



Term Evaluation (Odd) Semester Examination September 2025

Roll no., 2419052

Name of the Course: Bachelor of Technology

Semester: 3rd

Name of the Paper: Discrete Structures and Combinatorics

Paper Code: TMA 316

Time: 1.5 Hour

Maximum Marks: 50

Note:

- Answer all the questions by choosing any one of the sub-questions
- Each question carries 10 marks.

Q1.

(10 Marks) (CO 1)

a) Let $S = \{1, 2, 3\}$ and $P(S)$ denotes the power set of set S . Given $(P(S), \subseteq)$ is a poset, construct its Hasse diagram. Also find the element(s) which is/are

- (i) Greatest (ii) Maximal (iii) Minimal (iv) Least.

OR

b) Prove that the relation $R = \{(a, b) \in A \times A : a \mid b \text{ (} a \text{ divides } b)\}$ on the set $A = \{1, 2, 3, 4, 6, 12\}$ forms a lattice.

Q2.

(10 Marks) (CO1)

a) Define equivalence relation. Prove that the relation

$$R = \{(x, y) \in \mathbb{Z} \times \mathbb{Z} : (x - y) \text{ is divisible by } 3\}$$

is an equivalence relation.

OR

b) Prove that the function $f(x) = ax + b$, where $f: \mathbb{R} \rightarrow \mathbb{R}$; $a, b \in \mathbb{R}$ and $a \neq 0$, is an invertible function. Hence find inverse of the function f .

Q3.

(10 Marks) (CO1&2)

a) Let R and S be the relations defined on set $A = \{1, 2, 3\}$ as $R = \{(1, 1), (1, 3), (2, 1), (2, 2)\}$ and $S = \{(1, 2), (2, 3), (3, 1), (3, 3)\}$.

- Find the composition of relations S and R , i.e. $(S \circ R)$.
- Give matrix and digraph representation of the relation $S \circ R$.
- Find $R \cup S$, $R \cap S$ and their cardinality.

OR

b) An unbiased coin is tossed 6 times. Find the probability of obtaining:

- (i) Exactly 4 heads (ii) Less than 3 heads (iii) More than 4 heads (iv) At least 2 heads.

Q4.

(10 Marks) (CO2)

a) A random variable X has the following probability distribution:

X	0	1	2	3	4	5	6	7
$P(X = x)$	k	$3k$	$5k$	$7k$	$9k$	$12k$	$5k$	$8k$

- Find the value of k .
- Find the expected mean (expectation) and variance of X .
- Find $P(X < 3)$ and $P(2 < X < 6)$.

OR

b) Suppose an item is manufactured by 3 machines X , Y and Z . All the 3 machines have equal capacity and operate at the same rate. It is known that percentages of defective items produced by X , Y and Z are 2%, 7% and 12%, respectively. All the items produced by X , Y and Z are put into one bin. From this bin 1 item is drawn at random and found to be defective. What is the probability that this item was produced by Y ?



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Q5.

(10 Marks) (CO2)

a) X is normally distributed with mean 12 and standard deviation 4. Find

(i) $P(X \geq 20)$

(ii) $P(X \leq 20)$

(iii) $P(0 \leq X \leq 12)$

Given $\phi(2) = 0.9772$, $\phi(0) = 0.5$ and $\phi(3) = 0.9987$, where $\phi(z) = P(Z \leq z)$.

OR

b) Calls arrive at a helpdesk at an average rate of 2 per minute (Poisson distribution with $\lambda = 2$).

Evaluate the following:

(i) Probability of getting exactly 3 calls in a minute,

(ii) Probability of getting at most 2 calls in a minute.