

Program: B.Sc. in CSE

CT-1 (Section - C [Set B])

Spring - 2025

4th year 1st Semester

Course Code: CSE 401 Course Title: Mathematics for Computer Science

Credit: 3

Time: 20 Minutes.

Full Mark: 10

1. The **Tower of Hanoi** is a classic mathematical puzzle that involves moving a set of disks from one peg to another, following specific rules. [5]
-“The minimum number of moves to solve the Double Tower of Hanoi (DTOH) problem with n disks is always twice the number of moves required to solve the Single Tower of Hanoi (TOH) problem with the same number of disks” – do you agree? Please justify your answer with the necessary derivations. Then, find the minimum number of moves necessary to solve the DTOH problem with 15 disks.
2. The **Lines in the Plane** problem explores the maximum number of regions into which a plane can be divided by drawing n straight lines. [5]
 - I. Find the maximum number of regions that can be obtained from n number of intersecting **ZigZag** lines in a plane.

CT-1 (Section - C [Set A])

Spring - 2025

4th year 1st Semester

Course Code: CSE 401 Course Title: Mathematics for Computer Science

Credit: 3

Time: 20 Minutes.

Full Mark: 10

1. The **Tower of Hanoi** is a classic mathematical puzzle that involves moving a set of disks from one peg to another, following specific rules.
 - I. Write the **recurrence** for the minimum number of moves required to solve the Triple Tower of Hanoi (TTOH) problem. Derive the **closed form expression** for the recurrence. Then, find the minimum number of moves necessary to solve the TTOH problem with 12 disks.
2. I. The **Lines in the Plane** problem explores the maximum number of regions into which a plane can be divided by drawing n straight lines.
 - I. Find the maximum number of regions that can be obtained from n number of intersecting **W-Object** lines in a plane.

CT-1 (Section - B [Set A])**Spring - 2025****4th year 1st Sem**

Course Code: CSE 401

Course Title: Mathematics for Computer Science

Credit: 3

Time: 20 minutes.

Full Mark: 1

1. The **Tower of Hanoi** is a classic mathematical puzzle that involves moving a set of disks from one peg to another, following specific rules.
 - I. Write the **recurrence** for the minimum number of moves required to solve the Triple Tower of Hanoi (TTOH) problem. Derive the **closed form expression** for the recurrence. Then, find the minimum number of moves necessary to solve the TTOH problem with 12 disks.
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 - I. The Lines in the Plane problem explores the maximum number of regions into which a plane can be divided by drawing n straight lines.
 - I. Find the maximum number of regions that can be obtained from n number of intersecting **ZigZag** lines in a plane.

Program: B.Sc. in CSE**CT-1 (Section - B [Set B])****Spring - 2025****4th year 1st Sem**

Course Code: CSE 401

Course Title: Mathematics for Computer Science

Credit: 3

Time: 1.00 Hour.

Full Mark: 1

1. The **Tower of Hanoi** is a classic mathematical puzzle that involves moving a set of disks from one peg to another, following specific rules.
 - “The minimum number of moves to solve the Double Tower of Hanoi (DTOH) problem with n disks is always twice the number of moves required to solve the Single Tower of Hanoi (TOH) problem with the same number of disks” – do you agree? Please justify your answer with the necessary derivations. Then, find the minimum number of moves necessary to solve the DTOH problem with 15 disks.
2. The **Lines in the Plane** problem explores the maximum number of regions into which a plane can be divided by drawing n straight lines.
 - I. Derive the recursive definition of the function to calculate the maximum number of regions created when n lines intersect in a plane.

CT-2 (Set - B)**Spring- 2025****4th year 1st Sem**

Course Code: CSE 401

Course Title: Mathematics for Computer Science

Credit: 3

Time: 30 minutes.

Full Mark:

1. The Josephus Problem is a theoretical puzzle involving people standing in a circle and being eliminated in a fixed pattern until only one person remains.
 - I. Find the smallest **three** values of N such that the person standing at the $N/3$ -rd position survives.
2. Two fair 7-sided dice are rolled. Each die has faces numbered from 1 to 7. Let X be the sum of the two numbers rolled. What is the probability that the sum X is a prime number?

Program: B.Sc. in CSE**CT-2 (Set - A)****Spring- 2025****4th year 1st Sem**

Course Code: CSE 401

Course Title: Mathematics for Computer Science

Credit: 3

Time: 30 minutes.

Full Mark:

1. The Josephus Problem is a theoretical puzzle involving people standing in a circle and being eliminated in a fixed pattern until only one person remains.
 - I. Find the smallest **three** values of N such that the person standing at the 25-th position survives.
2. Two fair 7-sided dice are rolled. Each die has faces numbered from 1 to 7. Let X be the sum of the two numbers rolled. What is the probability that the sum X is a power of 2?

CT-2 (Set - A)**Spring- 2025****4th year 1st Sem**

Course Code: CSE 401

Course Title: Mathematics for Computer Science

Credit: 3

Time: 30 minutes.

Full Mark: 1

1. The Josephus Problem is a theoretical puzzle involving people standing in a circle and being eliminated in a fixed pattern until only one person remains.
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CT-2 (Set - B)

Spring- 2025

4th year 1st Sem

Course Code: CSE 401

Course Title: Mathematics for Computer Science

Credit: 3

Time: 30 minutes.

Full Mark: 1

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Course Code: CSE 401 Course Title: Mathematics for Computer Science

Time: 1.00 Hour

There are **Three** Questions. Answer all of them. Part marks are shown in the margins.

- a. Demonstrate the steps for moving 4 disks from pole 1 to pole 3 in the Tower of Hanoi problem.
- b. Describe the derivation of the recursive formula for the solution to the Josephus problem.



A bookshelf has n shelves, each initially empty. On the first day, 1 book is placed on the first shelf. On the second day, 2 books are placed on the second shelf. On the third day, 3 books are placed on the third shelf, and so on. How many books will be on the bookshelf after n days? Deduce through mathematical derivation.

Two 5-sided dice are rolled. Discuss what is the probability that the sum of the numbers on the two dice is 4?

Mid Semester Examination, Fall 24
Program: B.Sc. in CSE
4th year 1st Semester

Course Title: Mathematics For Computer Science
 Time: 1 hour. Credit Hour: 3.00

Course Code: CSE
 Full Marks: 20

There are Two Questions. Answer all of them. Part marks are shown in the margins.

QUESTION 1 [10 MARKS]

- a. Demonstrate the maximum number of regions that can be formed by n zig-zag lines. Calculate the maximum number of regions that can be obtained by ZZ_n where,

$$n = (\text{last digit of your ID}) + 1 \quad [\text{if last digit of your ID} < 9]$$

$$n = 3 \quad [\text{if last digit of your ID} = 9]$$

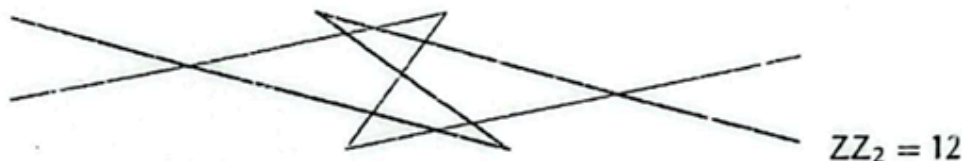


Figure 1. Regions Created by 2 Zig-Zags

- b. Prove $J(2^m + L) = 2L + 1$ for the Josephus Problem using the mathematical induction method where $n = 2^m + L$. Also, find $J(103)$ using the recurrence method.

QUESTION 2 [10 MARKS]

- a. Compare Googol and Googolplex. Then Generate the value of $A(2,1)$ by categorizing each step of Ackermann functions.
- b. Two fair 12-sided dice are rolled. Let X be the sum of the numbers appearing on the two dice. Develop the probability that the sum is at most 6 ($X \leq 6$).

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1. a. Let $m = 2^9 5^{24} 11^7 17^{12}$ and $n = 2^3 7^{22} 11^{211} 13^1 17^9 19^2$, compute mn by using \gcd and lcm . [3]
- b. Let ϕ be Euler's function, compute $\phi(500)$. 200 [4]
2. Let $A(m, n)$ be Ackermann recurrence function and m, n are nonnegative integers, calculate the value of $A(1, 1)$, $A(2, 1)$ and $A(3, 1)$ by using the formulas of Ackermann's recurrence function. [6]
3. Insert the keys $79, 69, 98, 72, 14, 50$ into the hash table of size 13. Identify and resolve all collisions using double hashing where first hash-function is $h_1(k) = k \bmod 13$ and second hash-function is $h_2(k) = 1 + (k \bmod 11)$. [7]

There are Three Questions. Answer all of them. Part marks are shown in the margins.

1. a. Determine Greatest Common Divisor (GCD) of 3289 and 2415 using Euclid's Algorithm. [5]

b. Let ϕ be Euler's function, prove that $k^{\phi(n)} \equiv 1 \pmod{n}$, where n and k are relatively prime numbers. [5]

2. Let $A(m, n)$ be Ackermann recurrence function and m, n are nonnegative integers, identify the value of $A(1, 2)$, $A(2, 2)$ and $A(3, 2)$ by using the formulas of Ackermann's recurrence function. [2*3=6]

3. Suppose, there are 3 pegs A, B and C. Now, you want to move n disk from the first peg A to the second peg B in a way that [4]

- must move one disk at a time;
- larger disk cannot be on top of any smaller disks at any time, and
- do it in as few moves as possible
- Direct move from A to B is disallowed; the move is possible via peg C only.

Here, $n = (\text{Last 2 digits of your id}) \% 2 + 6$

Note that, $\%$ refers to the **mod** operation.

Compute the total number of moves using Tower of Hanoi recursion method.