B.E. / B.Tech. - DEGREE EXAMINATIONS, APRIL / MAY 2025

Second Semester

Computer Science and Engineering

(Common to Artificial Intelligence and Data Science & Information Technology)

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. The domain of the function $f(x) = \frac{x+2}{x-1}$ is — 1, K2, CO1
   (a) R (b) $R - \{1\}$ (c) $R - \{2\}$ (d) $\{1\}$

2. If a function is both one-to-one and onto, then it is called — 1, K1, CO1
   (a) Surjection   (b) Injection   (c) Bijection   (d) Composition

3. If y is a factor of $a^n - b^n$ for all positive integers n then y is — 1, K2, CO2
   (a) $a + b$ (b) $a - b$ (c) $a^2 + b^2$ (d) $a^2 - b^2$

4. The number of integers between 1 and 250 both inclusive that are divisible by 2 and 3 is — 1, K2, CO2
   (a) 47   (b) 41   (c) 38   (d) 45

5. How many types of quantifier are there in predicate logic? — 1, K1, CO3
   (a) 2   (b) 3   (c) 4   (d) 5

6. Which of the following Propositions its tautology? — 1, K1, CO3
   (a) $(P \wedge Q) \rightarrow (P \vee Q)$ (b) $(P \vee Q) \rightarrow Q$ (c) $P \vee (Q \rightarrow P)$ (d) Both (a)and (b)

7. The multiplicative group $\{1, -1\}$ is a subgroup of the multiplicative group_____ — 1, K1, CO4
   (a) $\{1, i, -i\}$ (b) $\{1, -1, i, -i\}$ (c) $\{1, 0, -1, i\}$ (d) $\{-1, i, -i\}$

8. The Boolean product is denoted by — 1, K1, CO4
   (a) OR   (b) AND   (c) BUT   (d) NOT

9. What is the number of edges present in complete graph K_n 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. The number of edges of a tree with n vertices is — 1, K1, CO5
    (a) $n - 1$ edges   (b) n edges   (c) $n - 2$ edges   (d) $2n$ edges

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

11. Determine whether the function $f(x) = x + 1$ from the set of real numbers to itself is one-one or not? — 2, K2, CO1

12. Let A = {1, 2, 3, 4} and B = {5, 7, 9} R, S are relations from A to B defined as R = {(1, 5), (1, 7), (2, 7), (2, 9) (3, 7), (4, 5)} and S = {(1, 7), (2, 9), (3, 7), (4, 7)}. Compute R^{-1}, $R \cap S$. — 2, K2, CO1

13. What is partial order relation? — 2, K1, CO1

14. Use mathematical induction to show that $n! \geq 2^{n+1}, n = 5,6 \ldots$ — 2, K2, CO2

15. State the Principle of Mathematical Induction. — 2, K1, CO2

16. In how many ways can 8 people sit around round table? — 2, K2, CO2

17. Show that $p \rightarrow q$ and $\neg p \vee q$ are logically equivalent. — 2, K2, CO3

18. Obtain disjunctive normal forms of $(p \rightarrow q) \wedge \neg q$. — 2, K2, CO3

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

20. Prove that a group $(G, *)$ is abelian iff $(a * b)^2 = a^2 * b^2 \ \forall \ a, b \in G$. — 2, K2, CO4

K1 – Remember; K2 – Understand; K3 – Apply; K4 – Analyze; K5 – Evaluate; K6 – Create   **13755**

21. Define complete bipartite graph.		*2*	*K1*	*CO5*
22. Give an example of an Euler graph.		*2*	*K1*	*CO5*

PART - C (6 × 11 = 66 Marks)

Answer ALL Questions

23. a) Let $A = \{1,2,3,4,5\}$. The relation R on A is defined as aRb *iff* $3|a - b|$ Test whether R is an equivalence relation.   *11 K3 CO1*

OR

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

24. a) Using mathematical induction, show that for all positive integers n, is $3^{2n+1} + 2^{n+2}$ divisible by 7.   *11 K3 CO2*

OR

   b) In a survey of 100 students, it was found that 40 studied maths, 64 studied physics,35 studied chemistry 1 studied all the three subjects, 25 studied Maths and physics, 3 studied Maths and chemistry and 20 studied physics and chemistry. Find the number of students who studied chemistry only.   *11 K3 CO2*

25. a) Show that the following premises are inconsistent.   *11 K3 CO3*
   (i) If Jack misses many classes through illness then he fails high school.
   (ii) If jack fails high school, then he is uneducated.
   (iii) If Jack reads a lot of books then he is not uneducated.
   (iv) Jack misses many classes through illness and reads a lot of books.

OR

   b) Prove that the premises $P \rightarrow Q, Q \rightarrow R, S \rightarrow 7R$ and $P \wedge S$ are inconsistent.   *11 K3 CO3*
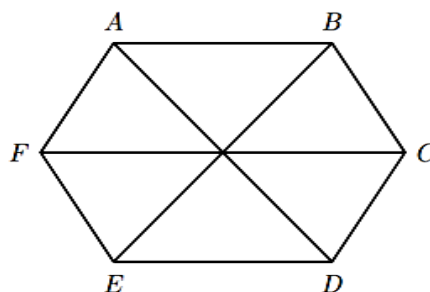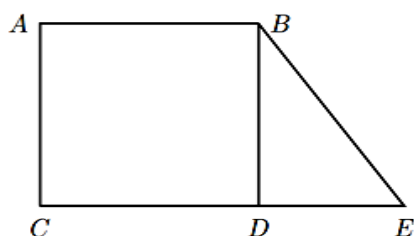
26. a) In any Boolean algebra, prove that the following statements are equivalent.   *11 K3 CO4*
$$a + b = b,$$
$$a.b = a,$$
$$a' + b = 1,$$
$$a.b' = 0$$

OR

   b) State and prove Lagrange's theorem.   *11 K3 CO4*

27. a) Find an Euler path or an Euler circuit, if it exists in the following graphs. If it does not exist, explain why?   *11 K3 CO5*
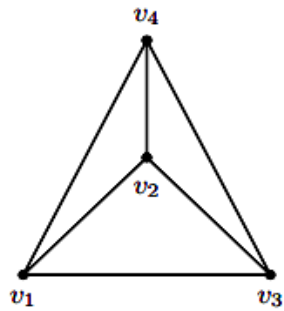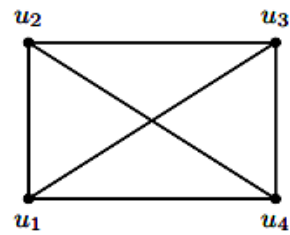

OR

   b) Let G be a graph of order n and size m. If G has no cycles and m = n − 1 then G is a tree.   *11 K3 CO5*

28. a) (i) Establish an isomorphism for the following graphs. 6   K3   CO5
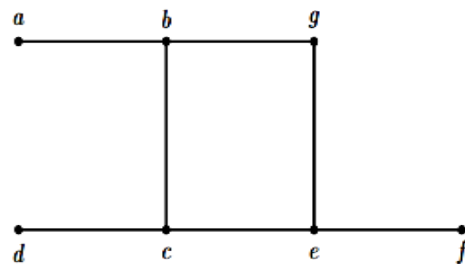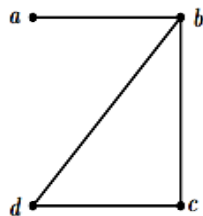

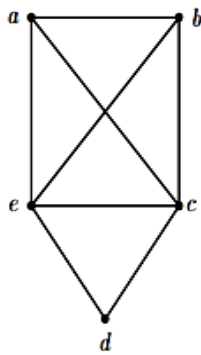G_1 G_2

   (ii) State and prove De-Morgan's law for Boolean Algebra.   5   K3   CO4

OR

b) (i) Which of the following simple graphs have a Hamiltonian circuit or, a Hamiltonian path?   6   K3   CO5

   (ii) In a Boolean algebra show that that $a.b' + a'.b = 0$ if and only if $a = b$.   5   K3   CO4