| Roll No. | | | | | | | |
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**24-MA-25**

# M.Sc. II SEMESTER [MAIN/ATKT] EXAMINATION
## JUNE - JULY 2024

# 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 five questions. Each question carries an internal choice.
Each question carries **15 marks.**

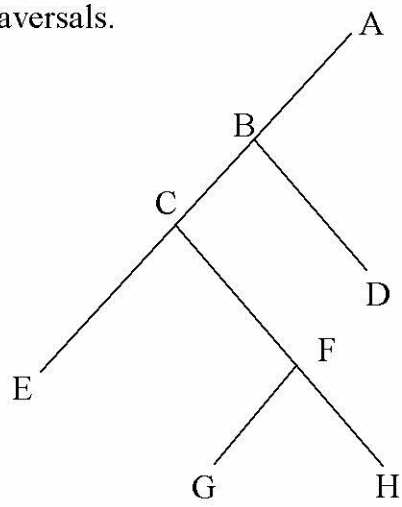
**Q. 1 a)** Define the following with an example (**any two**) - **(7½ Marks)**

i) Search Tree.

ii) Strong connectivity.

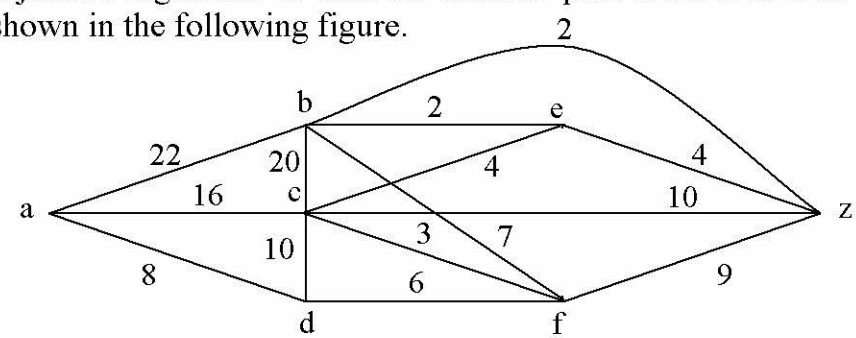
iii) Post order Traversal.

**b)** List the order in which the vertex of the binary tree shown in the following figure are processed using preorder, in order and post order traversals. **(7½ Marks)**



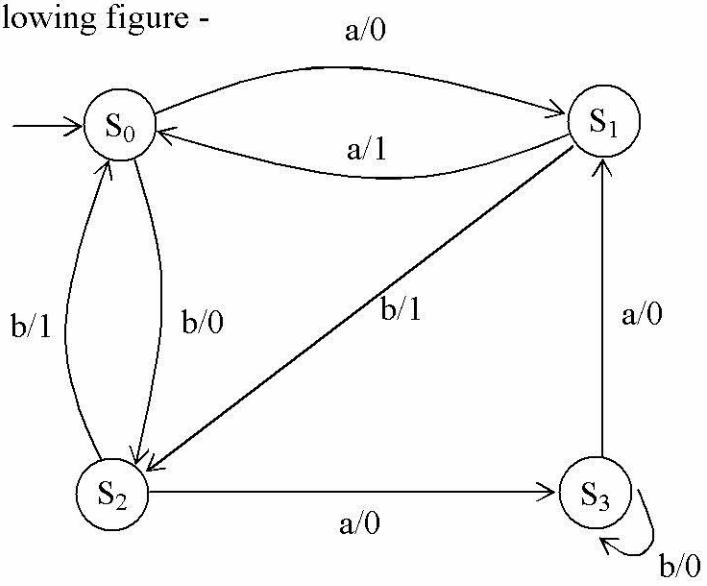

**OR**

Use Disjkstra's algorithm to find its shortest path from a to z in the graph shown in the following figure.




**P.T.O.**

**Q. 2 a)** Find the set S, I and O, the initial state and the transition table defining the next state and output function for the finite state machine given in following figure - **(7½ Marks)**

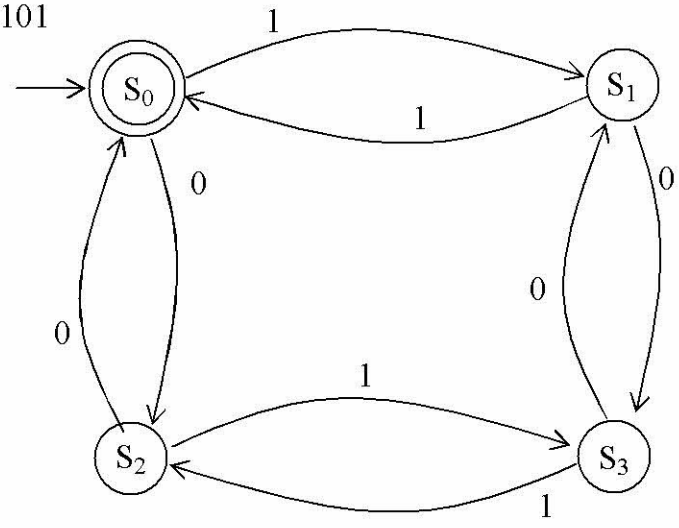



**OR**

Determine the reduced equivalent machine which corresponds to the machine described by the following table - **(7½ Marks)**

| Present State ↓ | Input Symbols | | Input Symbols | |
|---|---|---|---|---|
| | 0 | 1 | 0 | 1 |
| $S_0$ | $S_5$ | $S_3$ | 0 | 1 |
| $S_1$ | $S_1$ | $S_4$ | 0 | 0 |
| $S_2$ | $S_1$ | $S_3$ | 0 | 0 |
| $S_3$ | $S_1$ | $S_2$ | 0 | 0 |
| $S_4$ | $S_5$ | $S_2$ | 0 | 1 |
| $S_5$ | $S_4$ | $S_1$ | 0 | 1 |

**b)** Consider the transition diagram of the following figure construct the state table and give the entire sequence of states for the input string 110101 **(7½ Marks)**




**Cont. . . .**

**OR**

**b)** Design an FSM that outputs 1 if K 1's have been input, where k is a multiple of 3 and output 0 otherwise. **(7½ Marks)**

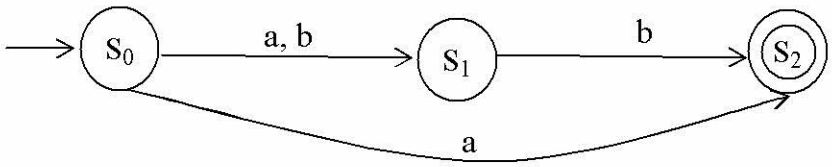
**Q. 3 a)** Find the DFA equivalent to the NFA for which the state table is given in following table and $S_2$ is the accepting state : **(7½ Marks)**

| I / S | a | b |
|---|---|---|
| $S_0$ | $\{S_0, S_1\}$ | $S_2$ |
| $S_1$ | $S_0$ | $S_1$ |
| $S_2$ | $S_1$ | $\{S_0, S_1\}$ |

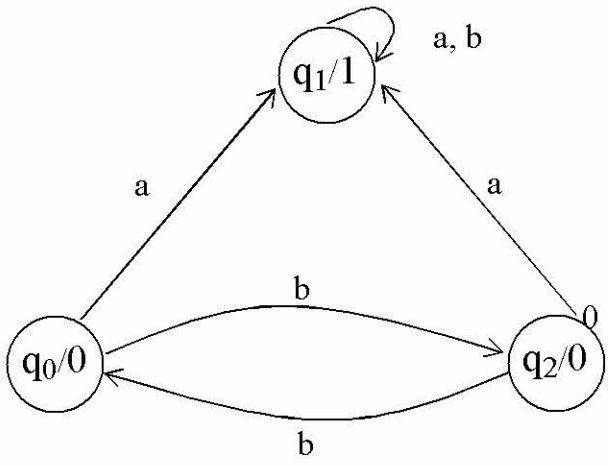
Find the state diagram for DFA.

**OR**

Draw the state diagram of the DFA equivalent to the following NFA - **(7½ Marks)**




**b)** Define Mealy Machine convert the given Moore machine to equivalent Mealy machine - **(7½ Marks)**




**OR**

What is the five difference between Moore and Mealy Machines. **(7½ Marks)**

**Q. 4 a)** Design a Turing Machine that accept the following Language - **(10 Marks)**

$L = \{a^n b^n c^n : n \geq 1\}$

Find transition diagram.

**P.T.O.**

**OR**

Design a Turing Machine that accept the following Language $L = \{0^n\ 1^n : n \geq 1\}$. (10 Marks)
Find transition table

**b)** Explain the following with an example (**any two**) - (05 Marks)

i) Turning Machine.

ii) Rewriting Rules.

iii) Grammer.

**Q. 5 a)** Show that the language $L(G) = \{a^n\ b^n\ c^n : n \geq 1\}$ can be generated by $G = \{N, T, P, S\}$ where (7½ Marks)
$N = \{S, B, C\}$, $T = \{a, b, c\}$, $P = \{S \rightarrow a\ S\ Bc,\ S \rightarrow a\ B\ c,\ c\ B \rightarrow Bc,\ aB \rightarrow ab,\ bB \rightarrow bb,\ Bc \rightarrow bc\ ,\ cc \rightarrow cc\}$ and S is the sytarting symbol.

**OR**

Define Polish Notation and Reverse polish notation with examples. (7½ Marks)

**b)** State and prove Pumping Lemma (7½ Marks)

**OR**

Each of the grammer with the following production is a type - $i$ grammer but not a type $(i + 1)$ grammer where $0 \leq i \leq 2$. Find the value of $i$ for the grammer. Give the reason also (7½ Marks)

i) $S \rightarrow a\ A\ B\ ,\ A \rightarrow Bb,\ B \rightarrow \lambda$

ii) $S \rightarrow AB,\ B \rightarrow a\ Ab,\ aAb \rightarrow b$

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