# 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) Reverse of (0+1)* will be
(a) Φ (b) Null (c) (0+1)* (d) (0+1).

(ii) The language accepted by finite automata is
(a) type 0 (b) type 1 (c) type 2 (d) type 3.

(iii) Which is the language generated by the grammar S→aSb, S→A, A→aA?
(a) $a^m b^m$ (b) Φ (c) $a^n b^m$ (d) $a^m b^n$.

(iv) k-level equivalence is possible between two finite automata
(a) if all equivalences above k level exist between them
(b) if all equivalences up to k-1 level already exist
(c) if both contain at least k number of states
(d) if both contain exactly k number of states.

(v) If Σ = {a,b}, then the number of possible different strings with length exactly n are
(a) $2^{n-1}$ (b) $2^n$ (c) $2^n - 1$ (d) none of these.

(vi) A Moore machine accepts a string w of length k. The length of the output string is
(a) k+1 (b) k-1 (c) k (d) $k^2$.

(vii) The intersection of CFL and RE is always
(a) CFL (b) RE (c) CSL (d) both (a) and (c).

(viii) Which of the following is true?
(a) (01)*0 = 0(10)*
(b) (0+1)*0(0+1)*1(0+1) = (0+1)*01(0+1)*
(c) (0+1)*01(0+1)*+1*0* = (0+1)*
(d) all of the mentioned.





(ix) CFLs are not closed under
(a) union (b) concatenation
(c) intersection (d) homomorphism.

(x) A pumping lemma is used for proving that
(a) a language is context free (b) a language is not context free
(c) two CFLs are the same (d) two CFLs are different.

## Group – B

2. (a) 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 1101 occurs. Overlapping sequences are accepted; for example, if the input is 011011011……., the required O/P is 000010010…… .
(i) Draw a state diagram for a sequence (1101) detector.
(ii) Select an assignment and show the excitation and O/P tables.
(iii) Draw a logic diagram of a sequence (1101) detector.

(b) Define K-equivalence with example.

**(3 + 3 + 4) + 2 = 12**

3. (a) Find a minimum state reduced machine (given below) containing the original one.

| PS | NS,Z | | |
|---|---|---|---|
| | $I_1$ | $I_2$ | $I_3$ |
| A | C,0 | E,1 | __ |
| B | C,0 | E, _ | __ |
| C | B, _ | C,0 | A,_ |
| D | B,0 | C,_ | E,_ |
| E | __ | E,0 | A,_ |

(b) Determine whether or not the following machine has a finite memory, and if it does find its order.

| PS | NS,z | |
|---|---|---|
| | X = 0 | X = 1 |
| A | D,0 | C,1 |
| B | A,0 | E,0 |
| C | C,1 | E,0 |
| D | C,1 | C,1 |
| E | B,0 | B,1 |

**7 + 5 = 12**

## Group – C

4. (a) Write the difference between Mealy machine and Moore machine. Consider the following Mealy machine as shown below. Convert it to equivalent Moore machine.

| PS | Next State,O/P | |
|---|---|---|
| | X=a | X=b |
| $s_1$ | $s_1$, a | $s_2$, a |
| $s_2$ | $s_2$, b | $s_1$, b |
| $s_3$ | $s_2$, a | $s_3$, a |
| $s_4$ | $s_1$, a | $s_4$, a |

(b) Write Regular Expression (RE) over $\sum = \{0, 1, 2\}$ for set of all strings which contains atleast one '1' and atleast one '2'.

(c) Prove that $(a^* ab + ba)^* a^* = (a + ab + ba)^*$.

**(2 + 4) + 2 + 4 = 12**

5. (a) Convert the following Deterministic Finite Automata (DFA) to Regular Grammar (RG), where $q_0$ is the initial state and $q_f$ is the final state.

| PS | Next State | |
|---|---|---|
| | X = 0 | X = 1 |
| $q_0$ | $q_0$ | $q_1$ |
| $q_1$ | $q_f$ | $q_f$ |
| $q_f$ | $q_f$ | $q_0$ |

(b) Define Regular Expression recursively. State Arden's theorem. Draw Finite Automata Transition Diagram of the following Regular Expression:

$$(((ab+c)^*(ac+ba)^* + (a+b)(b+cd)^*)^* + (a+bd)^*)^* abc$$

**6 + (2 + 1 + 3) = 12**

## Group – D

6. (a) Define Pumping Lemma for Context Free Language. Show that the language $\{a^{n^2} | n \geq 1\}$ is not context free.

(b) Define Left Recursive Grammar (CFG) with example.

(c) Show that the following grammar is ambiguous:

$S \rightarrow aB \mid ab$
$A \rightarrow aAB \mid a$
$B \rightarrow ABb \mid b$

**(2 + 4) + 2 + 4 = 12**





7. (a) Reduce the following grammar to Greibach Normal Form (GNF):
$S \rightarrow AaBC$
$A \rightarrow B|aA$
$B \rightarrow ccCC|acB|a|C$
$C \rightarrow aC| \lambda$

(b) Write context free grammar that generates
(i) odd and even palindrome strings with 0 and 1.
(ii) alternating sequence of 0's and 1's.

**5 + (4 + 3) = 12**

## Group – E

8. (a) What is Instantaneous Description(ID) in PDA? Explain with example.

(b) Let L be the set of all strings over {a, b} consisting of twice as many a's as b's. Construct,
(i) a CFG accepting L
(ii) a PDA accepting L by empty store.

**(2 + 2) + (4 + 4) = 12**

9. (a) Deign Turing Machine over $\sum=\{0,1\}$ to accept the language $L=\{0^m1^n | m, n \text{ are even}\}$.

(b) Write short note on Multi-tape Turing Machine(TM).

**7 + 5 = 12**