NATIONAL ACADEMY OF SCIENCE AND TECHNOLOGY

(Affiliated to Pokhara University)

Dhangadhi, Kailali

Pre-University Examination

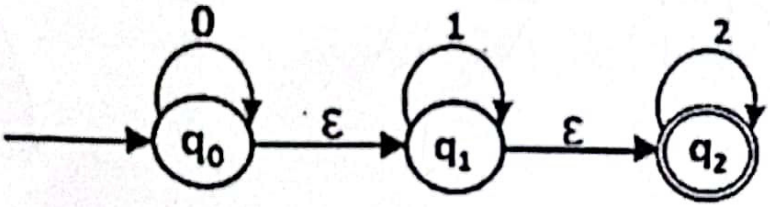
Level: Bachelor
Semester: IV_Spring
Year : 2024
Programme: B.E. Computer
Full Marks : 100
Course: : Theory of Computation
Pass Marks : 45
Time : 3hrs.

Candidates are required to give their answer in their own words as for as practicable. The figures in the margin indicate full marks.

Attempt all the questions.

1. a) Define FA and regular expression. Design a DFA for the language L = {w ∈ (a,b)* : w ends with bb} 5

b) Consider the following NFA with Є-transition. 5



Convert this NFA with Є-transition into NFA without Є-transition.

c) For all n>=1, prove that $1^2 + 2^2 + 3^2 + ... + n^2 = n(n+1)(2n+1)/6$ by using mathematical induction. 5

2. a) When the grammar is ambiguous? For given grammar rule: 8

S ⟶ aB | ab
A ⟶ aAB | a
B ⟶ ABb | b

Check grammar is ambiguous or not. Also, convert it into CNF.

b) Explain the process of simplifying context free grammar. Simplify the following CFG, G = (V, ∑,R,S) where 7

V = {S,A}
∑ = {a,b}
R = {S -> aAB | AaB | B
A -> aA | Є
B -> ab | bA }.

3. a) Give the formal definition of pushdown automata? Construct a PDA accepting the language $L = \{a^{3n}b^n \mid n > 0\}$ and test for strings ***aaaaaabb*** and ***aaaabb***. 8

b) State pumping lemma. Prove that language $L = \{a^n b^{2n} \mid n > 0\}$ is not regular language. 7

4. a) Explain the concept of "epsilon transitions" in a Pushdown Automata. How do they affect the computation? 8

OR

Why we prefer PDA rather than FA? State the closure properties of CFL's 7

b) Describe the concept of ***accepting state*** and ***halting state in*** Turing Machine. Prove that the following function is computable: f(x): x + 1.

5. a) Define Universal Turing Machine. Construct a *Turing Machine that* accepts the language of strings over (a ,b) with *each string of even* length. Also show it accepts string ***abab***. 8

b) What is recursive and recursively enumerable language? Show that the union and intersection of two recursive language is also recursive. 7

6. a) What is 'Algorithm' according to Church Turing thesis? Why it is called thesis and not a theorem? Explain 7

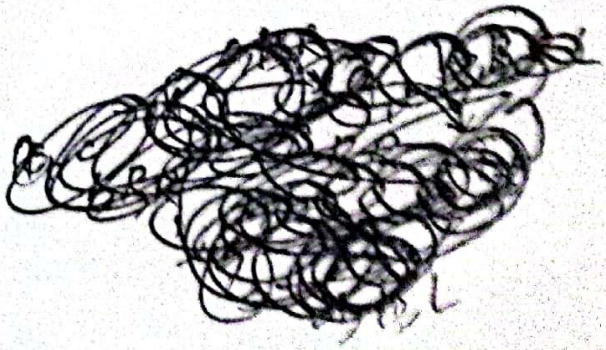
b) Is P = NP? Explain. Also differentiate between Tractable and Intractable problem with examples. 8

OR

Define NP-hard and NP-Complete. Show that ***"Travelling Salesman Problem"*** is NP –Complete.

7. Write short notes on following **(Any Two)** 5x2

a) Chomsky Hierarchy
b) Recursive Function Theory
c) Halting Problem



POKHARA UNIVERSITY
FACULTY OF SCINCE AND TECHNOLOGY

SCHOOL OF ENGINEERING

Exam	Final Internal Examination 2024		
Level	B.E.	F M	100
Program	Computer	P M	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? Explain pigeon hole principle with an example.	7
	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}.	8
2.	a)	State the pumping lemma for regular set. Show that $L = \{0^i1^i \mid i>0\}$ 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→aB|ab, A→aAB | a, B→AB|b is ambiguous or not. OR Design a CFG to for the language $a^nba^{n+1} \mid n>=0$.	7
	b)	Convert the following CFG into Chomsky Normal Form. $S \rightarrow Sbb\|aabb\|Aa\|Bb$ $A \rightarrow Aa\|a$ $B \rightarrow Bb\|b\|\varepsilon$ OR Convert the following CFG into Chomsky Normal Form. $S \rightarrow PoKhArA$.	8
4.	a)	Design a PDA for the language $L=\{a^nb^{2n}$, where $n>=1\}$.	7
	b)	"TM is stronger than PDA and FA". Explain this statement with their suitable block diagram.	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.	8
	b)	Convert the following CFG to equivalent PDA. $S \rightarrow AS \mid A$, $A \rightarrow 0A \mid 1B \mid 1$, $B \rightarrow 0B \mid 0$	8
6.	a)	Write about Church Turing thesis and universal Turing machine.	7
	b)	Differentiate between Recursive and Recursively enumerable languages.	5
	c)	Define computational complexity theory. Define class P and class NP	5
7.	**Write short notes on:** *(Any two)*		2×5
	a)	Halting problem	
	b)	Decision properties of regular sets	
	c)	Chomsky's hierarchy	

**** Best of Luck ****

POKHARA UNIVERSITY
FACULTY OF SCINCE AND TECHNOLOGY

SCHOOL OF ENGINEERING

Exam	Final Internal Examination 2024		
Level	B.E.	F M	100
Program	Computer	PM	45
Year/ Part	III/I	Time	3 Hrs

Subject: Theory of Computation

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)	Define DFA. Design a DFA that accepts a set of string such that every string ends in 010 over alphabet {0,1}.	7
	b)	Define regular expression. Construct a finite automata equivalent to the following regular expression. (a + a (b+aa) * b)* a (b + aa)* a	8
2.	a)	a) State the pumping lemma for regular set. Show that L = {0^i1^i i>0 } is not regular.	8
	b)	Convert the following CFG into Chomsky Normal Form. S →Sbb|aabb|Aa|Bb A →Aa|a B →Bb|b|ε	7
3.	a)	Define Context Free Grammar. Check whether the given grammar S→aB|ab, A→aAB | a, B→AB|b is ambiguous or not.	7
	b)	Design a PDA for the language L={$a^mb^nc^{m+n}$, where m & n>=1}.	8
4.	a)	"TM is stronger than PDA and FA". Explain this statement with their suitable block diagram.	7
	b)	State the pumping lemma for context free language. Prove that L={a^n , n is prime number is not context free language}.	8
5.	a)	Explain the possible extensions of basic model of Turing Machine.	8
	b)	Convert the following CFG to equivalent PDA. S→0S1 |00 | 11	7
6.	a)	Write about Church Turing thesis and universal Turing machine.	5
	b)	Differentiate between Recursive and Recursively enumerable languages.	5
	c)	Define computational complexity theory. Define class P and class NP	5
7.		**Write short notes on:** *(Any two)* a) Halting problem b) Properties of regular language c) Tractable and Intractable Problems	2×5

**** Best of Luck ****

NEPAL COLLEGE OF INFORMATION TECHNOLOGY

Level: Bachelor | Semester: Spring | Year: 2024
Programme: BE | Full Marks: 100
Course: Theory of Computation | 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)** State and prove the pigeonhole principle. Prove by mathematical induction that 7

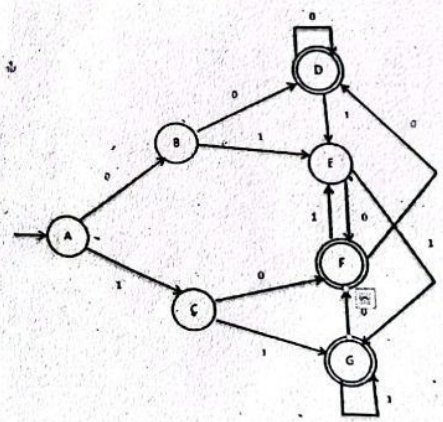
$$1^2 + 3^2 + 5^2 + \ldots\ldots + (2n-1)^2 = \frac{n(2n+1)(2n-1)}{3}$$

b) Why DFA is called a language recognizer? Given $\sum = \{a, b\}$, construct a DFA that shall recognize the language 8
$L=\{a^{2n}b^{2m+1} \mid n>=0, m>=0\}$

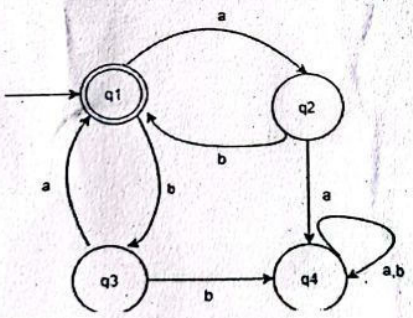
OR

Design a DFA , Given $\sum = \{a, b\}$, string with an even number of a and an odd number of b .

2. a) Write steps to minimize DFA. Minimize the DFA given on RHS. 7

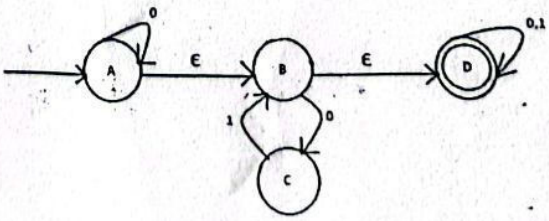


b) What is Arden's theorem? Find the regular expression for the fig just below using Arden's theorem. 8



3. 7

a) Convert the following e-NFA to DFA.



8

b) Show that the given grammar is ambiguous. Also, mention how can we remove ambiguity from grammar.

S-> a /aAb/ abSb A->aAAb /bS is ambiguous.

4. a) State and prove Pumping Lemma for Regular Grammar and prove that L=O^n|n is prime number is not a regular language. 7

   b) Prove CFL is closed under union and concatenation. Also, show that the language L={ww |w ε (0,1)* is not CFL using pumping lemma. 8

5. a) What is CFL? Convert the given Grammar into CNF. 8

   S->ABAB A-> aA| ϵ B->bB| ϵ

   b) Can production rules realize for the Grammar for the language given by L={$a^m b^n$ m and n>0}.How.If yes then write their left and right sentential form and also draw their Left most derivation tree and Right most derivation tree. 7

6. a) PDA is Stronger than FA and for every CFG there is an equivalent PDA. Justify this statement with an example. 7

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

   Or

   State the rules followed to design a PDA for a given CFG. Design a PDA that accepts L= {a^{3n} b^n: n>0} and check the string aaaaaabb. 8

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

   a) Types of function
   b) Decision properties of Regular Language
   c) Importance and scope of TOC

NEPAL ENGINEERING COLLEGE

Level: Bachelor
Programme: BE

Year : 2024
Full Marks : 100
Pass Mark : 45
Time : 3 hrs

Course: Theory of Computation

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 Regular Expression. Write Regular Expression which should have atleast one 1 and atleast one 0 over alphabet $\sum=\{0,1\}$. 7

   b. State the Pumping Lemma for Regular Set. Show the Language
   $L= \{a^n b a^n$ for $n=0,1,2,3,\ldots.\}$ is not Regular. 8

   OR

   Minimise the following DFA by using state minimization method.
   Where → represents initial state and * represents final state

∂ /$\sum$	0	1
→q_0	q_1	q_2
* q_1	q_1	q_3
q_2	q_2	q_2
* q_3	q_5	q_2
*q_4	q_4	q_2
*q_5	q_4	q_2
q_6	q_5	q_6
q_7	q_5	q_6

2. a. Define Derivation Tree. When a grammar is called ambiguous? Explain with an Example. 8

   b. Reduce the following CFG to CNF 7

   S→aB/bX
   A→Bad/bSX/a
   B→aSB/bBX
   X→SB/aBx/ad/B

3. a. Define PDA. Design a PDA which accepts the language $L=\{a^n b^n c | n \geq 1\}$ — 7

OR

Why PDA is designed? Design a PDA to accept set of all palindromes over alphabets $\sum=\{0,1\}$ — 8

b. In what aspect PDA is stronger than Finite Automata. State closure properties of context Free languages

4. a. Define a Turing Machine. Design a TM that accepts the language $L=1^n 2^n 3^n | n \geq =0$ — 7, 8

b. Design a TM which computes the function f(m)=m+1 for each m that belongs to set of natural numbers.

5. a. Distinguish Turing Machine from Finite Automata and Push Down Automata. Illustrate with example problems — 8

b. Explain briefly about recursive and recursively enumerable language — 7

6. a. Describe Church's Hypothesis. Also illustrate your understanding of Halting Problem. — 8

b. What is traceable and intractable problem? Describe each of them with examples — 7

7. Write short notes on (Any Two): — 2×5

a. Pumping Lemma for CFL
b. Universal Turing Machines
c. Alphabet and Languages

Pokhara University

Everest Engineering College

Final Internal Assessment
Spring - 2024

Level: Bachelor
Program: BE CMP(4th Semester)
Faculty: Science & Technology
Section: A
Subject: Theory of Computation

F.M. 100
P.M. 45
Time: 3hrs

Attempt all the questions.

1 a) Define and describe injective, surjective, and bijective functions with appropriate examples. 7

b) You are given languages $L_1 = \emptyset$, $L_2 = \{\varepsilon\}$, and $L_3 = \{aa, bb\}$. Calculate the following algebraic operations. 8

$L_1.L_2$	$L_2.L_3$	$L_1^*.L_3$	$L_2^*.L_3$
$L_1 \cap L_2$	$L_2 \cap L_3$	L_3^*	L_3^+

2 a) Define the extended transition function for non-deterministic finite automata. 8

b) Convert the following ε-NFA to DFA. 7

State	ε	0	1
→ A	{B,D}	{A}	{A}
B	----	{C}	----
C	----	{F}	----
D	----	----	{E}
E	----	----	{F}
* F	----	{F}	{F}

3 a) Describe the decision properties of context-free languages. 8

b) Simplify the following CFG. 7

S→AB | C
A→B | a | ε
B→aB | Bb | b
M→C | AB

4 a) Design a Pushdown Automata to accept the language $\{0^n 1^n : n \leq m\}$. Trace your Pushdown Automata for the inputs 11000 and 11100. 7 8

b) Define recursively enumerable and recursive languages. Prove that if a langue and its complement both are recursively enumerable, then the language is recursive.

5 a) Design a Turing machine that computes the function $f(m,n) = m - n$ for $m \geq n$. If $m < n$, the machine should halt without entering a final state. 7

b) Describe the Church-Turing thesis. 8

6 a) Prove that the universal language 7

$$L_U = \{< M, w > : M \text{ halts on input } w\}$$

is recursively enumerable but not recursive. Here, by halting, we mean the machine stops (either by reaching the final state or by reaching an undefined transition) but not enters an infinite loop. 8

b) How can you convert a mathematical problem into a language decision problem? Explain in the context of solving the linear equation $ax + b = 0$.

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

a) Chomsky Normal Form

b) Pumping lemma for regular languages

c) Unrestricted grammar

Best Wishes

GANDAKI COLLEGE OF ENGINEERING AND SCINECE

Level: Bachelor
Programme: BE
Course: Theory of Computation

Semester: Spring

Year : 2024
Full Marks: 100
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) Give the formal definition of DFA. Design a DFA that accepts a set of string such that string contains string not ending with aba over alphabet {a,b}. 8

   b) Convert the following R.E. to equivalent E-NFA 7

      1. a*(a+b)*bb
      2. (0+1)* (00+11)* (0+1)*

2. a) State the pumping lemma for regular set. Show that L = {$a^n b^n$| n>0 } is not regular. 7

   b) Convert the following CFG into Chomsky Normal Form. 8

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

$A \rightarrow Aa|a$

$B \rightarrow Bb|b|\varepsilon$

a) Define Context Free Grammar. Check whether the given grammar S→aB|ab 7

A→aAB | a

B→AB | b is ambiguous or not.

b) Design a PDA for the language $L=\{a^n b^{2n}$, where $n>=1$. 8

4. a) "TM is functionally stronger than PDA and FA". Explain this statement with their suitable block diagram. 8

b) State the pumping lemma for context free language. Prove that $L=\{a^n b^n c^n$, not context free language$\}$. 7

5. a) Construct a Turing Machine that recognizes the language $L=\{ a^n b^n c^n>=0\}$. Check the acceptance of string aaabbbccc. 8

b) Convert the following CFG to equivalent PDA 7

$S \rightarrow 0S1|0AA|1BB$

$A \rightarrow 1A|0$

$B \rightarrow 0B|1$

6. a) Write Turing machine used for computing of a function with example. 5

b) Differentiate between Recursive and Recursively enumerable languages. 5

c) Define computational complexity theory. Define class P and class NP. 5

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

d) Halting problem is undecidable

e) Write about Church Turing thesis and universal Turing machine.

f) Chomsky hierarchy.

Lumbini Engineering College

Final Internal Exam

Level: Bachelor | Year : 2081
Programme: BE (Computer) | Full Marks: 100
Semester: IV (4th) | Pass Marks: 45
Course: Theory of Computation (TOC) | 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) Explain Chomsky Hierarchy with languages, forms of productions in grammars and accepting devices. [7]

   b) Define the transition function of a Finite Automaton. Design a Deterministic Finite Automaton (DFA) that accepts all strings with exactly two 1's over the alphabet {0, 1}. [8]

2. a) Construct a FA equivalent to the following R.E [8]
      i) (1 + 10 + 110)*0
      ii) 10 + (0+11)0*1

   b) Compare and contrast Context-Free Languages with Regular Languages, providing examples of each. [7]

3. a) What do you mean by Normal Form? Reduce the following grammar to GNF: S → aA | bB, A → ab | Aa, B → BA | ε [8]

   b) Explain the process of accepting strings by a Pushdown Automata. Use an example to illustrate the steps involved. [7]

4. a) "TM is stronger than PDA". Justify this statement. Construct a PDA that will accepts the language L = {ww^R | w is a string over {a, b}* and w^R is the reverse of w}. [8]

   b) Construct a Push Down Automata accepting the following language [7]
      $\{0^{2n} 1^n \mid n > 0\}$ Test it with input w = 000011

5. a) Explain the concept of a Universal Turing Machine and provide a detailed explanation of its encoding technique, supported by relevant example. [7]

   b) Describe the concept of an "accepting state" and a "halting state" in a Turing Machine. Show that the function, f(n) = n+2 is a turing computable. [8]

6. a) Describe the computational complexity theory. What do you mean by reducibility? Explain with example. [7]
   b) What will happen if P = NP? Explain NP problems giving examples. [8]

7. Write short notes on: (Any two) 2×5
   a) Pigeon hole Principle
   b) Unrestricted Grammar
   c) Church-Turing Thesis

Madan Bhandari College of Engineering

Urlabari-3, Morang

Final Internal Examination

Level: Bachelor — Full Marks: 100

Programme:B.E Computer — Pass Marks: 45

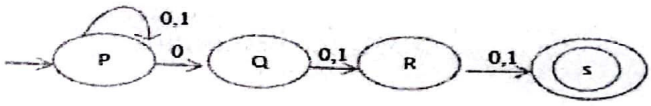
Year/Part:II/II — Time: 3 hrs

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 *{0, 1}* in which each strings end with 11. [8]

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

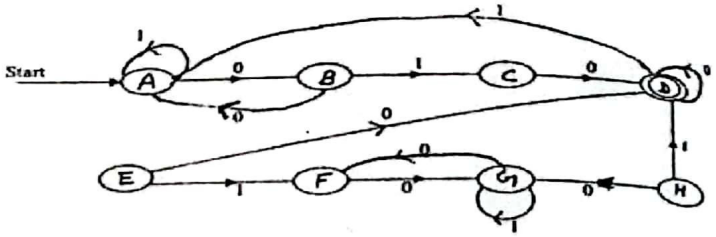


2.A) What is Set? Give the regular expression for the following languages over alphabet {0, 1} [7]

a. Set of all strings starting with substring 01.

b. Set of all strings with ending with 11.

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



3.A)Define Pumping Lemma. Show that $L=\{a^n b^{2n} : n>1\}$ 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, $L1 \cap L2$ is also regular. [8]

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

B)Convert following grammar into equivalent PDA [7]

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

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→aB/bX

A→Bad/bSX/a

B→aSB/bBX

X→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

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? Design a FA which starts with either 01 or end with 01 over the given alphabet $\sum = \{0,1\}$. 8

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: {q0, q1, q2}
- Alphabet: {a, b}
- Transition function: δ(q0, a) = {q0, q1}, δ(q0, b) = {q0}, δ(q1, a) = {q2}, δ(q1, b) = {q2}, δ(q2, a) = {}, δ(q2, b) = {q2}
- Start state: q0
- Accept states: {q2}

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→ mCnS | mCnSeS | a
C→ b

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

∑ = {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 $L=\{a^n b^m : n >= m\}$. 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 $L=\{x^n y^n \mid n>=1\}$. 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

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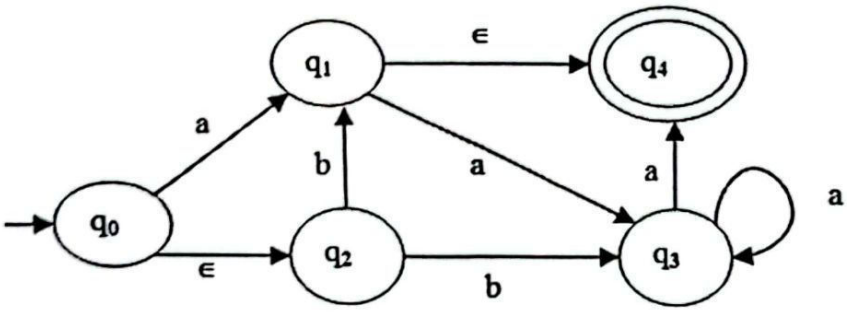
POKHARA UNIVERSITY
UNIVERSAL SCIENCE & ENGINEERING COLLEGE

Level: Bachelor | Pre-Board Examination | Year : 2024
Programme: BE | 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) Define set with examples. Show that the sum of first n natural numbers, $1+2+3+.....+n$ is $\frac{n(n+1)}{2}$ by using mathematical induction. [8]

   b) Convert following ∈-NFA to DFA? [7]



2. a) What is regular language? Use Pumping lemma to show that the language $L = \{a^n b^n : n>0\}$ is not regular. [8]

   b) State closure properties of regular language. Prove that regular languages are closed under union. [7]

3. a) Design a PDA for $L = \{wcw^R: w \in \{a, b\}^*\}$. Hence test your design for any two acceptable and rejectable strings. [8]

   b) What is ambiguous grammar? Write CFG for $L = \{w \in \{ (,) \}^* : w$ has the balanced parenthesis$\}$ and also draw parse trees for the derivation of any two strings. [7]

4. a) What is GNF? Convert following CFG into CNF with explanation of each steps. [8]

   G= (V, Σ, R, S), where
   V={S, A, B, a, b}

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

$R=\{S \rightarrow bA|Ba|AaA,$

$A \rightarrow S|\epsilon,$

$B \rightarrow aB|ab\}$

b) State pumping lemma for CFL. Show that CFL are not closed under complementation. [7]

5. a) Design a Turing machine that works as a simple eraser, which changes every non-blank symbols to blank with alphabet $\Sigma = \{0, 1, \#\}$. Hence test your design for #0101# to ######. [8]

   b) Compare and contrast between PDA and TM. [7]

6. a) What is universal Turing machine? Explain Church thesis. [8]

   b) What type of language is recognized by Turing machine? Show that if language is recursive then its complement is also recursive language. [7]

7. Write short notes on: **(Any two)** [2X5]

   (a) Alphabet and language
   (b) Class P and class NP problems
   (c) Chomsky hierarchy of language

UNITED TECHNICAL COLLEGE

Semester-Spring

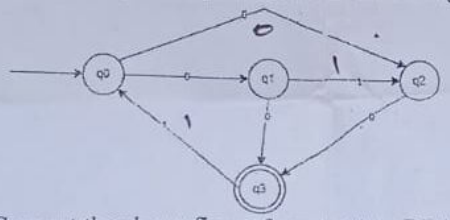
Level	:	Bachelor	Year	:	2024
Programme	:	BE	Full Marks	:	100
Course	:	Theory of Computation	Pass Marks	:	40
			Time	:	3hrs

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

Attempt all questions.

1 a. Design a FA that accepts a set of string such that every string has sta 7
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 7
$L = \{a^n b^n \mid n>0\}$.

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. 7

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. 8

b. Define computability theory. Difference between P complete problem and NP complete problem with example. Does P problem equal to NP problem? 7

7 Write a short note on (ANY TWO) 2*5

a. Relation and function

b. Time and space complexity

c. Halting problem

COSMOS COLLEGE
OF MANAGEMENT AND TECHNOLOGY

Term Test I

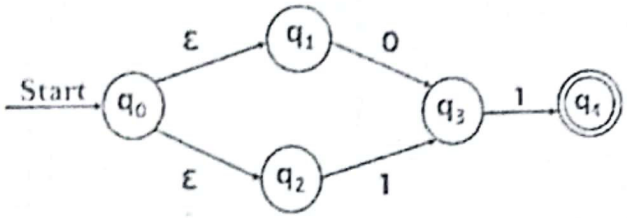
Date: 2081/02/30			
Level	BE	Full Marks	50
Programme	BCE	Time	
Semester	IV	1.5 hrs	

Subject: - Theory of Computation

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

1 a) Design a DFA that accepts the language L such that the string contains "abab" as substring. Test your design using the string "aababba" [7]

b) Convert the following NFA to its equivalent DFA [8]

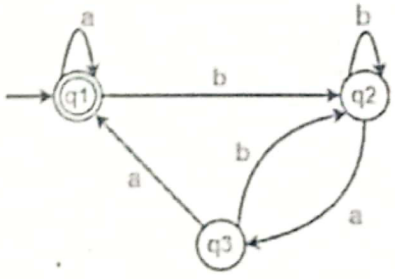


2 a) Prove that the language {L : $a^{2n}b^n$: n>0} is not Regular using pumping lemma regular language. [7]

b) Design a Push Down Automata for the language L : WcW^R over $\sum$ = {a,b}. Test the design using a valid string. [8]

3 a) Convert the following grammar into Chomsky Normal Form. [7]
S—AACD , A-aAb/€, C-aC/a, D- aDa/bDb/€

b) Convert the following state diagram into its equivalent regular expression. [8]



4 Write short notes (***Any One***): [1*5=5]
a) Decision properties for regular language
b) Ambiguity in Grammar and Parse Tree

COSMOS COLLEGE
OF MANAGEMENT AND TECHNOLOGY

Term Test II

Date: 2081/04/09			
Level	BE	Full Marks	50
Programme	BCE	Time	
Semester	IV	1.5 hrs	

Subject: *- Theory of Computation*

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

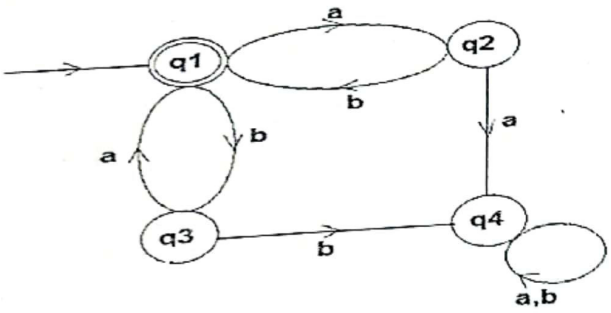
1. a) Show that the language L= $\{a^n b^n c^n : n>0\}$ is not context free using the concept of pumping lemma. [7]

   b) Design a PDA which accepts the language given by $L= \{w \varepsilon \{a,b\}^* : a^n b^{n+m} a^m$ .Consider Z_0 to be the bottom of the stack. [8]

2 **a)** Design a Turing machine for the language that replaces each occurrence of 0 by 1 and vice versa. Test your design using the string #001101#.Consider the reading head to be in the left most # symbol. [7]

   b) Design a Turing machine which contains Equal number of a's and b's over $\sum$= {a, b} by replacing a by X and b by Y and test your design using a valid string. [8]

3 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]**

[2*5=10]

4 Write short notes on (Any Two):
   a) P class and NP class problems
   b) Church-Turing Thesis
   c) Closure properties of Context free Grammar