ITER, SOA (Deemed to be) University, Bhubaneswar

MCA I^{st} Semester
Assignment 7, January 2026
Subject: Discrete Mathematics (MA 3001)
Sections: 25C2A1, 25C2A2, 25C2B1, & 25C2B2

Answer all questions

8.1 Relations and Their Properties

1. Determine whether the relation R on the set of all real numbers is reflexive, symmetric, antisymmetric and/or transitive, where $(x, y) \in R$ if and only if
   (a) $x + y = 0$
   (b) $x - y$ is a rational number
   (c) $x = 2y$
2. Let R be the relation $\{(1, 2), (1, 3), (2, 3), (2, 4), (3, 1)\}$, and let S be the relation $\{(2, 1), (3, 1), (3, 2), (4, 2)\}$. Find $S \circ R$.
3. Give an example of a relation on a set that is
   (a) both symmetric and antisymmetric.
   (b) neither symmetric nor antisymmetric.

8.3 Representing Relations

4. Represent the relation $R = \{(1, 1), (1, 4), (2, 2), (3, 3), (4, 1)\}$ on $\{1, 2, 3, 4\}$ with a matrix. Also, check whether it is reflexive, symmetric, anti-symmetric and/or transitive.
5. Draw the directed graph that represents the relation $\{(a, a), (a, b), (b, c), (c, b), (c, d), (d, a), (d, b)\}$. Also, check whether it is reflexive, symmetric, anti-symmetric and/or transitive.

8.5 Equivalence Relations

6. Let R be the relation on the set of integers such that aRb if and only if $a = b$ or $a = -b$. Check weather it is an equivalence relation or not.
7. Let R be the relation on the set of real numbers such that aRb if and only if $a - b$ is an integer. Is R is an equivalence relation?
8. Suppose that R is the relation on the set of strings of English letters such that aRb if and only if $l(a) = l(b)$, where $l(x)$ is the length of the string x. Is R an equivalence relation?

9. Show that the "divides" relation on the set of positive integers in not an equivalence relation.

10. Let R be the relation on the set of real numbers such that xRy if and only if x and y are real numbers that differ by less than, that is $|x - y| < 1$. Show that R is not an equivalence relation.

8.6 Partial Orderings

11. Which of these are posets?
    (a) $(\mathbb{Z}, \neq)$
    (b) $(\mathbb{Z}, \geq)$
    (c) $(\mathbb{R}, <)$

12. Draw the Hasse diagram for the greater than or equal to relation on $\{0, 1, 2, 3, 4, 5\}$.

13. Draw the Hasse diagram for divisibility on the set $\{1, 2, 3, 6, 12, 24, 36, 48\}$.