

The background of the cover is white with scattered binary digits (0s and 1s) in a light purple color. There are also several large, faint, stylized numbers (0, 1, 2) in the same color, some of which are partially cut off by the edges of the page. The main title is centered and rendered in a bold, green, sans-serif font with a slight shadow effect.

DISCRETE MATHEMATICS

FOR BEGINNERS

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Preface

Welcome to *Discrete Mathematics for Beginners*, a book curated with our students in mind. This book aims to provide comprehensive support and a self-explained guide to help our students master the concepts required for the Discrete Mathematics course, particularly for our diploma programmes.

Discrete Mathematics for Beginners covers the fundamental concepts for studying sets, counting, relations and functions, directed graphs, logic, and number theory. These concepts are tailored to the scope of the course syllabus. Every chapter starts with a straightforward introduction before presenting all the necessary concepts of the chapter in a modular format as individual topics. At the end of each chapter, there is a summary of key points to take away. Each chapter explains each concept in the topics, followed by examples of questions with step-by-step solutions. For self-assessment, students are given exercises related to the respective topics as test-yourself questions. Finally, students can evaluate their learning with revision questions given at the end of each chapter.

Below are the special highlights and emphases of each chapter:

Chapter 1: Cover the set theory concept, including number systems, Venn diagrams, set operations, and set theory laws. It then explores problem-solving involving applications related to the set.

Chapter 2: Begin with basic counting methods, progressing to combinatorics, specifically permutation and combination. The combination concept is further utilised to derive the Binomial Theorem, a significant algebraic theorem.

Chapter 3: Discuss Cartesian products of sets, various types of relations, their properties, and functions that represent object relationships, including special functions.

Chapter 4: Introduce the definitions and properties of directed graphs and explore the connectedness concepts from relations and functions extended to graphs and trees. It covers various types of graphs and trees, along with their properties.

CHAPTER 1

SET THEORY

INTRODUCTION

The concept of a set is very common in our daily lives. It refers to a group of objects that fulfil specific pre-defined characteristics or features. These objects share similar or common characteristics. A list of students in a class, a list of school classes, a list of schools in a district, a list of districts in a state, a list of states in a country, and a list of countries in a region like Southeast Asia are examples of different sets. This chapter discusses the set system, such as sets and subsets, including number systems, Venn diagrams, set operations, and the laws of set theory, before addressing problems involving applications of the set.

1.1 SETS

In mathematics, the capital Roman letters A to Z are used as a variable to represent a set. All the objects that fulfil the predefined characteristics of a set are enclosed within an opening curly bracket, '{' and a closing curly bracket, '}'. The objects that belong to a set are referred to as members or elements of a set. Each of these members is separated by a comma within the curly brackets. This collection of members can be presented in an unordered manner, although an ordered presentation of members of a set is usually preferable. Repetition of the same member in a set is allowed even though it is less practised. To look at a few examples of sets, the common characteristics of each set are defined, and a variable is assigned for each set.

Let A be a set of states in Malaysia; let B be a set of days in a week; let C be a set of prime numbers that is no more than 17; and let D be a set of polygons with more than three sides but less than nine sides. These four sets can be expressed in mathematical set notation below, listing all its members.

$$A = \{ \text{Sarawak, Sabah, Perlis, Pulau Pinang, Kedah, Perak, Selangor,}$$

$$\text{Kelantan, Terengganu, Pahang, Negeri Sembilan, Melaka, Johor} \}$$

$$B = \{ \text{Monday, Tuesday, Wednesday, Thursday, Friday, Saturday, Sunday} \}$$

$$C = \{ 2, 3, 5, 7, 11, 13, 17 \}$$

$$D = \{ \text{Square, Pentagon, Hexagon, Heptagon, Octagon} \}$$

Discrete Mathematics for Beginners addresses fundamental concepts essential for novices enrolled in a discrete mathematics course. Beginning with Set Theory, the book explains the fundamentals of sets, their operations, laws, and real-world applications. It then delves into counting principles, offering discussions on permutations, combinations, and the Binomial Theorem. It continues with Functions and Relations, focusing on understanding Cartesian products, relation properties, and functions. The chapter on Directed Graphs presents fundamental concepts and properties related to graphs and paths, trees, Eulerian and Hamiltonian paths, and circuits. Next, the chapter on logic discusses logical statements, truth tables, laws of logic, the construction of sound arguments, and rules of inference. Finally, Basic Number Theory is illustrated through sequences and summations, mathematical induction, and recursive definitions. With succinct summaries and revision exercises, the book is a comprehensive companion in equipping the readers with the skills needed to master key topics in discrete mathematics.



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