

No. of Printed Pages : 4

Roll No.....

ED-2805

**M.A./M.Sc. (Previous)
EXAMINATION, 2021**

MATHEMATICS

Paper Fifth

(Advance Discrete Mathematics)

Time : Three hours

Maximum Marks : 100

Note : Attempt any two parts from each question. All questions carry equal marks.

Unit-1

1. (a) State and prove Basic Homomorphism Theorem.
- (b) Define the following :
 - (i) Tautology,
 - (ii) Semigroup,
 - (iii) Congruence Relation,
 - (iv) Submonoid,
 - (v) Direct Product.

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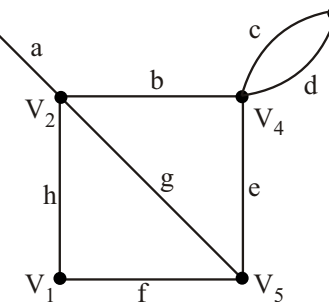
- (c) Define Monoid and show that for any commulative monoid $(M, *)$, the set of idempotent elements of M forms a sub-monoid.

Unit-2

2. (a) Define Distributive lattice and show that the direct product of any two distributive lattice is a distributive lattice.
- (b) Discuss Karnaugh map with one, two, three and four variables.
- (c) Write the following Boolean expressions in an equivalent sum of products canonical form in three variables x_1, x_2 and x_3 :
 - (i) $x_1 * x_2$
 - (ii) $x_1 \quad x_2$
 - (iii) $(x_1 \quad x_2) * x_3$

Unit-3

3. (a) Define circuit matrix and find the circuit matrix in given graph :



- (b) Discuss about Warshall's Algorithm.

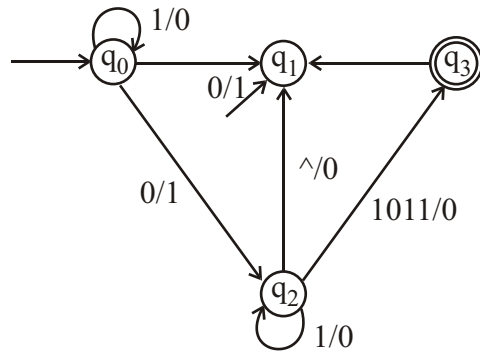
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- (c) Define graph and show that a simple graph (i.e. a graph without parallel edges or self loops) with n vertices and k components can have at most $\frac{(n-k)(n-k-1)}{2}$ edges.

Unit-4

4. (a) Define transition system and consider the transition system in the following fig. Determine the initial states, final states and the acceptability of 101011, 111010.



- (b) Define non-deterministic finite automata and a deterministic acceptor equivalent $M = (\{q_0, q_1, q_2\}, \{a, b\}, q_0, \{q_2\})$ is given following table :

State Table

State/	a	b
q_0	q_0, q_1	q_2
q_1	q_0	q_1
q_2		q_0, q_1

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- (c) Let S be any state in a finite state machine and x and y be any words, then prove :

$$(S, xy) \subseteq ((S, x), y)$$

and $(S, xy) \subseteq ((S, x), y)$

Unit-4

5. (a) Define the following :

- (i) Grammar
- (ii) Regular set
- (iii) Context sensitive grammar
- (iv) Notions of Syntax Analysis
- (v) Conversion of Infix Expressions to Polish Notation.

- (b) Define Polish notation. Convert the expression $a \ b \ \frac{c \cdot d}{g \ f}$ into Polish notation.

- (c) Define Language and let language $L(G_S) = \{a^n b^n c^n \mid n \geq 1\}$ is generated by the following grammar $G_S = (\{S, B, C\}, \{a, b, c\}, S)$, where consists of the production.

$$S \rightarrow aSBC, S \rightarrow aBC, CB \rightarrow BC, aB \rightarrow ab, bB \rightarrow bb, bC \rightarrow bc, cC \rightarrow cc.$$

Then find the derivation for the strings $abc, a^2b^2c^2$ and $a^3b^3c^3$.