

**SWITCHING THEORY & AUTOMATA
(INFO 2201)**

Time Allotted : 3 hrs

Full Marks : 70

Figures out of the right margin indicate full marks.

*Candidates are required to answer Group A and
any 5 (five) from Group B to E, taking at least one from each group.*

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

**Group – A
(Multiple Choice Type Questions)**

1. Choose the correct alternative for the following: **10 × 1 = 10**
- (i) Regular expression are
(a) Type 0 language (b) Type 1 language
(c) Type 2 language (d) Type 3 language.
- (ii) Which of the following regular expressions over {a, b} denotes all words begin and end with 'a' and in between any word using 'b'
(a) ab^*a (b) $a + ab^*a$
(c) $(a + b)^*a$ (d) $a(a+b)^*a$.
- (iii) $L = \{ a^n b^n c^n \mid n \geq 1 \}$ is accepted by
(a) a DFA (b) a NFA
(c) a PDA (d) none of these.
- (iv) Which among the following is not a part of the Context free grammar tuple?
(a) End symbol (b) Start symbol
(c) Variable (d) Production.
- (v) Which of the following regular expressions over {a, b} denotes all words contain exactly one 'b'
(a) $(a + b)^*$ (b) $(ab)^*$
(c) a^*ba^* (d) ba^* .
- (vi) If a machine of n states is μ definite, then
(a) $\mu \leq n - 1$ (b) $\mu \geq n - 1$
(c) $\mu = n - 1$ (d) none of these.
- (vii) Which of the following sets is regular?
(a) $\{ a^n \mid n \text{ is a prime} \}$ (b) $\{ a^{2n} \mid n \geq 1 \}$
(c) $\{ a^n b^n c^n \mid n \geq 1 \}$ (d) $\{ ww \mid w \text{ is in } (a, b)^+ \}$.

(viii) Consider the following grammar

$S \rightarrow aABC \mid a$

$A \rightarrow aA \mid B$

$B \rightarrow aBA \mid C$

$C \rightarrow \lambda \mid aC$

The null-able variables for the above grammar are

(a) S, A, B, C

(b) S, A, C

(c) A, B

(d) A, B, C.

(ix) Which is true of the following?

(a) Merger graph is directed graph

(b) Compatible graph is directed graph

(c) Both are directed

(d) None of these.

(x) A grammar in CNF may contain productions like

(a) $A \rightarrow B$

(b) $A \rightarrow BC$

(c) $A \rightarrow Ab$

(d) $A \rightarrow aBCD$.

Group - B

2. A long sequence of pulses enters a two I/P, two O/P synchronous sequential circuit, which is required to produce an O/P pulse $z=1$ whenever the sequence 0110 occurs. Overlapping sequences are accepted; for example, if the input is 0101101101010101....., the required O/P is 00000100100000.....

(i) Draw a state diagram.

(ii) Select an assignment and show the excitation and O/P tables.

(iii) Draw a Logic Diagram of the sequence (0110) detector.

(3 + 4 + 5) = 12

3. (a) Consider the following machine:

PS	NS,Z			
	I1	I2	I3	I4
A	—	B,1	C,0	D,0
B	C,0	C,1	A,0	—
C	C,0	D,1	B,1	A,0
D	—	E,1	B,0	—
E	A,0	—	D,1	B,0

(i) Draw the merger graph.

(ii) Draw the compatibility graph.

(iii) Find the minimal closed covering with justification.

(b) Explain with an example when two states of a machine are distinguishable.

(4 + 3 + 2) + 3 = 12

Group - C

4. (a) Convert the following NFA into it's equivalent DFA where p is the start state and r is the final state

Current States	I/P Symbol	
	a	b
p	q,r	---
q	r	p,r
r	q	p,q

- (b) Design a DFA that will accepts those words from $\Sigma=\{0, 1\}$ where the numbers of '1' is divisible by three.

$$8 + 4 = 12$$

5. (a) Construct a Moore machine equivalent to the following Mealy machine:

PS	Input Symbol			
	a=0		a=1	
	NS	o/p	NS	o/p
q1	q3	1	q2	1
q2	q1	1	q4	1
q3	q2	0	q1	1
q4	q4	1	q3	0

- (b) Write short notes on the following
 (i) Pumping lemma of regular language
 (ii) Arden's theorem.

$$4 + (2 \times 4) = 12$$

Group - D

6. (a) Consider the grammar $G=(\{S,A,B\},\{0,1\}, P,S)$
 where $P: S \rightarrow 0S1 \mid 0A \mid 0 \mid 1B \mid 1; A \rightarrow 0A \mid 0; B \rightarrow 1B \mid 1$.
 Test whether the string 000001, 01111, 01010 are in language generated by the grammar or not.

- (b) Prove that $L = \{a^n b^n c^n \mid n \geq 1\}$ is not Context Free Language.

$$(3 \times 3) + 3 = 12$$

7. Write short notes of the following:
 (i) Context Free Grammar
 (ii) Chomsky Normal Form (CNF)
 (iii) Greibach Normal Form (GNF).

$$(3 \times 4) = 12$$

Group - E

8. Construct a PDA for the languages

- (i) $L = \{ w \in \{a,b\}^* \mid w \text{ has the equal number of a's and b's} \}$.
- (ii) $L = \{ 0^n 1^m \mid n > m \geq 0 \}$
- (iii) $L = \{ a^n b^{2n} \mid n > 0 \}$.

(3 × 4) = 12

9. Write short notes of the following:

- (i) Deterministic Push Down Automata
- (ii) Non Deterministic Push Down Automata
- (iii) Turing Machine.

(3 × 4) = 12