National University of Computer and Emerging Sciences



# CS-1005- DISCRETE STRUCTURES

**Assignment # 2**

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| **Course Instructor:** | Sir Tayyab Javed |
| **Semester:** | Fall 2024 |
| **Sections:** | CS-3C, CS-3D |
| **Deadline:** | **Friday 15, November**  **2024** |

# Instructions:

1. Submit your assignment in **Hard Form**.
2. Use **A4 Paper** for your assignment.
3. Submit your assignment within the due date and time. Late submissions will result in a deduction of marks. No excuse or resubmission is permissible.
4. Mention Name, Roll Number and Section clearly on your Assignment.
5. Solve each question of the assignment individually and on your own.
6. Plagiarized work will be penalized by marks decuction.

# Question No 1: [Marks 10]

Consider these relations on the set of integers:

R1= {(a, b) |a≥b} R2= {(a, b) |a<b}

R3= {(a, b) |a=b} R4= {(a, b) |a=b or a=-b}

R5= {(a, b) |a=b-1} R6= {(a, b) |a+b≤3}

(a) Which of these relations contain each of the pairs (1,1), (1, 2), (2, 1), (1, −1), and (2, 2)?

(b) Which of these relations are reflexive, justify your answer?

(c) Which of these relations are symmetric, justify your answer?

(d) Which of these relations are transitive relations, justify your answer?

(e) Which of these relations are anti-symmetric, justify your answer?

# Question No 2: [Marks 10]

If R be a relation in the set of integers Z, defined by R = {(x, y): x ɛ z, y ɛ z, (x-y) is divisible by 6}

Then prove that R is an equivalence relation.

# Question No 3: [Marks 10]

* 1. What is congruence class [4]n when n is:

1. -5

ii) 9

* 1. What is congruence class [n]7 when n is:

1. 3

ii) 6

* 1. Let ak = k + 1 and bk = k − 1 for all integers k.

1. Write expression  in single summation.

ii) Write expression  in single product.

# Question No 4: [Marks 10]

Write first 3 terms of following arithmetic sequences:

1. a5 =17 and a9 =37
2. 3a7=7a4 and a10=33

# Question No 5: [Marks 10]

For each positive integer n, let P(n) be the formula

12 + 22 +···+ n2 = (n (n + 1) (2n + 1))/ 6.

1. Write P (1). Is P (1) true?
2. Write P(k).
3. Write P (k + 1).
4. In a proof by mathematical induction that the formula holds for all integers n ≥ 1, what must be shown in the inductive step?

# Question No 6: [Marks 10]

What is the minimum number of students, each of whom

comes from one of the 50 states, who must be enrolled in

a university to guarantee that there are at least 100 who

come from the same state?

# Question No 7: [Marks 10]

How many possibilities are there for the win, place, and

show (first, second, and third) positions in a horse race

with 12 horses if all orders of finish are possible?

# Question No 8: [Marks 10]

A club has 25 members.

a) How many ways are there to choose four members of

the club to serve on an executive committee?

b) How many ways are there to choose a president, vice

president, secretary, and treasurer of the club, where

no person can hold more than one office?

# Question No 9: [Marks 10]

Give a recursive definition of an, where a is a nonzero real number and n is a nonnegative

integer.

# Question No 10: [Marks 10]

Use structural induction to prove that l(xy) = l(x) + l(y), where x and y belong to ∗, the set of strings over the alphabet .