

86097

Master of Science (Mathematics)

1st Semester

Examination – December, 2024

DISCRETE MATHEMATICS

Paper : 24MAT201SE01

Time : Three Hours] [Maximum Marks : 70

Before answering the questions, candidates should ensure that they have been supplied the correct and complete question paper. No complaint in this regard, will be entertained after examination.

Note : Attempt *five* questions in all, selecting *one* question from each Section. Question No. 9 (Section - V) is *compulsory*. All questions carry equal marks.

SECTION – I

1. (a) Find an explicit formula for the recurrence relation

$$a_0 = 1, a_n = a_{n-1} + 2. \quad 7$$

(b) Find an explicit formula for the sequence defined by the recurrence relation $a_n = a_{n-1} + 2a_{n-2}, n \geq 2$ with the initial conditions $a_0 = 1$ and $a_1 = 8$. 7

2. (a) Find the particular solution of the difference equation $a_n - 5a_{n-1} + 4a_{n-2} = 56 \cdot 3^n$. Hence find the total solution of this difference equation. 7

(b) Using generating function methods, find the explicit formula for Fibonacci sequence. 7

SECTION – II

3. (a) Define propositional function by giving two examples. If $P(x) : x$ is even ; $Q(x) : x$ is a prime number ; $R(x, y) : x + y$ is even. The variables x and y represent integers, then write each of the following in terms of $P(x), Q(x), R(x, y)$, logical connectives and quantifiers : 7

(i) Every integer is an odd integer.

(ii) The sum of any two integers is an even number.

SECTION - III

(iii) There are no even prime numbers.

(iv) Every integer is even or a prime.

(b) A software engineer makes the following observations in a computer programming : 7

(i) There is an undeclared variable or there is syntax error in the first five lines.

(ii) If there is a syntax error in the first five lines, then there is a missing semicolon or a variable name is misspelled.

(iii) There is not a missing semicolon.

(iv) There is not a misspelled variable name. Using logical forms, find the mistake in the program.

4. (a) Let L be a complemented lattice with unique complements. Then show that the join irreducible elements of L , other than 0 , are its atoms. 7

(b) Show that the idempotent laws follow from the absorption laws. 7

86097- (P-7)(Q-9)(23) (3)

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5. (a) Let $n = p_1 p_2 \dots p_k$ where p_k where p_i are distinct primes, known as set of atoms. Show that D_n is a Boolean algebra. 7

(b) Find the prime implicant of $E = xyz + x'z' + xyz' + x'y'z + x'yz'$. 7

6. (a) Show that for any two elements a and b in a Boolean algebra : 7

(i) $(a \vee b)' = a' \wedge b'$

(ii) $(a \wedge b)' = a' \vee b'$

(b) Let $B = \{1, 2, 5, 7, 10, 14, 35, 70\}$. For any a, b in B , define $+$, $*$ and as follows :

$$a + b = \text{lcm}(a, b),$$

$$a * b = \text{gcd}(a, b), a' = \frac{70}{a}$$

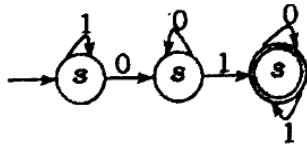
86097- (P-7)(Q-9)(23) (4)

Then show that B is a Boolean algebra with 1 as zero element and 70 as unit element. 7

SECTION - IV

7. (a) Show that language $L = \{a^p : p \text{ is prime}\}$ is not regular. 7

(b) A finite state automaton M is described by the following diagram : <https://www.mdustudy.com>



Find the corresponding grammar G and L(G). 7

8. (a) Let L be a set accepted by a non-deterministic finite automaton. Then prove that there exists a deterministic finite automaton that accepts L. 7

(b) Let M_1 be a mealy Machine whose transition table is given by :

	f		G	
S\I	0	1	0	1
s_0	s_2	s_1	0	0
s_1	s_0	s_3	1	0
s_2	s_1	s_0	1	1
s_3	s_3	s_2	1	0

Find equivalent Moore machine M_2 . 7

SECTION - V

9. (a) Define linear recurrence relation of order k. 14

(b) Define generating function. - which d.

(c) Define Boolean function.

(d) Define AND Gate.

(e) Discuss the contradiction rule.

(f) Define complete lattice with example.

(g) Define Equivalence of Finite State Machines.

(h) Define Ambiguous Grammar.

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