Roll No.							

25-MA-25

M.Sc. II SEMESTER [MAIN/ATKT] EXAMINATION
MAY - JUNE 2025

MATHEMATICS

Paper - V

[Advanced Discrete Mathematics - II]

[Max. Marks : 75] *[Time : 3:00 Hrs.]* *[Min. Marks : 26]*

Note : Candidate should write his/her Roll Number at the prescribed space on the question paper.
Student should not write anything on question paper.
Attempt all five questions. Each question carries an internal choice.
Each question carries **15 marks.**

Q. 1 For the finite state machine shown below, find all the equivalent states and obtain an equivalent finite state machine with the smallest number of states.

State	Next State		Output
	0	1	
S_0	S_1	S_5	0
S_1	S_0	S_5	0
S_2	S_6	S_0	0
S_3	S_7	S_1	0
S_4	S_0	S_6	0
S_5	S_7	S_2	1
S_6	S_0	S_3	1
S_7	S_0	S_2	1

OR

Define finite state homomorphism. Construct an FSA that accepts all strings over {a, b} which begin with a and end with b.

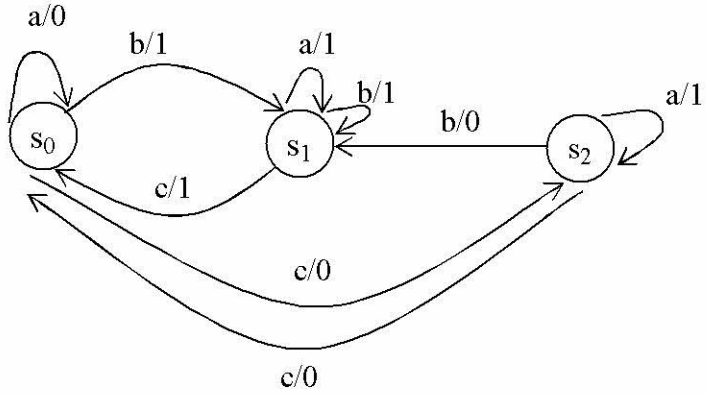
b) Let M = < S, I, O, δ, λ > be finite state machine with transition table given in the following table -

Draw the state diagram. If α = aababaabbab is an input word, find the corresponding sequence of state and the output word.

I / S	δ		λ	
	a	b	a	b
S_0	S_1	S_2	*x*	y
S_1	S_3	S_1	y	z
S_2	S_1	S_0	z	*x*
S_3	S_0	S_2	z	*x*

OR

Find the sets S, I and O, the initial state transition table defining the next state and output function for the finite state machine given in following figure -



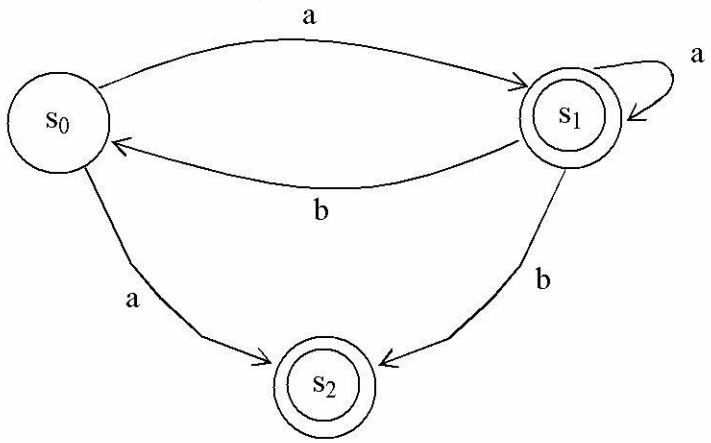
Q. 2 a) Find the DFA equivalent to the NFA for which the state table is given in the following table and S_2 is the accepting state -

I / S	f	
	a	b
S_0	ϕ	$\{S_1, S_2\}$
S_1	S_2	$\{S_0, S_1\}$
S_2	S_0	ϕ

Find the state diagram for DFA.

OR

Draw the state diagram and state table of the deterministic finite automation. equivalent to the following non - deterministic finite automation.



b) Let Me be a Mealy Machine whose transition table is given below -

I / S	f		g	
	0	1	0	1
S_0	S_3	S_1	0	1
S_1	S_1	S_2	1	0
S_2	S_2	S_3	0	0
S_3	S_3	S_0	0	0

Find equivalent Moore Machine M_0

Cont. . . .

OR

Let the transition table of a Moore machine $M_0 = < \{0, 1\}, \{S_0, S_1, S_2, S_3\}, \{0, 1\}, S_0, f, g >$ be as given below -

	f		g
I / S	0	1	
S_0	S_3	S_1	0
S_1	S_1	S_2	1
S_2	S_2	S_3	0
S_3	S_3	S_0	0

Construct a Mealy Machine Me equivalent to M_0.

Q. 3 Design a Turing Machine that accept the following language
$L = \{a^n b^n : n \geq 1\}$
Find transition table and diagram.

OR

Construct a Turing Machine that will accept the language L on {a, b} given by L = {W : | W | is a multiple of 3}

b) If M is the Turing machine defined by the quintuples (s_0, a, s_1, b, R), (s_0, b, s_1, a, L) , (s_0, B, s_1, b, R) (s_1, a, s_2, b, R) , (s_1, b, s_1, b, R), (s_1, B, s_2, a, R) and (s_2, B, s_3, a, R) give the sequence of configurations of the tape leading to the halt of M where the initial configuration is given by
i) $s_0$aaBaa ii) s_0BBBB

OR

Define partial recursive functions. Explain Turing Machine with an example.

Q. 4 a) Find the language generated by each of the following grammars -

i) G = { (S, A, B) , (a, b) , S, P } where P is the set of productions

{S → AB, S → AA, A → aB, A → ab, B → b}

ii) Consider the grammar G with

G = { (S, 0 1 1), (0 1 1), S, P} where P = {S 11 S, S → 0}. Find L(G)

OR

Find a grammer that generate the set of words $\{a^n b^n c^n : n \geq 1\}$

b) Explain the following with an example (**any two**) -

i) Backus Naur Form.

ii) Context Sensitive Grammar.

iii) Language.

P.T.O.

OR

Determine the type of grammar G which consists of the following productions -

i) $S \rightarrow aB, B \rightarrow AB, aA \rightarrow b, A \rightarrow b, B \rightarrow A\ a$

ii) $S \rightarrow aA, A \rightarrow a, A \rightarrow A\ B, B \rightarrow b$

iii) $S \rightarrow aAb, S \rightarrow ab\ Sb, S \rightarrow a, A \rightarrow bS, A \rightarrow a\ A\ A\ b$

Q. 5 a) State pumping lemma, prove that

$L = \{a^i . b^j : i \leq j\}$ is not regular.

OR

Express each of the following sets using regular expression -

i) The set of all strings of 0's and 1's ending in 00.

ii) The set of all strings of one or more 0's followed by a 1.

b) Construct the binary tree whose inorder and preorder traversals are respectively -
E A C I F H D B G and F A E I C D H G B

OR

In which order does (i) a preorder (ii) Post order traversal visit the vertices of the ordered rooted tree given in following figure -