

# United College of Engineering and Research, Allahabad

## Department of Computer Science & Engineering

### B.Tech CSE- III Semester

#### Set-1

**Course Name:** Discrete Structure and Theory of Logic

**AKTU Course Code:** KCS-303

**Time:** 60 Minutes

**Max. Marks:** 30

- All Questions are compulsory.
- All Questions carry one mark.

Q. No.	Questions	CO
1	Power set of empty set has exactly _____ subset. (A) One (B) Two (C) Zero (D) Three	CO1
2	What is the Cardinality of the Power set of the set $\{0, 1, 2\}$ ? a) 8 b) 6 c) 7 d) 9	CO1
3	Two sets are called disjoint if there _____ is the empty set. a) Union b) Difference c) Intersection d) Complement	CO1
4	The binary relation $\{(1,1), (2,1), (2,2), (2,3), (2,4), (3,1), (3,2)\}$ on the set $\{1, 2, 3\}$ is _____ a) reflexive, symmetric and transitive b) irreflexive, symmetric and transitive c) neither reflexive, nor irreflexive but transitive d) irreflexive and antisymmetric	CO1
5	Let S be a set of $n>0$ elements. Let be the number $B_r$ of binary relations on S and let $B_f$ be the number of functions from S to S. The expression for $B_r$ and $B_f$ , in terms of n should be _____	

	a) $n^2$ and $2(n+1)^2$ b) $n^3$ and $n^{(n+1)}$ c) $n$ and $n^{(n+6)}$ d) $2^{(n*n)}$ and $n^n$	CO1
6	Consider the binary relation, $A = \{(a,b) \mid b = a - 1 \text{ and } a, b \text{ belong to } \{1, 2, 3\}\}$ . The reflexive transitive closure of A is? a) $\{(a,b) \mid a \geq b \text{ and } a, b \text{ belong to } \{1, 2, 3\}\}$ b) $\{(a,b) \mid a > b \text{ and } a, b \text{ belong to } \{1, 2, 3\}\}$ c) $\{(a,b) \mid a \leq b \text{ and } a, b \text{ belong to } \{1, 2, 3\}\}$ d) $\{(a,b) \mid a = b \text{ and } a, b \text{ belong to } \{1, 2, 3\}\}$	CO1
7	Let A and B be two non-empty relations on a set S. Which of the following statements is false? a) A and B are transitive $\Rightarrow A \cap B$ is transitive b) A and B are symmetric $\Rightarrow A \cup B$ is symmetric c) A and B are transitive $\Rightarrow A \cup B$ is not transitive d) A and B are reflexive $\Rightarrow A \cap B$ is reflexive	CO1
8	The inverse of function $f(x) = x^3 + 2$ is _____ a) $f^{-1}(y) = (y - 2)^{1/2}$ b) $f^{-1}(y) = (y - 2)^{1/3}$ c) $f^{-1}(y) = (y)^{1/3}$ d) $f^{-1}(y) = (y - 2)L$	CO1
9	The function $f(x) = x^3$ is bijection from R to R. Is it True or False? a) True b) False	CO1
10	Let f and g be the function from the set of integers to itself, defined by $f(x) = 2x + 1$ and $g(x) = 3x + 4$ . Then the composition of f and g is _____ a) $6x + 9$ b) $6x + 7$ c) $6x + 6$ d) $6x + 8$	CO1
11	A relation R is said to be circular if $aRb$ and $bRc$ together imply $cRa$ . Which of the following options is/are correct? (A) If a relation S is reflexive and symmetric, then S is an equivalence relation. (B) If a relation S is circular and symmetric, then S is an equivalence relation. (C) If a relation S is reflexive and circular, then S is an equivalence relation. (D) If a relation S is transitive and circular, then S is an equivalence relation.	
12	Consider the following sets, where $n \geq 2$ : <b>S1:</b> Set of all $n \times n$ matrices with entries from the set $\{a,b,c\}$ <b>S2:</b> Set of all functions from the set $\{0,1,2 \dots, n^2-1\}$ to the set $\{0,1,2\}$ Which of the following choice(s) is/are correct?	

	<p>(A) There does not exist a bijection from S1 to S2</p> <p>(B) There exists a surjection from S1 to S2</p> <p>(C) There exists a bijection from S1 to S2</p> <p>(D) There does not exist an injection from S1 to S2</p>	
13	<p>Let S be a set of consisting of 10 elements. The number of tuples of the form (A,B) such that A and B are subsets of S, and <math>A \subseteq B</math> is _____ .</p> <p>(A) 59049</p> <p>(B) 1024</p> <p>(C) 50049</p> <p>(D) 59000</p>	
14	<p>Consider the binary relation <math>R = \{(x, y), (x, z), (z, x), (z, y)\}</math> on the set <math>\{x, y, z\}</math>. Which one of the following is TRUE?</p> <p>(A) R is symmetric but NOT antisymmetric</p> <p>(B) R is NOT symmetric but antisymmetric</p> <p>(C) R is both symmetric and antisymmetric</p> <p>(D) R is neither symmetric nor antisymmetric</p>	
15	<p>If P, Q, R are subsets of the universal set U, then</p> <p><math>(P \cap Q \cap R) \cup (P^c \cap Q \cap R) \cup Q^c \cup R^c</math> is</p> <p>(A) U</p> <p>(B) <math>P^c \cup Q^c \cup R^c</math></p> <p>(C) <math>P \cup Q^c \cup R^c</math></p> <p>(D) <math>Q^c \cup R^c</math></p>	
16	<p>Let S be a set of nelements. The number of ordered pairs in the largest and the smallest equivalence relations on S are:</p> <p>(A) n and n</p> <p>(B) <math>n^2</math> and n</p> <p>(C) <math>n^2</math> and 0</p> <p>(D) n and 1</p>	
17	<p>Let R be a relation on the set of ordered pairs of positive integers such that <math>((p, q), (r, s)) \in R</math> if and only if <math>p-s = q-r</math>. Which one of the following is true about R?</p> <p>(A) Both reflexive and symmetric</p> <p>(B) Reflexive but not symmetric</p>	

	<p>(C) Not reflexive but symmetric</p> <p>(D) Neither reflexive nor symmetric</p>	
18	<p>Let <math>f</math> be a function from a set <math>A</math> to a set <math>B</math>, <math>g</math> a function from <math>B</math> to <math>C</math>, and <math>h</math> a function from <math>A</math> to <math>C</math>, such that <math>h(a) = g(f(a))</math> for all <math>a \in A</math>. Which of the following statements is always true for all such functions <math>f</math> and <math>g</math>?</p> <p>(A) <math>g</math> is onto <math>\Rightarrow h</math> is onto</p> <p>(B) <math>h</math> is onto <math>\Rightarrow f</math> is onto</p> <p>(C) <math>h</math> is onto <math>\Rightarrow g</math> is onto</p> <p>(D) <math>h</math> is onto <math>\Rightarrow f</math> and <math>g</math> are onto</p>	
19	<p>Let <math>A</math> be a set with <math>n</math> elements. Let <math>C</math> be a collection of distinct subsets of <math>A</math> such that for any two subsets <math>S_1</math> and <math>S_2</math> in <math>C</math>, either <math>S_1 \subset S_2</math> or <math>S_2 \subset S_1</math>. What is the maximum cardinality of <math>C</math>?</p> <p>(A) <math>n</math></p> <p>(B) <math>n + 1</math></p> <p>(C) <math>2^{(n-1)} + 1</math></p> <p>(D) <math>n!</math></p>	
20	<p>A function <math>f : \mathbb{N}^+ \rightarrow \mathbb{N}^+</math>, defined on the set of positive integers <math>\mathbb{N}^+</math>, satisfies the following properties:</p> $f(n) = f(n/2) \quad \text{if } n \text{ is even}$ $f(n) = f(n+5) \quad \text{if } n \text{ is odd}$ <p>Let <math>R = \{i \mid \exists j : f(j) = i\}</math> be the set of distinct values that <math>f</math> takes. The maximum possible size of <math>R</math> is _____.</p> <p>[This Question was originally a Fill-in-the-Blanks question]</p> <p>(A) 1</p> <p>(B) 2</p> <p>(C) 3</p> <p>(D) 4</p>	
21	<p>A binary relation <math>R</math> on <math>N \times N</math> is defined as follows:  <math>(a, b) R (c, d)</math> if <math>a \leq c</math> or <math>b \leq d</math>.</p> <p>Consider the following propositions:  <math>P</math>: <math>R</math> is reflexive  <math>Q</math>: <math>R</math> is transitive</p>	

	<p>Which one of the following statements is TRUE?</p> <p>(A) Both P and Q are true.</p> <p>(B) P is true and Q is false.</p> <p>(C) P is false and Q is true.</p> <p>(D) Both P and Q are false</p>	
22	<p>Let P, Q and R be sets let <math>\Delta</math> denote the symmetric difference operator defined as <math>P \Delta Q = (P \cup Q) - (P \cap Q)</math>. Using Venn diagrams, determine which of the following is/are TRUE? <math>P \Delta (Q \cap R) = (P \Delta Q) \cap (P \Delta R)</math> <math>P \cap (Q \cap R) = (P \cap Q) \Delta (P \Delta R)</math></p> <p>(A) I only</p> <p>(B) II only</p> <p>(C) Neither I nor II</p> <p>(D) Both I and II</p>	
23	<p>What is the cardinality of the set of integers X defined below? <math>X = \{n \mid 1 \leq n \leq 123, n \text{ is not divisible by either } 2, 3 \text{ or } 5\}</math></p> <p>(A) 28</p> <p>(B) 33</p> <p>(C) 37</p> <p>(D) 44</p>	
24	<p>Suppose A is a finite set with <math>n</math> elements. The number of elements in the largest equivalence relation of A is</p> <p>(A) <math>n</math></p> <p>(B) <math>n^2</math></p> <p>(C) 1</p> <p>(D) <math>n+1</math></p>	
25	<p>Let X, Y, Z be sets of sizes <math>x, y</math> and <math>z</math> respectively. Let <math>W = X \times Y</math>. Let E be the set of all subsets of W. The number of functions from Z to E is:</p> <p>(A) <math>z^{2xy}</math></p> <p>(B) <math>z \times 2^{xy}</math></p> <p>(C) <math>z^{2x+y}</math></p>	

	(D) $2^{xyz}$	
26	<p>Let S denote the set of all functions <math>f: \{0,1\}^4 \rightarrow \{0,1\}</math>. Denote by N the number of functions from S to the set <math>\{0,1\}</math>. The value of <math>\text{Log}_2 \text{Log}_2 N</math> is _____.</p> <p>(A) 12</p> <p>(B) 13</p> <p>(C) 15</p> <p>(D) 16</p>	
27	<p>Consider the following relation on subsets of the set S of integers between 1 and 2014. For two distinct subsets U and V of S we say <math>U &lt; V</math> if the minimum element in the symmetric difference of the two sets is in U. Consider the following two statements:</p> <p>S1: There is a subset of S that is larger than every other subset.</p> <p>S2: There is a subset of S that is smaller than every other subset.</p> <p>Which one of the following is CORRECT?</p> <p>(A) Both S1 and S2 are true</p> <p>(B) S1 is true and S2 is false</p> <p>(C) S2 is true and S1 is false</p> <p>(D) Neither S1 nor S2 is true</p>	
28	<p>Let X and Y be finite sets and <math>f: X \rightarrow Y</math> be a function. Which one of the following statements is TRUE?</p> <p>(A) For any subsets A and B of X, <math> f(A \cup B)  =  f(A)  +  f(B) </math></p> <p>(B) For any subsets A and B of X, <math>f(A \cap B) = f(A) \cap f(B)</math></p> <p>(C) For any subsets A and B of X, <math> f(A \cap B)  = \min \{ f(A) ,  f(B) \}</math></p> <p>(D) For any subsets S and T of Y, <math>f^{-1}(S \cap T) = f^{-1}(S) \cap f^{-1}(T)</math></p> <p>(A) A</p> <p>(B) B</p> <p>(C) C</p> <p>(D) D</p>	
29	<p>Let E, F and G be finite sets. Let <math>X = (E \cap F) - (F \cap G)</math> and <math>Y = (E - (E \cap G)) - (E - F)</math>. Which one of the following is true?</p> <p>(A) <math>X \subset Y</math></p>	

	<p>(B) <math>X \supset Y</math></p> <p>(C) <math>X = Y</math></p> <p>(D) <math>X - Y \neq \emptyset</math> and <math>Y - X \neq \emptyset</math></p>	
<b>30</b>	<p>Let A, B and C be non-empty sets and let <math>X = (A - B) - C</math> and <math>Y = (A - C) - (B - C)</math>. Which one of the following is TRUE?</p> <p>(A) <math>X = Y</math></p> <p>(B) <math>X \subset Y</math></p> <p>(C) <math>Y \subset X</math></p> <p>(D) none of these</p>	

## Answer

1-A	2-A	3-C	4-C	5-D	6-A	7- C	8-B	9-A	10-A
11-C	12-B,C	13-A	14-D	15-A	16-B	17-C	18-C	19-B	20-B
21-B	22-C	23-B	24-B	25-D	26-D	27-A	28-D	29-C	30-A