**B.E. / B.Tech. - DEGREE EXAMINATIONS, NOV / DEC 2025**
Second Semester
**Computer Science and Engineering**
(Common to Information Technology, Computer Science and Engineering (Cyber Security), Artificial Intelligence and Data Science)
**20BSMA204 - DISCRETE STRUCTURES**
Regulations - 2020

Duration: 3 Hours                                                                  Max. Marks: 100

**PART - A (MCQ) (10 × 1 = 10 Marks)**
Answer ALL Questions

|  |  | Marks | K-Level | CO |
|---|---|---|---|---|

1. A Relation $R$ on a set $A$ is a partial ordering relation if _____. — 1, K1, CO1
   (a) Reflexive, symmetric     (b) Reflexive, symmetric, anti-symmetric
   (c) Reflexive, symmetric, transitive     (d) Reflexive antisymmetric, transitive

2. The domain of the function $f(x) = \frac{x+2}{x-1}$ is _____. — 1, K1, CO1
   (a) $R$     (b) $R - \{1\}$     (c) $R - \{2\}$     (d) $\{1\}$

3. If $|A| = 6$, $|B| = 9$ and $|A \cup B| = 10$ then the value of $|A \cap B|$ is _____. — 1, K2, CO2
   (a) 8     (b) 9     (c) 4     (d) 5

4. How many distinguishable ways can the letters of COMPUTER be arranged? — 1, K2, CO2
   (a) 8!     (b) 3!     (c) 5!     (d) 7!

5. $((\neg q \wedge (p \rightarrow q)) \rightarrow \neg p$ is a _____. — 1, K1, CO3
   (a) Contingency     (b) Tautology     (c) Contradiction     (d) None of these

6. $p \rightarrow q$ is logically equivalent to _____. — 1, K1, CO3
   (a) $\neg p \vee \neg q$     (b) $p \vee \neg q$     (c) $\neg p \vee q$     (d) $\neg p \wedge q$

7. Let $G = \{1, -1, i, -i\}$ is group under multiplication then inverse if $i$ is _____. — 1, K2, CO4
   (a) 1     (b) -1     (c) I     (d) -i

8. Let $= Q^+$ and $a * b = \frac{ab}{2}, \forall a, b \in Q^+$. The inverse of $a$ is _____. — 1, K2, CO4
   (a) $1/a$     (b) $2/a$     (c) $3/a$     (d) $4/a$

9. What is the maximum number of edges of simple graph having $n$ vertices? — 1, K1, CO5
   (a) $\frac{n(n+1)}{2}$     (b) $\frac{n(n-1)}{2}$     (c) $n^2$     (d) None of these

10. An acyclic directed graph is called _____. — 1, K1, CO5
    (a) Regular     (b) Complete     (c) Circuit     (d) Tree

**PART - B (12 × 2 = 24 Marks)**
Answer ALL Questions

11. What is partial order relation? — 2, K1, CO1
12. Let $f, g: R \rightarrow R$ defined by $f(x) = 2x + 5$ and $g(x) = x - 5$ $\forall$ x $\in$ R. Find the composites $f \circ g$. — 2, K2, CO1
13. Define equivalence relation. — 2, K1, CO1
14. Show that if seven colours are used to paint 50 bicycles, at least 8 bicycles will be of the same colour. — 2, K2, CO2
15. State the principle of mathematical induction. — 2, K1, CO2
16. How many permutations are there in the word MISSISSIPPI? — 2, K2, CO2
17. Find the contra-positive of the conditional statement 'If it is raining then I will get wet'. — 2, K2, CO3

*K1 – Remember; K2 – Understand; K3 – Apply; K4 – Analyze; K5 – Evaluate; K6 – Create*

18. Show that $(p \wedge q) \rightarrow (p \vee q)$ is a tautology.    *2*   *K2*   *CO3*

19. Show that the identity element of a group is unique.    *2*   *K2*   *CO4*

20. Define boolean algebra.    *2*   *K1*   *CO4*

21. State the handshaking theorem.    *2*   *K1*   *CO5*

22. Define complete graph.    *2*   *K1*   *CO5*

## PART - C ($6 \times 11 = 66$ Marks)
### Answer ALL Questions

23. (a) Examine whether $M$ is an equivalence relation or not where $M$ is the relation on the set of integers $Z$ defined as follows: For $a, b \in Z, aMb$ if and only if $a$ is a multiple of $b$.    *11*   *K3*   *CO1*

   **OR**

   (b) Let $f(x) = 2x + 3$ and $g(x) = x^2 + 4, h(x) = x + 2$ find $(f \circ g) \circ h$ & $f \circ (g \circ h)$.    *11*   *K3*   *CO1*

24. (a) Prove by induction, for $n \geq 1,$
$$\sum_{k=1}^{n} k^2 = \frac{n(n + 1)(2n + 1)}{6}$$
   *11*   *K3*   *CO2*

   **OR**

   (b) How many positive integers not exceeding 1000 are divisible by none of 3, 7 & 11?    *11*   *K3*   *CO2*

25. (a) Use indirect method to show that $R \rightarrow 7Q, R \vee S, S \rightarrow 7Q, P \rightarrow Q \Rightarrow 7P$.    *11*   *K3*   *CO3*
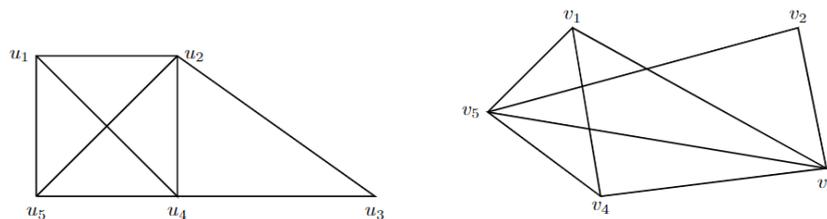
   **OR**

   (b) Without using truth table, find PCNF & PDNF of $P \rightarrow [(P \rightarrow Q) \wedge \neg(\neg Q \vee \neg P)]$.    *11*   *K3*   *CO3*

26. (a) State and prove Lagrange's theorem on finite group.    *11*   *K3*   *CO4*

   **OR**

   (b) If G is a group such that $(a * b)^2 = a^2 * b^2$ for all $a, b, c \in G$, then prove that G is abelian.    *11*   *K3*   *CO4*

27. (a) Examine whether the following pair of graphs are isomorphic. If not isomorphic, give the reasons.    *11*   *K3*   *CO5*



   **OR**

   (b) Prove that a connected graph $G$ is Euler graph if and only if every vertex of G is of even degree.    *11*   *K3*   *CO5*

28. (a) i) If $*$ is the operation defined on $S = Q \times Q$ where $Q$ is the set of all rational numbers and given by $(a, b) * (x, y) = (ax, \ ay + b)$, then show that $(S, *)$ is a Semigroup. Also find the identity element of S.    *6*   *K3*   *CO4*

   ii) Prove that number of vertices of odd degree in a graph is always even.    *5*   *K3*   *CO5*

   **OR**

   (b) i) If $(G, *)$ is a cyclic group generated by $a$, then prove that $a^{-1}$ is also a generator.    *5*   *K3*   *CO4*

   ii) Give an example of a graph which is (a) Eulerian but not Hamiltonian, (b) Hamiltoni not Eulerian and (c) Hamiltonian and Eulerian.    *6*   *K3*   *CO5*

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*K1 – Remember; K2 – Understand; K3 – Apply; K4 – Analyze; K5 – Evaluate; K6 – Create*     **14226**