



ABV- Indian Institute of Information Technology & Management, Gwalior

Discrete Structures (IT201)

Major Semester Examination (Session 2023–24)

Maximum Time: 3 Hours

Max Marks: 70

Note: All questions carry equal marks. Assume suitable data wherever required.

Section A is compulsory. In Section B, attempt any 4 questions.

Section A ($10 \times 2 = 20$ Marks)

Answer all questions in brief. Each question carries 2 marks.

1. Define tautology and contradiction with one example each.
2. Find the contrapositive of the statement: “If a number is divisible by 6, then it is divisible by 3.”
3. Write the set of all prime numbers less than 20 using roster form.
4. Give an example of a relation that is reflexive and symmetric but not transitive.
5. Define injective and surjective functions with one example each.
6. What is the degree of each vertex in a complete graph K_5 ?
7. State and prove the pigeonhole principle with an example.
8. Define a group. Is $(\mathbb{Z}, +)$ a group? Justify.
9. How many different ways are there to arrange the letters of the word “BANANA”?
10. Give an application of graph theory in computer science.

Section B ($5 \times 10 = 50$ Marks)

Attempt any five questions. Each question carries 10 marks.

11. (a) Construct a truth table for $((p \vee q) \rightarrow r) \leftrightarrow ((p \rightarrow r) \wedge (q \rightarrow r))$. (b) Using laws of logic, show that $\neg(p \vee q) \equiv (\neg p \wedge \neg q)$.

12. (a) Let $A = \{1, 2, 3\}$, $B = \{x, y\}$. Find the number of relations from A to B . (b) Define equivalence relation. Prove that the relation “congruence modulo 5” on Z is an equivalence relation.
13. (a) Define bijective function with an example. (b) Let $f : R \rightarrow R$, $f(x) = 2x + 1$ and $g : R \rightarrow R$, $g(x) = x^2$. Find $(f \circ g)(x)$ and $(g \circ f)(x)$.
14. (a) Draw all possible simple graphs with 4 vertices. (b) Prove that in any undirected graph, the sum of the degrees of all vertices is twice the number of edges.
15. (a) State and prove Cayley’s theorem for groups. (b) Prove that the set of integers under addition forms an abelian group.
16. (a) How many 6-digit numbers can be formed using digits 0–9 if repetition is allowed but the number should not start with 0? (b) In how many ways can a committee of 4 members be formed from 8 men and 6 women if at least 2 women must be included?
17. (a) Define Hamiltonian path and Eulerian circuit with examples. (b) Show that a simple graph with n vertices and more than $\frac{(n-1)(n-2)}{2}$ edges is connected.