

6. (a) Design a PDA to accept the language
 $L = \{ a^n b^m / n < m, n, m \geq 0 \}$
 (i) Through Empty Stack
 (ii) Through Final State
 4+4=8
- (b) Give the instantaneous description (ID) of PDA. 2
- (c) Show that $L = \{ a^P / P \text{ is a prime} \}$ is not regular. 5

7. Write short notes on : **(any three)**
 5×3=15
- (a) Pigeonhole principle
- (b) Regular expression
- (c) Greibach normal form
- (d) Pumping Lemma for context free language
- (e) Chomsky classification of languages

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2024

**THEORETICAL FOUNDATION OF
 COMPUTING**

Paper : ITB-HG-4016

Full Marks : 80

Time : Three hours

**The figures in the margin indicate
 full marks for the questions.**

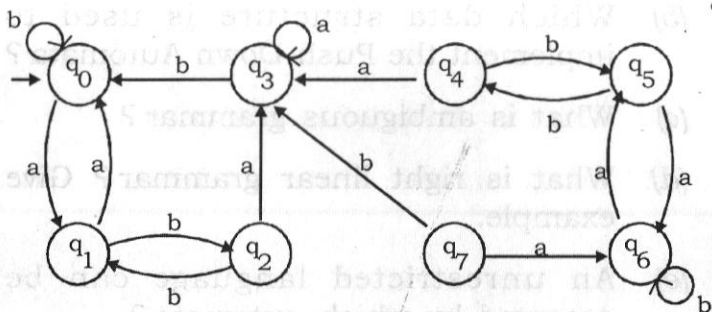
Answer Q No. 1 and **any five**
 from Q No. 2 to Q No. 7.

1. Answer the following : 1×5=5
- (a) What is finite automata ?
- (b) Which data structure is used to implement the Push Down Automata ?
- (c) What is ambiguous grammar ?
- (d) What is right linear grammar ? Give example.
- (e) An unrestricted language can be accepted by which automata ?

2. (a) Construct of DFA over $\{a, b\}$ such that
 (i) even number of a 's.
 (ii) exactly one b . 5
- (b) Define DFA and NFA. What is the difference between DFA and NFA? 5
- (c) Construct of DFA equivalent to the given NFA : 5

Input State	0	1
p	$\{p, q\}$	p
q	r	r
r	s	-
s	s	s

3. (a) Construct the minimum state automaton equivalent to the transition diagram given in following figures : 8



- (b) Define regular expression with example. 2
- (c) Construct a finite automata equivalent to the regular expression :
 $(0+1)^* (00+11) (0+1)^*$ 5

4. (a) Construct a CFG for the language having any number of a 's over the set $\Sigma = \{a\}$. 5
- (b) Derive the string "aabbabba" for Left Most Derivation and Right Most Derivation. Draw the derivation tree. 5
- (c) Find a reduced grammar equivalent to the grammar G whose productions are $S \rightarrow AB \mid CA$, $B \rightarrow BC \mid AB$, $A \rightarrow a$, $C \rightarrow aB \mid b$. 5

5. (a) Prove that CFL are closed under union and concatenation operation. 5+5=10
- (b) Find a grammar in CNF (Chomsky Normal Form) equivalent to $S \rightarrow aAbB$, $A \rightarrow aA \mid a$, $B \rightarrow bB \mid b$ 5