



10CS56

Fifth Semester B.E. Degree Examination, Jan./Feb. 2023
Formal Languages and Automata Theory

Max. Marks: 100

Note: Answer any FIVE full questions, selecting atleast TWO questions from each part.

PART - A

- 1 a. Briefly discuss why study automata theory. (06 Marks)
- b. Design a DFA to accept strings over {a, b} that contain the substring bb or do not contain the substring aa. (05 Marks)
- c. Design a DFA to accept set of strings over {0, 1} in which the number of 0's is divisible by three and 1's is divisible by two. (05 Marks)
- d. Explain the procedure subset construction for converting NFA to an equivalent DFA. (04 Marks)

- 2 a. Define ϵ -NFA. Consider the following ϵ -NFA :

δ	ϵ	0	1	2
$\rightarrow q_0$	{q ₁ }	{q ₀ }	ϕ	ϕ
q ₁	{q ₂ }	ϕ	{q ₁ }	ϕ
*q ₂	ϕ	ϕ	ϕ	{q ₂ }

- i) Compute the ϵ -closure of each state.
- ii) Convert the automaton to a DFA. (10 Marks)
- b. Define regular expression. Convert the following DFA to a regular expression, using the state elimination technique:

δ	0	1
$\rightarrow *p$	s	p
q	p	s
r	r	q
s	q	r

- 3 a. State and prove pumping lemma for regular languages. (05 Marks)
- b. Prove that if L is a regular language so L^R . (05 Marks)
- c. Minimize the following DFA using table filling Algorithm.

δ	0	1
$\rightarrow A$	B	E
B	C	F
C	D	H
D	E	H
E	F	I
F	G	B
G	H	B
H	I	C
I	A	E

(10 Marks)

Important Note : 1. On completing your answers, compulsorily draw diagonal cross lines on the remaining blank pages.
 2. Any revealing of identification, appeal to evaluator and/or equations written eg, 42+8 = 50, will be treated as malpractice.

- 4 a. Define context free grammar. Write a CFG for palindromes over $\{0, 1\}^*$. (05 Marks)
 b. What is ambiguous grammar? Show that following grammar is ambiguous for the string "abababa". $S \rightarrow Sbs|a$ (05 Marks)
 c. What is inherent ambiguity? Explain with an example. (05 Marks)
 d. Explain the application of CFG with respect to parsers. (05 Marks)

PART – B

- 5 a. Explain the working of PDA with a diagram. (05 Marks)
 b. Design a PDA for accepting the language $L = \{0^{2n}1^n \mid n \geq 1\}$. Draw the transition diagram for PDA obtained. Show the instantaneous description of the PDA for the string "000011". (10 Marks)
 c. Convert the following grammar to PDA
 $I \rightarrow a|b|I_a|I_b|I_0|I_1$
 $E \rightarrow I|E*E|E+E|(E)$. (05 Marks)
- 6 a. Consider the grammar:
 $S \rightarrow aAa|bBb|\epsilon$
 $A \rightarrow C|a$
 $B \rightarrow C|b$
 $C \rightarrow CDE|\epsilon$
 $D \rightarrow A|B|ab$
 i) Are there any useless symbols? Eliminate them if so.
 ii) Eliminate ϵ - productions
 iii) Eliminate unit productions
 iv) Put the resulting grammar into CNF. (10 Marks)
- b. Show that the language $L = \{a^n b^n i \mid n \leq i \leq 2n\}$ is not context-free. (05 Marks)
 c. Prove that if L is a CFL and R is a regular language, then $L \cap R$ is a CFL. (05 Marks)
- 7 a. Design a turning machine to recognize language $L = \{0^n 1^n \mid n \geq 1\}$ and write its transition diagram and give its ID for string 0011. (10 Marks)
 b. Explain working of turning machine with neat diagram and instantaneous description (ID) for turning machine. (05 Marks)
 c. Write a note on multitape turning machine. (05 Marks)
- 8 Write a note on:
 a. Post correspondence problem.
 b. Application of regular expression.
 c. L is recursive language, so is \bar{L}
 d. Universal language. (20 Marks)
