

B.Sc. DEGREE PROGRAMME
MATHEMATICS (CORE COURSE)

FIRST SEMESTER

(w.e.f.2010 admn.)

MM1B01: FOUNDATIONS OF MATHEMATICS

4 hours/week

4 credits

30 weightage

Aims

The course aims to:

- ∞ to explain the fundamental ideas of sets and functions;
- ∞ to introduce basic logic;

Brief Description of the Course

This course introduces the concepts of sets and functions from a rigorous viewpoint, mathematical logic, and methods of proof. These topics underlie most areas of modern mathematics, and to be applied frequently in the succeeding semesters.

Learning Outcomes

On completion of this unit successful students will be able to:

- ∞ prove statements about sets and functions;
- ∞ analyze statements using truth tables;
- ∞ construct simple proofs including proofs by contradiction and proofs by induction;

Future needs Introduction

All Mathematics course units, particularly those in pure mathematics and computer programming.

Syllabus

Text Books

1. K.H. Rosen: Discrete Mathematics and its Applications (fifth edition), Tata McGraw Hill Publishing Company, New Delhi.
2. S. Lipschutz: Set Theory and related topics (Second Edition), Schaum Outline Series, Tata McGraw-Hill Publishing Company, New Delhi.

Module 1 (16 hours)

Set theory

Pre-requisites: Sets, subsets, Set operations and the laws of set theory and Venn diagrams. Examples of finite and infinite sets. Finite sets and the counting principle. Empty set, properties of empty set. Standard set operations. Classes of sets. Power set of a set (Quick review).

Syllabus: Cartesian product of two and more sets, relations. Difference and Symmetric difference of two sets. Set identities, Generalized union and intersections (As in section 1.7 of Text book 1).

Relations: Product set, Relations (Directed graph of relations on set is omitted). Composition of relations, Types of relations, Partitions, Equivalence relations with example of congruence modulo relation, Partial ordering relations, n-ary relations. (As in Chapter 3 of text book 2 excluding 3.7).

Module 2 (22 hrs)

Functions

Pre-requisites: Basic ideas such as domain, co-domain and range of functions. Equality of functions, Injection, Surjection and Bijection (Quick review).

Syllabus: Identity function, constant functions, product (composition) of functions, theorems on one-one and onto functions, Mathematical functions, Recursively defined functions (As in Chapter 4 of text book 2).

Indexed collection of sets, Operations on indexed collection of sets (As in 5.1, 5.2 and 5.3 of text book 2).

Special kinds of functions, Associated functions, Algorithms and functions,

Complexity of Algorithms (As in Chapter 5.7 of text book 2).

Equipotent sets, Denumerable and countable sets, Cardinal numbers (Definitions and examples only as in 6.1, 6.2, 6.3 and 6.5 of text book 2).

Module 3(22hrs.)

Basic Logic-1

Pre-requisite: Nil.

Syllabus: Introduction, propositions, truth table, negation, conjunction and disjunction. Implications, biconditional propositions, converse, contra positive and inverse propositions and precedence of logical operators. Propositional equivalence: Logical equivalences. Predicates and quantifiers: Introduction, Quantifiers, Binding variables and Negations.

(As in Chapter 1 of Text book 1).

Module 4 (12 hrs.)

Basic Logic-2

Methods of proof: Rules of inference, valid arguments, methods of proving theorems; direct proof, proof by contradiction, proof by cases, proofs by equivalence, existence proofs, uniqueness proofs and counter examples. (As in Chapter 1 of Text book 1).

References

P.R. Halmos: Naive Set Theory, Springer.

E. Kamke, Theory of Sets, Dover Publishers.

Seminar Topics

Statement of fundamental theorem of Algebra: A polynomial equation of degree $n \geq 1$ has n and only n roots, relation between roots and coefficients, symmetric functions of the roots.