



DAYANANDA SAGAR COLLEGE OF ENGINEERING

(An Autonomous Institute Affiliated to VTU, Belagavi)

Shavige Malleshwara Hills, Kumaraswamy Layout, Bengaluru-560078

DEPARTMENT OF MATHEMATICS

COURSE : MATHEMATICAL STRUCTURES

COURSE CODE : 21MAT41A

MODULE – 1: Set Theory and Number Theory

Question Bank

Q.No	Questions
1.	a) For any three sets A, B, C prove that $A \cup (B \cap C) = (A \cup B) \cap (A \cup C)$ b) For any three sets A, B, C prove that $A \cap (B \cup C) = (A \cap B) \cup (A \cap C)$
2.	a) Using Venn Diagram, prove that for any three sets A, B, C $\overline{A \cap (B \cup C)} = (\bar{A} \cup \bar{B}) \cap \bar{C}$ b) Using Venn Diagram, prove that for any three sets A, B, C $\overline{(A \cup B) \cap C} = (\bar{A} \cap \bar{B}) \cup \bar{C}$
3.	a) Using Venn Diagram, prove that for any three sets A, B, C $A \Delta (B \Delta C) = (A \Delta B) \Delta C$ b) If for any sets A, B, C, $A \Delta C = B \Delta C$ then $A=B$
4.	a) The bit string for the set $\{1,2,3,4,5\}$ and $\{1,3,5,7,9\}$ are 11 1110 0000 and 10 1010 1010 respectively. Use bit strings to find the union and intersection of these sets. b) If the bit string for the set $\{1,3,5,7,9\}$ in $U \{1,2,3,4,5,6,7,8,9,10\}$ is 10 1010 1010 what is the bit string for the complement of this set?
5.	a) A certain computer center employs 100 programmers. Of these 47 can program in Java, 35 in Python, 20 in C++, 23 in Java and Python, 12 in C++ and Java, 11 in Python and C++ and 5 in all three of these languages. How many can program in none of these languages? b) A professor has two dozen textbooks on Computer Science and is concerned about their coverage of topics viz. (A) Compilers (B) Data Structures and (C) Operating Systems. Following are the numbers of books that contain material on these topics: $ A = 8$, $ B = 13 = C $, $ A \cap B = 5$, $ A \cap C = 3$, $ B \cap C = 6$, $ A \cap B \cap C = 2$. (i) How many of the books include material on exactly one of these topics? (ii) How many do not deal with any of the topics?
6.	a) How many integers are between 1 and 200 which are divisible by any one of the integers 2,3 and 5? b) How many integers are between 1 and 250 which are divisible by any one of the integers 3, 5 and 7?
7.	a) Let $A=\{1, 3, 5\}$, $B=\{2,3\}$ and $C=\{4,6\}$. Find the following: (i) $(A \cup B) \times C$ (ii) $(A \times B) \cap (B \times A)$ (iii) $(A \times B) \cup (B \times C)$ b) Verify that (i) $A \times (B - C) = (A \times B) - (A \times C)$ (ii) $A \times (B \cup C) = (A \times B) \cup (A \times C)$
8.	(a) For any two finite, non empty sets A and B, $ A \times B = A B $



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	<p>(b) For any three sets A, B and C prove that</p> <p>I. $A \times (B \cup C) = (A \times B) \cup (A \times C)$</p> <p>II. $A \times (B \cap C) = (A \times B) \cap (A \times C)$</p>
9.	<p>(a) Prove the De Morgan's laws also prove by using Venn diagram.</p> <p>(b) $A \equiv \{x 3x^2 - 7x - 6 = 0\}$ and $B \equiv \{x 6x^2 - 5x - 6 = 0\}$, Find $A \cap B$.</p>
10.	<p>(a) Two finite sets have m and n elements. The total number of subsets of the first set is 48 more than the total number of subsets of the second set. The values of m and n are?</p> <p>(b) In an examination 70% of the candidates passed in English, 65% in Mathematics, 27% failed in both the subjects and 248 passed in both the subjects. Find the total number of candidates.</p>
11.	<p>(a) In a survey of 100 students it was found that 50 used the college library, 40 had their own library and 30 borrowed books. Of these 20 used both the college library and their own, 15 used their own library and borrowed books and 10 used the college library and borrowed books. How many students used all the three sources of books?</p> <p>(b) A firm has 40 workers working in the factory premises, 30 working in its office and 20 working in both the factory and the office. How many workers are there in the firm? How many are working in</p> <p>i. the factory alone</p> <p>ii. office alone?</p>
12.	<p>(a) In a group of 20 adults there are 8 females, 9 literate and female literate. Find the number of male illiterates in the group.</p> <p>(b) Set A has 4 elements and set B has 7 elements. What can be the minimum number of elements in $A \cup B$?</p>
13.	<p>If $A = \{\alpha, \beta\}$, $B = \{1, 2, 3\}$. Prove that (i) $A \times B$, (ii) $B \times A$ (iii) $A \times A$ (iv) $B \times B$ (v) $(A \times B) \times A$ (vi) $(A \times B) \times B$ (vii) $(A \times B) \cap (B \times A)$</p>
14.	<p>(a) Find the number of positive integers ≤ 3000 and divisible by 3, 5, or 7.</p> <p>(b) Find the number of positive integers ≤ 2076 and divisible by neither 4 nor 5.</p>
15.	<p>(a) Express 10110_{two} in base ten.</p> <p>(b) Express $3ABC_{sixteen}$ in base ten.</p>
16.	<p>(a) Represent 15,036 in the hexadecimal system, that is, in base sixteen.</p> <p>(b) Express 3014 in base eight.</p>
17.	<p>(a) Add two more rows to the following pattern, conjecture a formula for the nth row, and prove it:</p> $9 \cdot 9 + 7 = 88$



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	$98 \cdot 9 + 6 = 888$ $987 \cdot 9 + 5 = 8888$ $9876 \cdot 9 + 4 = 88888$ $98765 \cdot 9 + 3 = 888888$ <p>(b) Establish the validity of the number pattern</p> $1 \cdot 9 + 2 = 11$ $12 \cdot 9 + 3 = 111$ $123 \cdot 9 + 4 = 1111$ $1234 \cdot 9 + 5 = 11111$ $12345 \cdot 9 + 6 = 111111$ $123456 \cdot 9 + 7 = 1111111$
18.	<p>(a) Prove that Every integer $n \geq 2$ has a prime factor.</p> <p>(b) Determine whether 1601 is a prime number.</p>
19.	<p>(a) Find the number of primes ≤ 100.</p> <p>(b) Find six consecutive integers that are composites.</p>
20.	<p>(a) Prove that there are at least $3\lfloor n/2 \rfloor$ primes in the range n through $n!$, where $n \geq 4$.</p> <p>(b) Find the primes such that the digits in their decimal values alternate between 0s and 1s, beginning with and ending in 1.</p>