



ABV- Indian Institute of Information Technology & Management, Gwalior

Discrete Structures (IT201)

Major Examination (Session 2024–25)

Maximum Time: 3 Hours

Max Marks: 70

Attempt any FIVE questions. All questions carry equal marks.

1. (a) Construct the truth table for the statement:

$$((p \rightarrow q) \wedge (\neg r \vee p)) \vee (q \leftrightarrow r)$$

- (b) Show that the argument below is valid using rules of inference:

$$p \rightarrow q, \quad q \rightarrow r \quad p \rightarrow r$$

[14]

2. (a) Prove by mathematical induction that:

$$1 + 3 + 5 + \dots + (2n - 1) = n^2$$

- (b) Using the resolution principle, prove the validity of:

$$(p \vee q), \quad (\neg p \vee r), \quad (\neg q \vee r) \vdash r$$

[14]

3. (a) Let $A = \{1, 2, 3, 4, 5, 6\}$. Define relation R on A by “ $aRb \iff a - b$ is even”. Prove that R is an equivalence relation. (b) Define bijective function. Prove that the composition of two bijective functions is also bijective. [14]

4. (a) Define a group. Prove that $(\mathbb{Z}_n, +)$ forms a group under addition modulo n . (b) Define subgroup. Show that the set of even integers under addition is a subgroup of $(\mathbb{Z}, +)$. [14]

5. (a) A committee of 5 people is to be formed from 8 men and 6 women. Find the number of ways if the committee contains at least 3 women. (b) How many different arrangements can be made with the letters of the word “MATHEMATICS”? In how many of these arrangements do all vowels occur together? [14]

6. (a) State and prove the pigeonhole principle. Using it, prove that in any group of 13 people, at least two have birthdays in the same month. (b) In how many ways can 10 identical balls be distributed into 4 distinct boxes such that no box is empty? [14]
7. (a) Define simple graph, multigraph, and complete graph with suitable examples. (b) Draw the incidence matrix and adjacency matrix of the graph with vertices $\{a, b, c, d\}$ and edges $\{ab, ac, bd, cd, da\}$. Is this graph Eulerian? Justify. [14]
8. (a) Explain the difference between Hamiltonian path and Eulerian path with examples. (b) Determine whether the following graph is bipartite: Vertices = $\{1, 2, 3, 4, 5, 6\}$, Edges = $\{12, 23, 34, 45, 56, 61, 13, 46\}$. [14]