

BACHELOR'S DEGREE EXAMINATION, OCTOBER 2025
2024 ADMISSIONS REGULAR
SEMESTER III - MAJOR (MATHEMATICS)
MT3DSCA02B24 - Building Blocks for Higher Mathematics

Time : 1.5 Hours

Maximum Marks : 50

Part AAnswer all questions. Each question carries 1 mark. (1x10=10)

1. Is the "greater than or equal to" relation (\geq) on the set of integers irreflexive? [CO1,Apply]
2. Is the "equal to" relation ($=$) on the set of real numbers antisymmetric? [CO1,Apply]
3. Check whether the relation $R = \{(1,1), (2,2), (3,3), (1,2), (2,1)\}$ is symmetric. [CO1,Apply]
4. State whether a poset can have more than one maximal element. [CO2,Apply]
5. Define a lower bound of a subset of a poset. [CO2,Apply]
6. Define the supremum of a poset. [CO2,Apply]
7. State the commutative property of addition for real numbers. [CO3,Understand]
8. Define an uncountable set. Give an example. [CO3,Understand]
9. Define an infinite set with an example. [CO3,Understand]
10. Give an example of a set in \mathbb{R} which has an infimum but no Supremum. [CO4,Understand]

Part BAnswer any 2 questions from the bunch of CO1. Each question carries 5 mark. (5x2=10)

11. 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? [CO1,Apply]
12. Check whether the relation $R = \{(1,1), (2,1), (3,2), (4,3)\}$ on $\{1, 2, 3, 4\}$ an equivalence relation? [CO1,Apply]
13. What are the equivalence classes of 0 and 1 for congruence modulo 4? [CO1,Apply]

Part BAnswer any 2 questions from the bunch of CO2. Each question carries 5 mark. (5x2=10)

14. Draw the Hasse diagram representing the partial ordering $\{(a,b) | a \text{ divides } b\}$ on $\{1, 2, 3, 4, 6, 8, 12\}$ [CO2,Apply]
15. Define comparable elements in a poset. In the poset $(\mathbb{Z}^+, |)$, where $|$ is the 'divides' relation, are the integers 3 and 93 comparable? Are 15 and 17 comparable? Justify your answers. [CO2,Apply]
16. Which elements of the poset $(\{2, 4, 5, 10, 12, 20, 25\}, |)$ are maximal, minimal and which are greatest and least? [CO2,Apply]

Part BAnswer any 2 questions from the bunch of CO3. Each question carries 5 mark. (5x2=10)

17. Show that the set of rational numbers \mathbb{Q} is denumerable. [CO3,Apply]
18. Find the solution set of the inequality: $x^2 - 3x - 10 \geq 0$ [CO3,Apply]
19. Determine the set B of all real numbers x such that $5x - 7 > 3$ [CO3,Apply]

Part CAnswer any 1 question from the bunch of CO4. Each question carries 10 mark. (10x1=10)

20. a) Define Nested Intervals. State the Nested Intervals Property. Give an example of a sequence of nested closed intervals in \mathbb{R} . b) State and prove the Archimedean Property of real numbers. [CO4,Apply]

21. a) Suppose A and B are nonempty subsets of \mathbb{R} such that $a \leq b$ for all $a \in A$ and for all $b \in B$. Prove that $\sup A \leq \inf B$. b) If $A = \{2, 4, 6\}$ and $B = \{7, 3\}$, Compute $\inf (A + B)$ and verify that $\inf (A + B) = \inf A + \inf B$. [CO4,Apply]