

**B.Sc.(MATHEMATICS) DEGREE PROGRAMME**  
**Model Question Paper**  
**MM1 B01 FOUNDATIONS OF MATHEMATICS**

Time : 3 Hours  
Maximum : 30 Weights

**Part A : (3 Bunches of Objective Type Questions.)**  
**(Answer All Questions.)**

3 X 1 = 3 Weights.

1. Who is considered to be the father of Set Theory ?  
(a) Bertrand Russel. (b) George Cantor.  
(c) Srinivasa Ramanujan. (d) George Boole.
2. A, B are subsets of a universal set having 12 elements. If A has 7 elements, B has 9 elements and  $A \cap B$  has 6 elements, then what is the number of elements in  $A \cup B$  ?  
(a) 7 (b) 8 (c) 9 (d) 10
3. Which of the following is an identity ?  
(a)  $(A - B)' = B - A$  (b)  $(A - B)' = A \cup B$   
(c)  $(A - B)' = A \cup B$  (d)  $(A - B)' = A \cup B$
4. Say True or False the statement: It is possible to find a set for which the number of elements of it and the number of non-trivial subsets of it are equal.  
(Recall that non-trivial subsets are those other than  $\phi$  and the whole set.)
5. What is the number of relations possible from a set A with 3 elements to a set B with 2 elements ?
6. A relation  $R : A \rightarrow B$  is given by  $R = \{(1,a), (1,b), (3,a), (3,b), (5,c)\}$ . What is the **minimum** possible number of ordered pairs in  $A \times B$  ?
7. How many functions can be defined from a set A having m elements into a set B having n elements ?

8. Which of the following is not a Logical Statement ?  
 (a)  $2 \times 3 = 8$ . (b) India and Pakistan are not neighbouring countries.  
 (c) It is very hot, today.  
 (d) Every English word includes the alphabet e.
9. In the statement "x is greater than 3", the underlined part is the  
 (a) Subject. (b) Predicate. (c) Quantifier. (d) Propositional Function.
10. The logical equivalent proposition of  $p \Rightarrow q$  is  
 (a)  $p \vee \neg q$  (b)  $\neg p \vee \neg q$  (c)  $\neg p \vee q$  (d)  $p \vee q$
11. For the statement  $p \Rightarrow q$ , the statement  $q \Rightarrow p$  is called the  
 (a) converse. (b) contrapositive. (c) negation. (d) premise.
12. A statement of the form  $p \vee \neg p$  is a  
 (a) contradiction. (b) tautology.  
 (c) counter example. (d) simplification.

**Part B : (Very Short Answer Type Questions.)**  
**(Answer All Questions.)**

9 X 1 = 9 Weights.

13. If  $A = \{1, 2, 3\}$ ,  $B = \{2, 3, 4, 5\}$ , then write  $[(A - B) \cup (B - A)]'$ .
14. Let A be the set of integers having modulus less than 4, B be the set of natural numbers less than 7 and C be the set of non-negative integers greater than -10.  
 Write the set  $(B \cup C) - A$
15. On the set of real numbers, a relation is defined by the set  $\{(x, y): x^2 + y^2 = 1\}$ . Write arguments to **prove** or **disprove** that the relation is a function.
16. Write the statement in English corresponding to " $\neg p \rightarrow q$ " where  $p$  is "it is not raining" and  $q$  is "it is possible to play football".
17. Give example of a function  $f : \mathbb{N} \rightarrow \mathbb{N}$  which is both **one-one** and **onto**.

18. Write the statement in English corresponding to  $\forall x P(x)$ , where  $x$  stands for "a student of the first semester B. Sc. Mathematics class" and  $P(x)$  stands for "x is doing a course in Mathematical Logic".
19. Evaluate  $| [3.8] | + [ | 1.7 | ]$
20. Give example of a **transitive relation** on the set of real numbers which does not satisfy the **reflexive** and **symmetric** conditions.
21. The truth values of the statements  $p$ ,  $q$  and  $r$  are respectively **T**, **F** and **F**. What is the truth value of the statement  $(p \rightarrow \neg q) \vee (q \wedge r)$  ?

**Part C : (Short Answer Type Questions.)**  
**(Answer Any Five Questions.)**

5 X 2 = 10 Weights.

22. For the non-empty sets  $A$ ,  $B$ ,  $C$  and  $D$ , **prove** or **disprove** the statement  $(A - C) \times (B - D) = (A \times B) - (C \times D)$ .
23. For three sets  $A$ ,  $B$  and  $C$ , prove that
 
$$(A \cap B) \cup C = (A \cup C) \cap (B \cup C).$$
24. Prove that the statements " $p \rightarrow q$ " and " $\neg p \vee q$ " are logically equivalent using truth tables.
25. The statements  
 $p$  : "Arjuna is the greatest Archer" and  
 $q$  : "Arjuna can hit the parrots eye with his arrow"  
 are given. Write the English statements corresponding to :  
 (a)  $p \rightarrow q$  (b)  $\neg (p \rightarrow q)$  (c)  $q \rightarrow p$  and (d)  $\neg p \vee \neg q$
26. A relation  $R$  on the set of real numbers is defined by

$$R = \{(x, y) : 1 + xy > 0\}.$$

Determine whether  $R$  satisfies the conditions **reflexivity**, **symmetry** and **transitivity**.

27. Give example of a relation from a set A having three elements into a set B having four elements and then write its inverse relation.
28. Show that  $(p \wedge q) \rightarrow (p \vee q)$  is a tautology.

**Part D : (Essay Type Questions.)**  
**(Answer Any Two Questions.)**

2 X 4 = 8 Weights.

29. Using the rules of inference prove that the hypotheses "It is not sunny in the afternoon and it is colder than yesterday", "We will go swimming only if it is sunny", "If we go swimming, then we will take a canoe-trip" and "If we take a canoe-trip, then we will be home by sunset" lead to the conclusion that "We will be home by the sunset".
30. Define the inverse of a function  $f : A \rightarrow B$  : if the function is defined as

$$f(x) = \frac{2x + 3}{3x - 5},$$

Then find

- (a) the domain of f, (b) the inverse function  $f^{-1}$  and (c) the range of f.
31. Explain the following with one example each:
- (a) Proof by Contraposition. (b) Proof by Contradiction.  
(c) Exhaustive Proofs.