you mean by Ambiguous Grammar? Explain with example. Define Parse tree, leftmost and rightmost derivation with example. [8]

6..A) Reduce the following CFG to CNF

[8]

$S \rightarrow aB/bX$

$A \rightarrow Ba/d/bSX/a$

$B \rightarrow aSB/bBX$

$X \rightarrow SB/aBX/ad/B$

B) Explain in brief the P and NP complete problems with suitable examples.

[7]

7. Write short notes on any two [2*5=10]

a Chomsky's hierarchy

b tractable and Intractable problems

c pigeon hole principle

Nepal College of Information Technology
Final Assessment

Semester :	IV	Year :	2025
Level :	Bachelor	Full Marks:	100
Program :	BE Computer	Pass Marks:	45
Subject :	Theory of Computation	Time :	3 hrs.

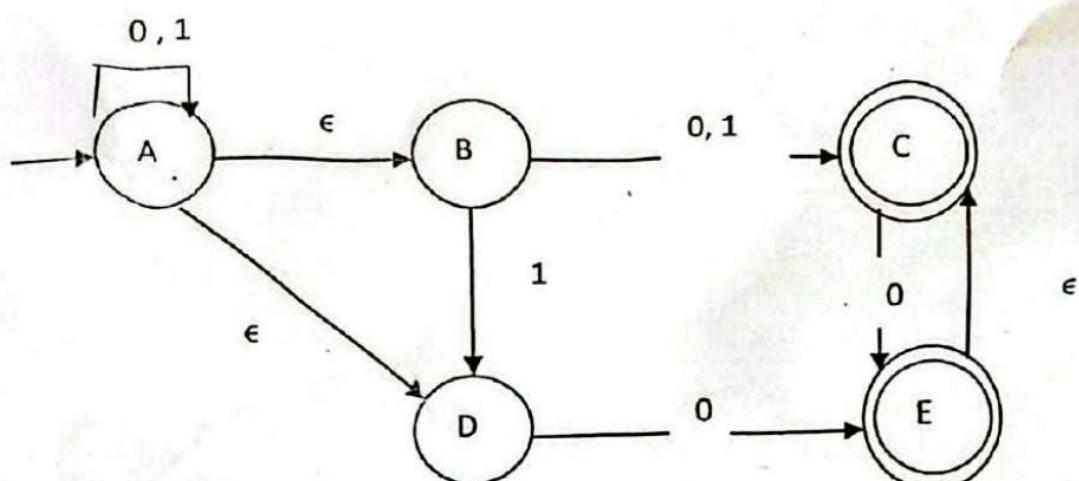
- ✓ Candidates are required to give their answer in their own words as far as practicable.
- ✓ The figures in the margin indicate the full marks
- ✓ Attempt ALL questions

1. a) What is a finite automaton? Design a NFA that accepts the language given by $L=\{w \in \{a,b\}^*: w \text{ contains the pattern "abba" or "baab"}\}$. Hence test your design for abaaba. [8]

OR

a) Differentiate DFA and NFA. Design a DFA that accepts the language given by $L=\{w \in \{0,1\}^*: w \text{ does not contain substrings "00" or "11"}\}$. Hence test your design for abaaba. [8]

b) Construct a DFA equivalent to NFA as shown: [7]



2. a) What is CFG? Design CFG for language $L(G)=\{a^m b^n : m \geq n\}$ along with parse tree. And also test your design for strings 'aaabb' and 'aabbb'. [7]

- b) What is CNF? Convert following CFG into CNF, $G=(V, \Sigma, R, S)$
where
 $V=\{S, A, B\}$,
 $\Sigma=\{a, b\}$,
 $R=\{S \rightarrow bA | aB, A \rightarrow bAA | aS | a, B \rightarrow aBB | bS | b\}$
3. a) What is instantaneous description of PDA? Design a PDA which accepts the language $L=\{0^{3n}1^n : n \geq 1\}$ and also test your design for '00000011' and '00001'. [8]
- OR
- a) Design a PDA which accepts the language $L=\{a^i b^j c^k : k = i+j\}$ and also test your design for strings "aaabccc" and "bbbccc". [8]
- b) State pumping lemma for context free language. Show that $L=\{a^n b^n c^n | n \geq 1\}$ is not context free language. [7]
4. a) Design a Turing machine that accepts the language $L=a^n b^n c^n | n \geq 0$. Also test your design for strings 'aabbcc' and 'aabcc'. [8]
- b) Explain different proof techniques with examples.. [7]
5. a) Explain Turing Machine with storage in states. Design a model of Turing Machine that recognizes a language $L=\{w \in \{0,1\}^*\}$ where it sees a first symbol either 0 or 1 and then checks that it does not appear elsewhere in string. [8]
- b) Write about church turing thesis and universal turing machine [7]
6. a) "For every regular expression there is a finite automaton and for every finite automaton there is regular expression." Justify this statement with examples. [8]
- b) Differentiate between tractable and intractable problems. What are P, NP and NP-Complete problems? [7]
7. Write short notes on : (any two) [2X5]
- a) Properties of Recursive Language.
b) Ambiguous Grammar
c) Closure properties of regular language.

NEPAL ENGINEERING COLLEGE

Level: Bachelor Semester – Spring Year : 2025
Programme: BE, Computer-IV Full Marks: 100
Course: Theory of Computation (New) Pass Marks: 45
 Time : 3hrs.

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) Define Deterministic finite Automata with 5-tuples. Design a DFA that accepts a set of strings where the number of 0's and no. of 1's are even in each string over alphabet, $\Sigma = \{0,1\}$. 7
b) Given the transition table as follows:

δ / Σ	0	1
$\rightarrow q_0$	$\{ q_0, q_3 \}$	$\{ q_0, q_1 \}$
q_1	Φ	$\{ q_2 \}$
q_2	$\{ q_2 \}$	$\{ q_2 \}$
q_3	$\{ q_4 \}$	Φ
$*q_4$	$\{ q_4 \}$	$\{ q_4 \}$

Draw the transition diagram and also check the NFA for the input string 8
01001.

OR

Construct a FA equivalent to the regular expression $a.(a+b)^*.bb$.

2. a) Define Regular Expression.State and prove pumping lemma for regular sets. 7
b) Define Context Free Grammar. Given a CFG for the language as follows, consider a string of length at least 7 and check whether the string can be derived or not. 8

$$L = \{wcw^R / w \in (a,b)^*\}$$

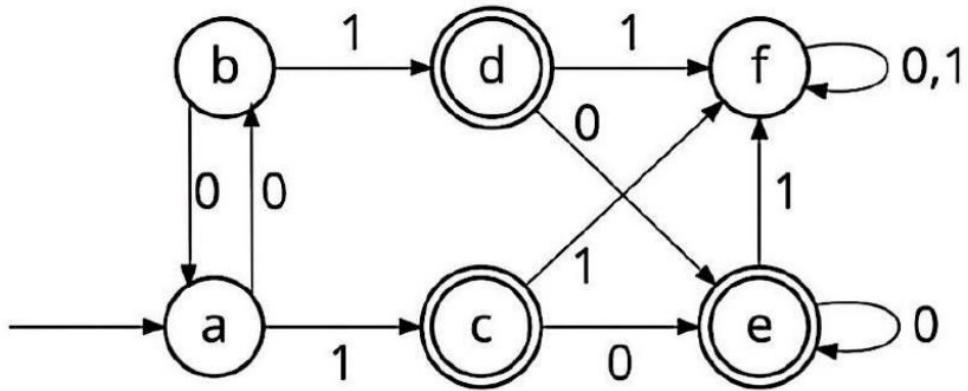
where the production rule is defined as;

$$S \rightarrow aSa/bSb/c$$

3. a) Define the ambiguity of a Context Free Grammar. Prove that following grammar is ambiguous. 8

$S \rightarrow iCtS$
 $S \rightarrow iCtSeS$
 $S \rightarrow a$
 $C \rightarrow b$

- b) What is Push Down Automata? Construct a PDA that will accept all strings over the alphabet, $\Sigma = \{0,1\}$ consisting of equal number of a's and b's. The acceptance of the above strings will be by empty stack rather than final state. 7
4. a) In what aspect the Non-deterministic PDA is more powerful than deterministic PDA? State and prove any five closure properties of regular languages. 7
- b) Explain with neat sketches about the hierarchy of Languages and their corresponding automata as given by Noam Chomsky. Prove that the language $L = \{a^n b^n c^n / n \geq 1\}$ is not regular language. 8
5. a) How can you represent a Turing Machine? Show that the function, $f(n) = n+3$, is Turing computable (assume $n=2$) 7
- OR
- Design a Turing machine to compute the function, $f(a,b) = a \times b$ such that a = 2 and b = 3. The output will be 6. 8
- b) What is normal form? Define GNF and use this definition to convert the following CNF into its equivalent GNF.
- $S \rightarrow AA/a,$
 $A \rightarrow SS/b$
6. a) How does a function differ from a relation? Define the function and the relation for a set, $A = \{1,2,3\}$. 7
- b) Minimize following DFA using any algorithm- 8



7. Write short notes on *any two*: 2×5

- a) Alphabet and Language.
- b) Computable languages and functions.
- c) Church's thesis and UTM.

OR

Unrestricted grammar, G and it's language, L(G).

Pokhara Engineering College
Internal Assessment-2025

Program : Computer
Level : Bachelor
Year/Part : II / II

Subject: Theory of Computation

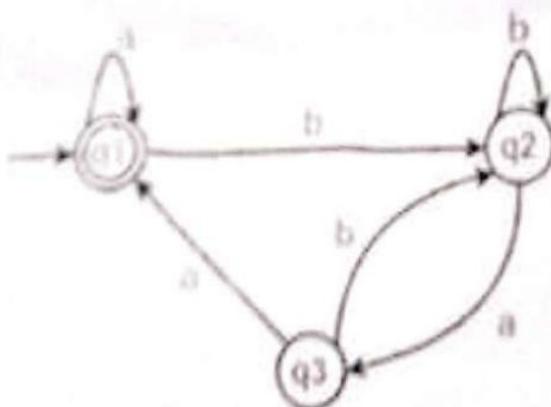
FM: 100
PM: 45
Time: 3 hrs

Candidates are required to give their answers in their own words as far as practicable. The figures in the margin indicate full marks. Neat and clean writing are extra credited. Attempt all the questions.

1. a) State Pigeon Hole principle. Using Mathematical Induction, prove that the sum of the first n odd positive integers is equal to n^2 7
- b) What is the primary distinction between regular languages and context-free languages? Design a DFA for a language that contains "00" as a substring or ends with "10" over the alphabet $\Sigma = \{0,1\}$. 8

OR

Find the Regular Expression for the below DFA:



2. a) Define left-recursive grammar. Show that the grammar below is ambiguous:
 $S \rightarrow aSb \mid aSSb \mid ab$ 7
- b) List the uses of regular expressions. Construct a context-free grammar for the language $L = \{a^n b^m : n \text{ is even and } m \geq 1\}$. 8

3. a) What is Greibach Normal Form (GNF)? Convert the following CFG into CNF; 7
- $G = (V, \Sigma, R, S)$, where
- $V = \{S, A\}$,
- $\Sigma = \{a, b\}$
- $R: S \rightarrow aAb \mid \epsilon$
- $A \rightarrow aA \mid b$
- b) Compare and contrast PDA and Turing Machine. Design a PDA that accepts the language $L = \{w \in \{a,b\}^*: \text{number of } a's = \text{number of } b's\}$. 8
4. a) State the Pumping Lemma for regular languages. Use it to show that $L = \{a^n b^n c^n d^n : n \geq 1\}$ is not regular. 7
- b) What is an Universal Turing machine? Justify whether the Halting problem can be solved using any machine model. 8
5. a) What is meant by Turing completeness? Show that the function $f(n) = 2n$ is Turing computable. 7
- b) Define a multi-tape Turing Machine. Design a Turing Machine for $L = \{a^n b^n c^n : n \geq 1\}$. Also verify your design for *aabbcc*. 8
6. a) What are Recursive and Recursive Enumerable languages? Show the relationship between them. 7

OR

- What are Turing recognizable and Turing Decidable languages? Show that the union of two recursive language is recursive.
- b) What are Tractable and Intractable problem? Explain the NP complete and NP hard problems with suitable examples. 8
7. Write short notes on: (any two) 10
- a) Relation and function
- b) State minimization of DFA.
- c) Post Correspondence Problem (PCP)

All the Best

UNITED TECHNICAL COLLEGE

Level:Bachelor

Semester: Spring

Year : 2025

Programme: BE

Full Marks : 50

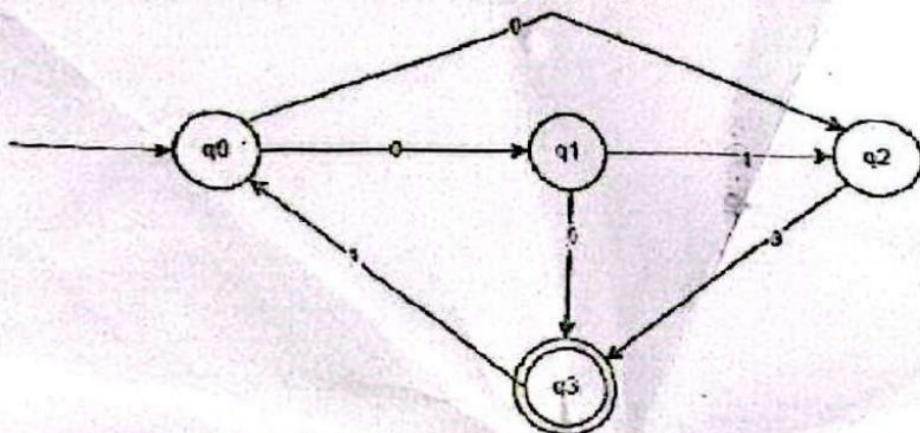
Course: Theory of Computation

Pass Marks : 23

Time : 1.5hrs.

- 1 a. Design a FA that accepts a set of string such that every string has starts with 00 and ends with 11, over alphabet {a,b}.
 b. Find the regular expression for the following finite automata

8



- 2 a. Convert the above figure from NFA to DFA. 7
 b. State and explain Arden's theorem with example. Also convert the following regular expression to finite automata: $00^*(0^*0+1)$. 8
- 3 a. Define Parse tree. When a grammar is called ambiguous? Explain with example 8
 b. Give the formal definition of pushdown automata. Construct a PDA accepting the language $L = \{a^n b^n \mid n > 0\}$. 7
- 4 a. State pumping lemma for context free language. Prove that language $L = \{a^n b^n c^n \mid n > 0\}$ is not context free language. 8
 b. Define Turing machine. Construct a TM machine for checking the even palindrome of the string with strings $\{a,b\}^*$. 8
- 5 a. How can you represent Turing machine for computing function? Show that the function $f(n) = n+1$, is Turing computable. 8
 b. Discuss the recursive function theory. Prove that the union of two recursive languages is recursive. 7

- 6 a. Write about church Turing thesis and universal Turing machine.
b. Define computability theory. Difference between P complete problem and NP complete problem with example. Does P problem equal to NP problem?
- 7 Write a short note on (ANY ONE)
a. Relation and function
b. Time and space complexity
Halting problem

Final Internal Examination 2025 Spring			
Exam	B.E.	F M	100
Program	Computer	PM	45
Year/ Part	II/II	Time	3 Hrs

Subject: Theory of Computation (new course)

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

The figure in the margin indicates full marks. Assume suitable data if necessary.

Attempt all the questions.

1. a) What are the different proof techniques? Prove the given statement L For any natural number n, $2^{2n} - 1$ is divisible by 3. 8
 - b) Define DFA. Design a DFA that accepts a set of strings having even number of a's and even number of b's over the alphabet {a,b}. 7
 2. a) State the pumping lemma for regular set. Show that $L = \{0^i 1^j | i > 0\}$ is not regular. 8
 - b) Define regular expression. Construct a finite automata equivalent to the following regular expression. $(a(a+b)b^* + bb(a)^*)$. 7
 3. a) Define Context Free Grammar. Check whether the given grammar $S \rightarrow aB|ab$, $A \rightarrow aAB | a$, $B \rightarrow AB|b$ is ambiguous or not. 7
 - OR
Design a CFG to for the language $a^n b a^{n+1} | n \geq 0$.
 - b) Convert the following CFG into Chomsky Normal Form. 8
- $S \rightarrow Sbb|aabbb|Aa|Bb$
 $A \rightarrow Aa|a$
 $B \rightarrow Bb|b|\epsilon$
4. a) Design a PDA for the language $L = \{a^n b^{2n} | n \geq 1\}$. 7
 - b) Explain the possible extensions of basic model of Turing Machine. 8
 - OR
Define Turing Machine. Design a Turing machine that accepts the language $L = \{a^n b^n c^n | n \geq 0\}$. 8
 5. a) Define Turing Machine. Design a Turing Machine which compute the function $f(m) = m+1$ for each m that belongs to set of natural numbers. 7
 - b) Convert the following CFG to equivalent PDA.
 ~~$S \rightarrow 0S1 | 00 | 11$~~
 6. a) Write about Church Turing thesis and universal Turing machine. 5
 - b) Differentiate between Recursive and Recursively enumerable languages. 5
 - c) Define class P, NP and NP complete problems with suitable examples. 5
 7. Write short notes on: (Any two) 2
 - a) Halting problem x
 - b) Decision properties of regular sets 5
 - c) Chomsky's hierarchy

*** Best of Luck ***

National Academy of Science and Technology

(Affiliated to Pokhara University)

Dhangadhi, Kailali

Pre University Examinations

Level: Bachelor

Semester: IV_Spring

Year : 2025

Program: B.E. Computer

F.M. : 100

Course: Theory of Computation

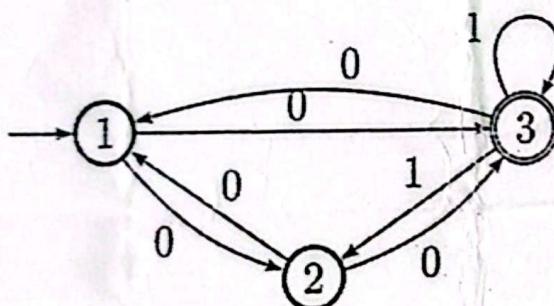
P.M. : 45

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) What is Chomsky hierarchy? Prove the formula 8
 $1+2+\dots+n=n(n+1)/2$ using mathematical induction. 7
b) Convert the following NFA to DFA



2. a) State and proof pumping lemma for regular language. 9
b) Construct a regular expression for: all strings over {a, b} containing even number of b's. 6
3. a) Construct a PDA to accept strings of the form $\{a^n b^n \mid n \geq 1\}$. 7
b) What is context free language? Show that the CFL are closed under union. 8

OR

State and explain the steps of pumping lemma for CFL to prove a language is not CFL with suitable example.

4. a) Consider the following grammar: 7
 $S \rightarrow bB \mid Aa$
 $A \rightarrow b \mid bS \mid aAA$
 $B \rightarrow a \mid aS \mid Bbb$
Find the left most and right most derivation. Also construct derivation tree for each.

- b) What is Normal Form in CFL? Explain the CNF and GNF with example.

8

OR

Simply the following grammar:

$$S \rightarrow aBB \mid aA$$

$$A \rightarrow Aaa \mid \epsilon$$

$$B \rightarrow bB \mid bbC$$

$$C \rightarrow b$$

5. a) Define Universal Turing Machine. Design a Turing Machine for $f(n) = n + 2$. 7
b) Describe multi-tape Turing machines. How do they compare with single-tape ones? 8

2

6. a) What is the Church-Turing Thesis? Explain its significance. 7
b) Explain the types of class problems like P, NP, NP-hard and NP-complete with example. 8
7. Write short notes on following (Any Two) 5x2
- a) Pigeonhole Principle
 - b) Halting Problem
 - c) Recursively Enumerable Language and Recursive Language

Universal Engineering & Science College

Affiliated to Pokhara University

Chankupat, Lalitpur

Level: Bachelor

Semester: 4th

Year : 2025

Programme : BE Computer

Time : 3 hours

Full Marks: 100

Subject: Theory of Computation

Pass Marks: 45

Pre-Board Examination-2082 (Spring 2025)

Candidates are required to give their answer in their own words as far as possible. The figure in the margin indicate full marks

Attempt all the questions:

1. a) Give formal definition of DFA Design a FA that accepts a set of string such that every string starts and ends with same symbol over $\Sigma\{a,b\}$ [hint aba,bab,bbab,abaa,babb..] (8)

- b) Define regular expression write regular expression for language $L = \{w \in \{a,b\}^* \text{ number of } a \text{ is divisible by } 3\}$ (7)

OR

Explain diagonalization principle.

2. a) Convert the following NFA to its equivalent DFA. (8)



- b) State the pumping lemma for regular language Show that $L = \{0^n1^n \text{ for } n \geq 1\}$ is not regular (7)

3. a) What is regular grammar? Show that the grammar $S \rightarrow aB|ab, A \rightarrow aAB|a, B \rightarrow ABB|b$ is ambiguous grammar. (7)

- b) Convert the following grammar into CNF. (8)

→ $S \rightarrow 1A/0B$
 $A \rightarrow 1AA/0S/0$
 $B \rightarrow 0BB/1$

4. a) State closure properties of CFL. Show that CFL are not closed under complementation (7)

- b) Define PDA formally. Design a PDA for $L = \{a^n b^n \mid n \geq 0\}$. (8)

5. a) State Church Turing thesis. Explain tractable and intractable problem with suitable example (8)

- b) Design a Turing machine for the following language: $L = \{w \in \{a,b\}^* \mid w \text{ has equal number of } a's \text{ and } b's\}$. (7)

OR

Design a Turing machine which works as a Copying machine for eg w/w [hint w is copied after blank symbol]

6. a) Explain about halting problem with suitable example and universal turing machine. (8)

OR

What is recursive and recursively enumerable language? Show that union of two recursive language is also recursive.

b) Define computational complexity theory. Explain Class P, Class NP and NP complete with suitable examples. (7)

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

- a) Elimination of useless symbols
- b) function and its types
- c) alphabet and language
- d) Ardens theorem

Lumbini Engineering Management & Science College
Final Term Assessment
2022

Program : Computer (4th Sem)

Semester : IV

Subject : Theory of Computation (TOC)

Time : 3 hrs

FM : 100

PM : 45

- ✓ Candidates are requested to give their answer as far as practicable in their own words.
- ✓ The figure in the margin indicates the full marks
- ✓ Attempt ALL question

1. a) Define alphabet, string and language with examples. Discuss the operational characteristics of a Finite Automata. [8]
b) Construct a FA equivalent to the following Transition Table and construct an equivalent DFA. [7]

$Q \setminus \Sigma$	0	1
$\rightarrow q_0$	$\{q_0, q_1\}$	q_0
q_1	q_2	q_1
q_2	q_3	$\{q_3, q_2\}$
$*q_3$	\emptyset	q_3

2. a) Construct a Finite Automata equivalent to the following Expression. [8]
i) $(xy + x)^* + x^*$
ii) $(num + n)^* (nn + m)^*$

- b) State and prove pumping lemma for regular languages. [7]

3. a) Show that the class of languages of FA is closed under union and kleene closure. [8]

- b) State pumping lemma for context free grammar. Show $L = \{a^n b^n c^n : n > 0\}$ is not context free. [7]
4. a) What do you mean by unit production and null production? Let G be $S \rightarrow AB, A \rightarrow a, B \rightarrow C \mid b, C \rightarrow D, D \rightarrow E$ and $E \rightarrow a$. Eliminate unit production and get an equivalent grammar. [7]
b) What do you mean by Normal Form? Reduce the following grammar to CNF. [8]

$$S \rightarrow 1A \mid 0B, A \rightarrow 1AA \mid 0S \mid 0, B \rightarrow 0BB \mid 1S \mid 1$$

5. a) "TM is stronger than PDA". Justify this statement. Construct a PDA that will accept all strings over {a, b} consisting of equal number of a's and b's. [7]
6. b) Define universal Turing Machine and explain its encoding technique in detail with suitable examples. [8]
6. a) What are P and NP problems? Explain NP complete problems giving examples. [7]
- b) Describe the Computational Complexity theory. [8]
7. Write short notes on (Any two) [5*2=10]
a) Chomsky Normal Form
b) Church Turing Thesis.
c) Halting problem

Lumbini Engineering Management & Science College
 Final Term Assessment
 2022

Program : Computer (6th Sem)

Semester : IV

Subject : Theory of Computation (TOC)

Time : 3 hrs

FM : 100

PM : 45

- ✓ Candidates are requested to give their answer as far as practicable in their own words.
- ✓ The figure in the margin indicates the full marks
- ✓ Attempt ALL question

- 1 a) Define alphabet, string and language with examples. Discuss the operational characteristics of a Finite Automata. [8]
- b) Construct a FA equivalent to the following Transition Table and construct an equivalent DFA. [7]

Q\Σ	0	1
→q ₀	{q ₀ , q ₁ }	q ₀
q ₁	q ₂	q ₁
q ₂	q ₃	{q ₃ , q ₁ }
*q ₃	Ø	q ₃

- 2 a) Construct a Finite Automata equivalent to the following Expression. [8]
- i) $(xy + x)^* + x^*$
 ii) $(num + n)^* (mn + m)^*$

- b) State and prove pumping lemma for regular languages. [7]

- 3 a) ✓ Show that the class of languages of FA is closed under union and kleene closure. [8]

- b) ✓ State pumping lemma for context free grammar. Show $L = \{a^n b^n c^n : n \geq 0\}$ is not context free. [7]

- 4 a) What do you mean by unit production and null production? Let G be $S \rightarrow AB, A \rightarrow a, B \rightarrow C \mid b, C \rightarrow D, D \rightarrow E$ and $E \rightarrow a$. Eliminate unit production and get an equivalent grammar. [7]

- b) What do you mean by Normal Form? Reduce the following grammar to CNF. [8]

$S \rightarrow IA \mid 0B, A \rightarrow IAA \mid 0S \mid 0, B \rightarrow 0BB \mid IS \mid I$

- 5 a) "TM is stronger than PDA". Justify this statement. Construct a PDA that will accept all strings over {a, b} consisting of equal number of a's and b's. [7]

- 6 b) Define universal Turing Machine and explain its encoding technique in detail with suitable examples. [8]

- 6 a) What are P and NP problems? Explain NP complete problems giving examples. [7]

- b) Describe the Computational Complexity theory. [8]

7. Write short notes on (Any two) [5*2=10]
- a) Chomsky Normal Form
 b) Church Turing Thesis.
 c) Halting problem

Universal Engineering & Science College

Affiliated to Pokhara University

Chakupat, Lalitpur

Level: Bachelor

Semester: 4th

Year : 2025

Programme : BB Computer

Time : 3 hours

Full Marks: 100

Subject: Theory of Computation

Pass Marks: 45

Pre-Board Examination-2082 (Spring 2025)

Candidates are required to give their answer in their own words as far as possible. The figure in the margin indicate full marks

Attempt all the questions:

1. a) Give formal definition of DFA Design a FA that accepts a set of string such that every string starts and ends with same symbol over $\Sigma\{a,b\}$ [hint aba,bab,bbab,abaa,babb..] (8)

- b) Define regular expression write regular expression for language $L = \{w \in \{a,b\}^* \text{ number of } a \text{ is divisible by } 3\}$ (7)

OR

Explain diagonalization principle.

2. a) Convert the following NFA to its equivalent DFA. (8)



- b) State the pumping lemma for regular language Show that $L = \{0^n1^n \text{ for } n \geq 1\}$ is not regular (7)

3. a) What is regular grammar? Show that the grammar $S \rightarrow aB|ab, A \rightarrow aAB|a, B \rightarrow ABB|b$ is ambiguous grammar. (7)

- b) Convert the following grammar into CNF. (8)

→ $S \rightarrow 1A/0B$
 $A \rightarrow 1AA/0S/0$
 $B \rightarrow 0BB/1$

4. a) State closure properties of CFL. Show that CFL are not closed under complementation (7)

- b) Define PDA formally. Design a PDA for $L = \{a^n b^n \mid n \geq 0\}$. (8)

5. a) State Church Turing thesis. Explain tractable and intractable problem with suitable example (8)

- b) Design a Turing machine for the following language: $L = \{w \in \{a,b\}^* \mid w \text{ has equal number of } a's \text{ and } b's\}$. (7)

OR

Design a Turing machine which works as a Copying machine for eg w/w [hint w is copied after blank symbol]

6. a) Explain about halting problem with suitable example and universal turing machine. (8)

OR

What is recursive and recursively enumerable language? Show that union of two recursive language is also recursive.

Final Internal Examination 2025 Spring			
Exam	B.E.	F M	100
Level	Computer	PM	45
Program	II/II	Time	3 Hrs

Subject: Theory of Computation (new course)

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

The figure in the margin indicates full marks. Assume suitable data if necessary.

Attempt all the questions.

1. a) What are the different proof techniques? Prove the given statement L For any natural number n, $2^{2n} - 1$ is divisible by 3. 8
 - b) Define DFA. Design a DFA that accepts a set of strings having even number of a's and even number of b's over the alphabet {a,b}. 7
 2. a) State the pumping lemma for regular set. Show that $L = \{0^i 1^j | i > 0\}$ is not regular. 8
 - b) Define regular expression. Construct a finite automata equivalent to the following regular expression. $(a(a+b)b^* + bb(a)^*)$. 7
 3. a) Define Context Free Grammar. Check whether the given grammar $S \rightarrow aB|ab$, $A \rightarrow aAB | a$, $B \rightarrow AB|b$ is ambiguous or not. 7
- OR
- Design a CFG to for the language $a^n b a^{n+1} | n \geq 0$.
- b) Convert the following CFG into Chomsky Normal Form. 8

$$S \rightarrow Sbb|aabbb|Aa|Bb$$

$$A \rightarrow Aa|a$$

$$B \rightarrow Bb|b|\epsilon$$

4. a) Design a PDA for the language $L = \{a^n b^{2n} | n \geq 1\}$. 7
- b) Explain the possible extensions of basic model of Turing Machine. 8

OR

Define Turing Machine. Design a Turing machine that accepts the language $L = \{a^n b^n c^n | n \geq 0\}$.

5. a) Define Turing Machine. Design a Turing Machine which compute the function $f(m) = m+1$ for each m that belongs to set of natural numbers. 8
- b) Convert the following CFG to equivalent PDA. 7

$$S \rightarrow 0S1 | 00 | 11$$

6. a) Write about Church Turing thesis and universal Turing machine. 5
 - b) Differentiate between Recursive and Recursively enumerable languages. 5
 - c) Define class P, NP and NP complete problems with suitable examples. 5
 7. Write short notes on: (Any two) 2
- a) Halting problem x
- b) Decision properties of regular sets 5
- c) Chomsky's hierarchy 5

***** Best of Luck *****