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3.3.2 Number of books and chapters in edited volumes/books published and papers published in national/ international conference proceedings per teacher during last five years.

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Mathematics Paper-V- DSC-C-5 Elements of Differential Equations-Cover Page

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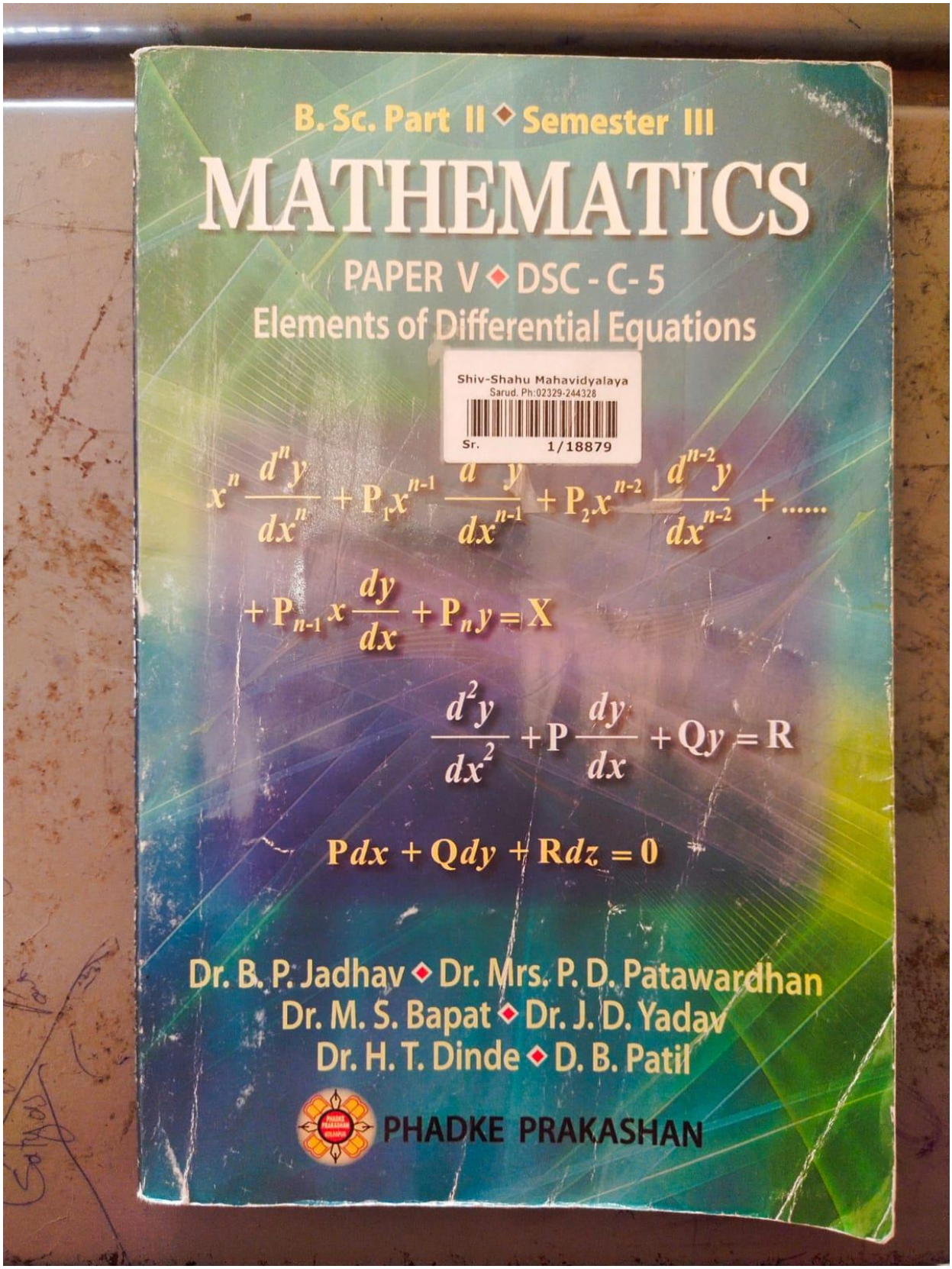

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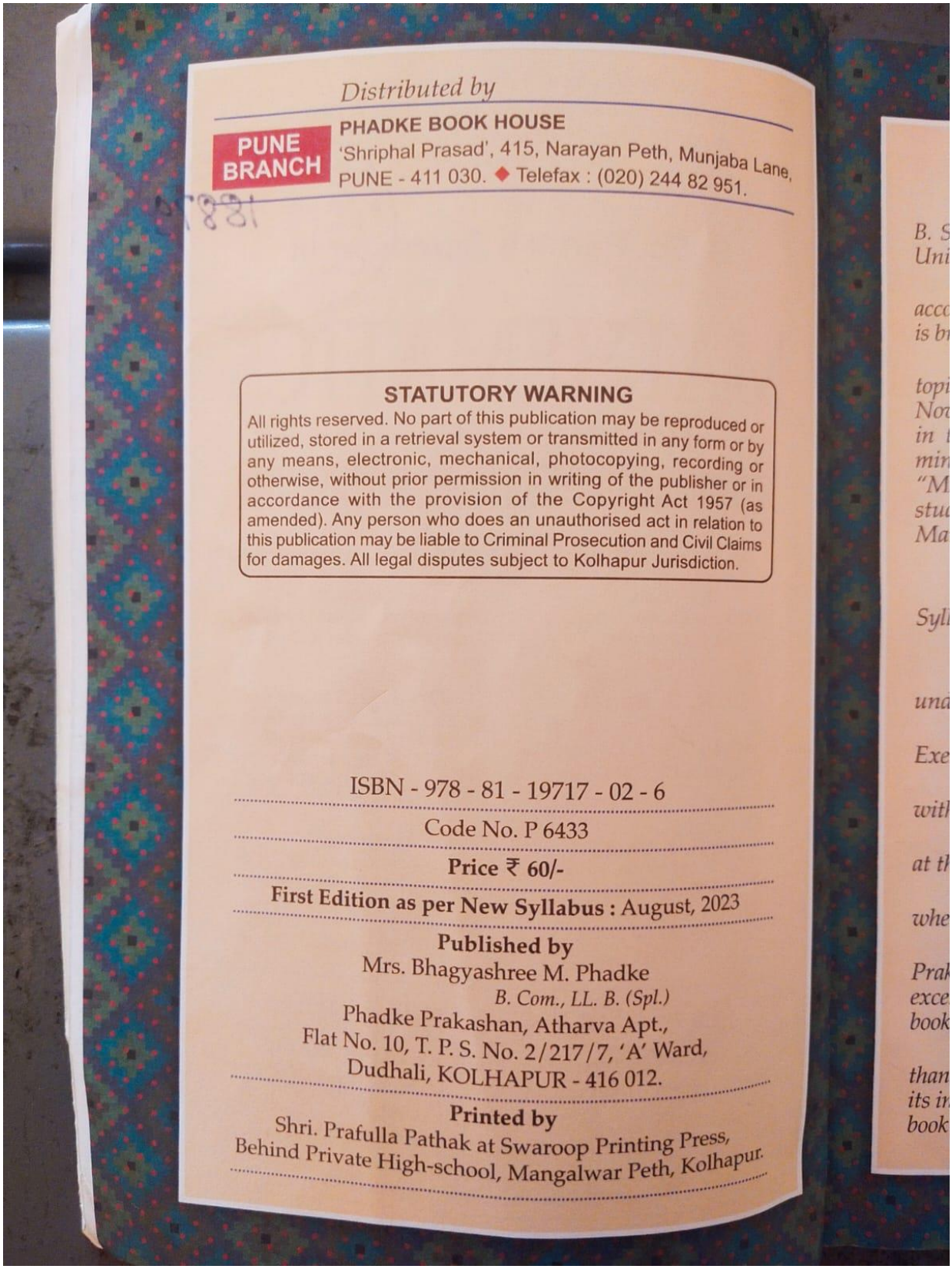

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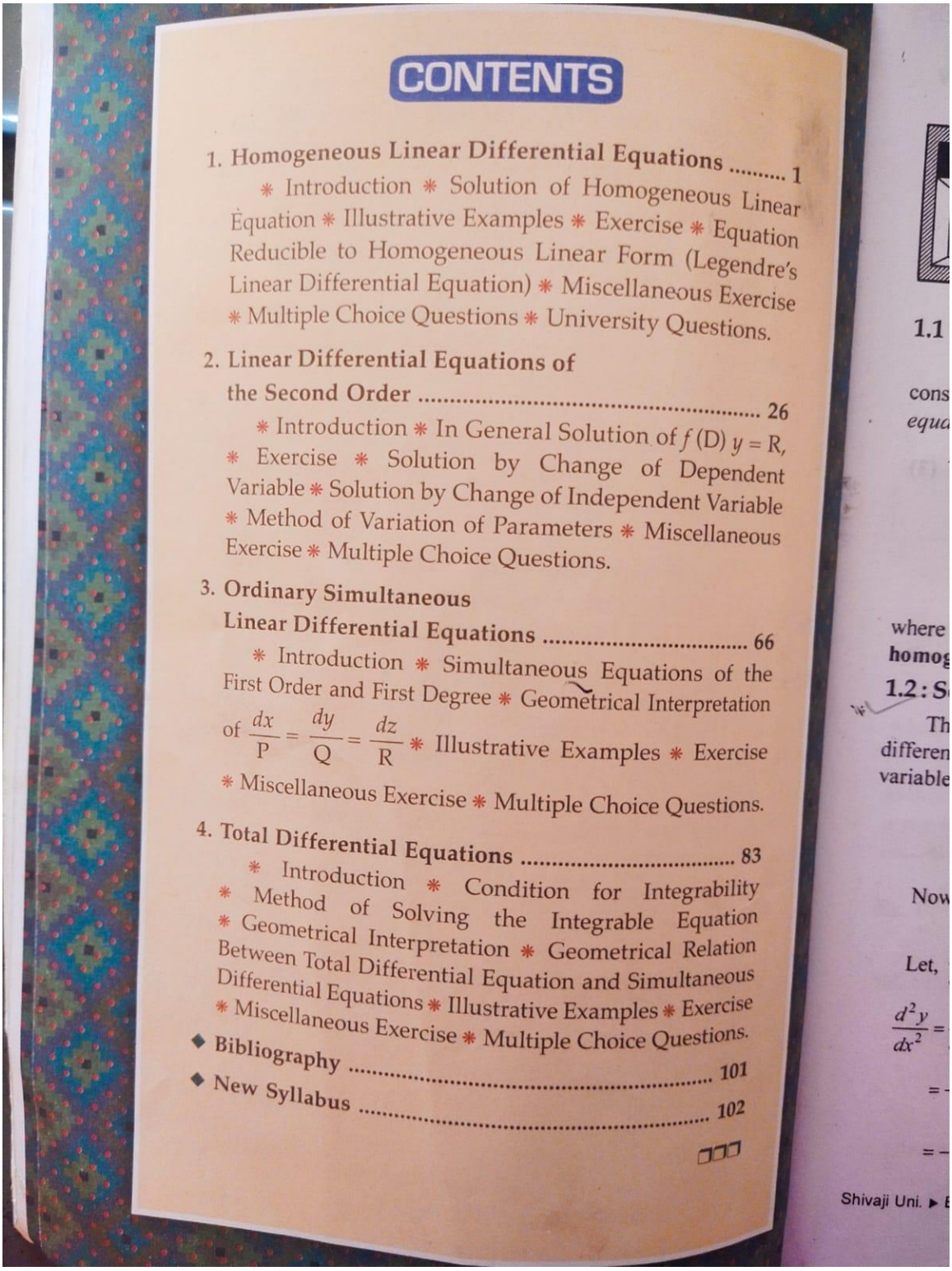

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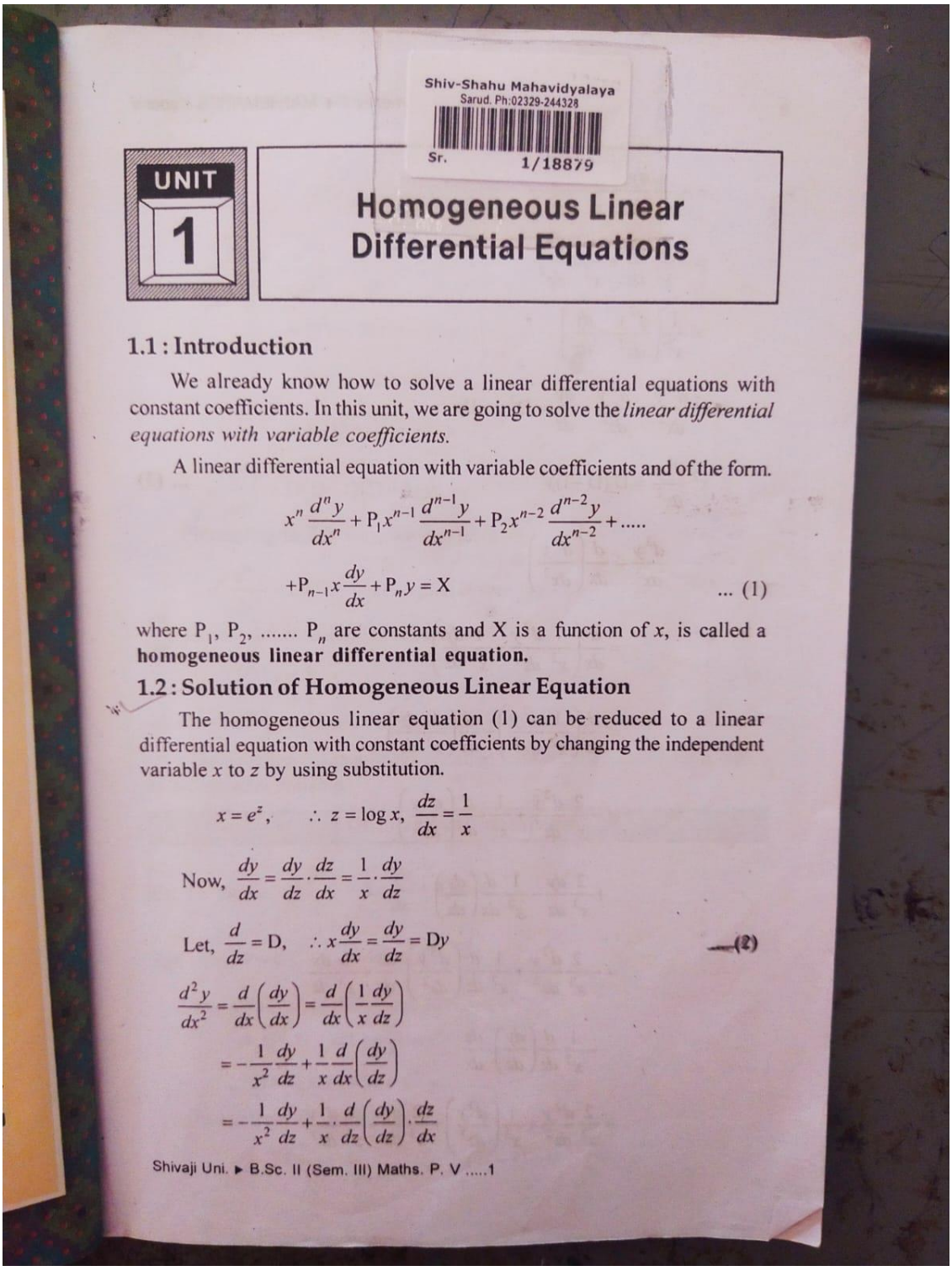


UNIT 1

Homogeneous Linear Differential Equations

1.1 : Introduction

We already know how to solve a linear differential equations with constant coefficients. In this unit, we are going to solve the *linear differential equations with variable coefficients.*

A linear differential equation with variable coefficients and of the form.

$$x^n \frac{d^n y}{dx^n} + P_1 x^{n-1} \frac{d^{n-1} y}{dx^{n-1}} + P_2 x^{n-2} \frac{d^{n-2} y}{dx^{n-2}} + ...$$

$$+ P_{n-1} x \frac{dy}{dx} + P_n y = X \qquad \ldots (1)$$

where P_1, P_2, ... P_n are constants and X is a function of x, is called a **homogeneous linear differential equation.**

1.2 : Solution of Homogeneous Linear Equation

The homogeneous linear equation (1) can be reduced to a linear differential equation with constant coefficients by changing the independent variable x to z by using substitution.

$$x = e^z, \quad \therefore z = \log x, \quad \frac{dz}{dx} = \frac{1}{x}$$

Now, $$\frac{dy}{dx} = \frac{dy}{dz} \cdot \frac{dz}{dx} = \frac{1}{x} \cdot \frac{dy}{dz}$$

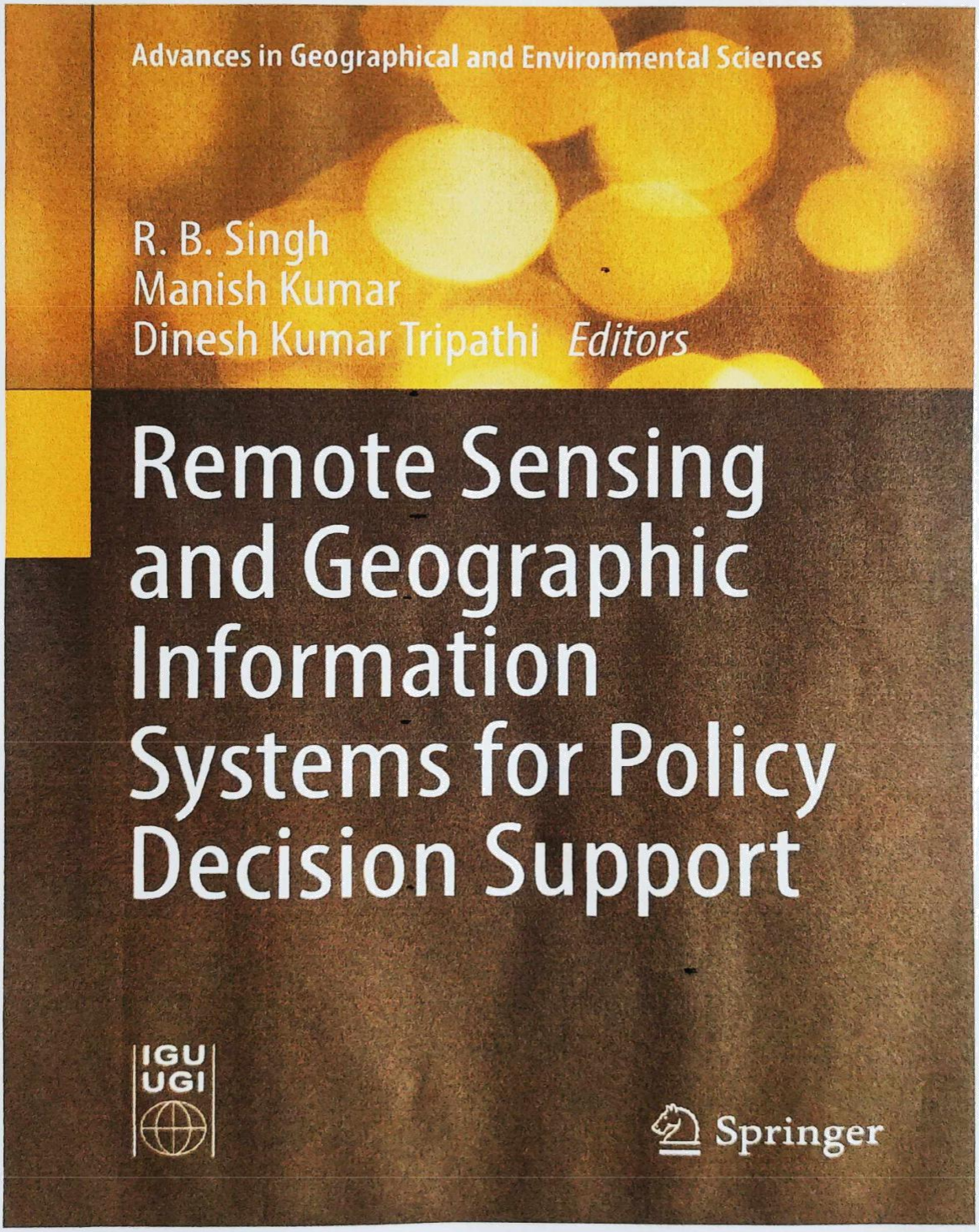
Let, $$\frac{d}{dz} = D, \quad \therefore x\frac{dy}{dx} = \frac{dy}{dz} = Dy \qquad \ldots (2)$$

$$\frac{d^2 y}{dx^2} = \frac{d}{dx}\left(\frac{dy}{dx}\right) = \frac{d}{dx}\left(\frac{1}{x}\frac{dy}{dz}\right)$$

$$= -\frac{1}{x^2}\frac{dy}{dz} + \frac{1}{x}\frac{d}{dx}\left(\frac{dy}{dz}\right)$$

$$= -\frac{1}{x^2}\frac{dy}{dz} + \frac{1}{x} \cdot \frac{d}{dz}\left(\frac{dy}{dz}\right) \cdot \frac{dz}{dx}$$

Remote Sensing and Geographic Information Systems for Policy Decision Support- Cover Page



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Chapter 4
Site Suitability Analysis for Identifying Water Conservation Structures Using Geoinformatics of Eastern Part of Satara District of Maharashtra, India

P. T. Waghmare and S. S. Panhalkar

Abstract Identification of a suitable site for water harvesting structure is significant for drought mitigation and management. Water conservation needs an in-depth study of rainfall-runoff features and a thorough assessment of surface topographical conditions. In this study, the researcher has identified appropriate site for water harvesting structures in the eastern part of Satara district of Maharashtra. The present investigation uses physical components as well as social components. Remote sensing data and toposheets and integrated weighted overlay methods are used to identification of proper suitable sites for water harvesting system. The minimum value was assigned to the factor that is least suitable for the water harvesting system and the maximum value was given to the factor that is highly favorable for the water harvesting structure. The influence factor values of thematic layers were summed up and the total score was calculated. Finally, the calculated score was classified into four classes. The investigation brings out that 31.15% area is highly suitable for establishing water harvesting structures. Moderately suitable area is about 45.65, whereas less suitable area is 20% for water conservation structures. The present study will be helpful to reduce the risk of future drought conditions.

Keywords Runoff · Weighted overlay analysis · SCS-CN method · GIS · Remote sensing

4.1 Introduction

Water is an essential component for fulfilling the basic needs of biotic and abiotic components. Water scarcity has increased due to quickly rising population, industry, economy, and climate change; managing water resources has always been a difficult task during the drought years in past decades (Hirsch 1981; Frick et al. 1990; Randall et al. 1990; Johnson and Kohne 1995; Smithers 1997). Due to over-exploitation and inadequate natural recharge, groundwater table in the study area is going

P. T. Waghmare (✉) · S. S. Panhalkar
Department of Geography, Shivaji University Kolhapur, Kolhapur, Maharashtra, India

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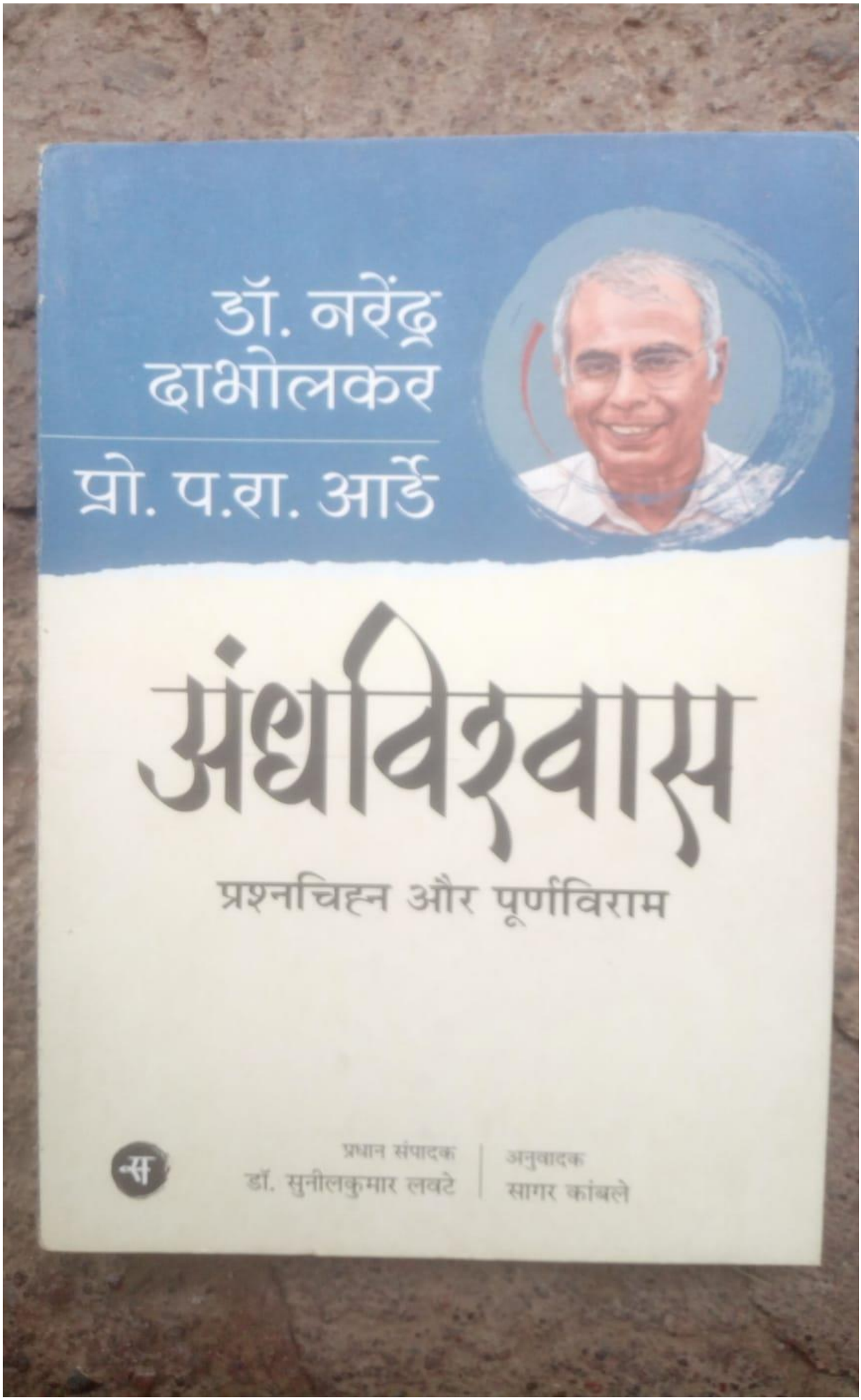

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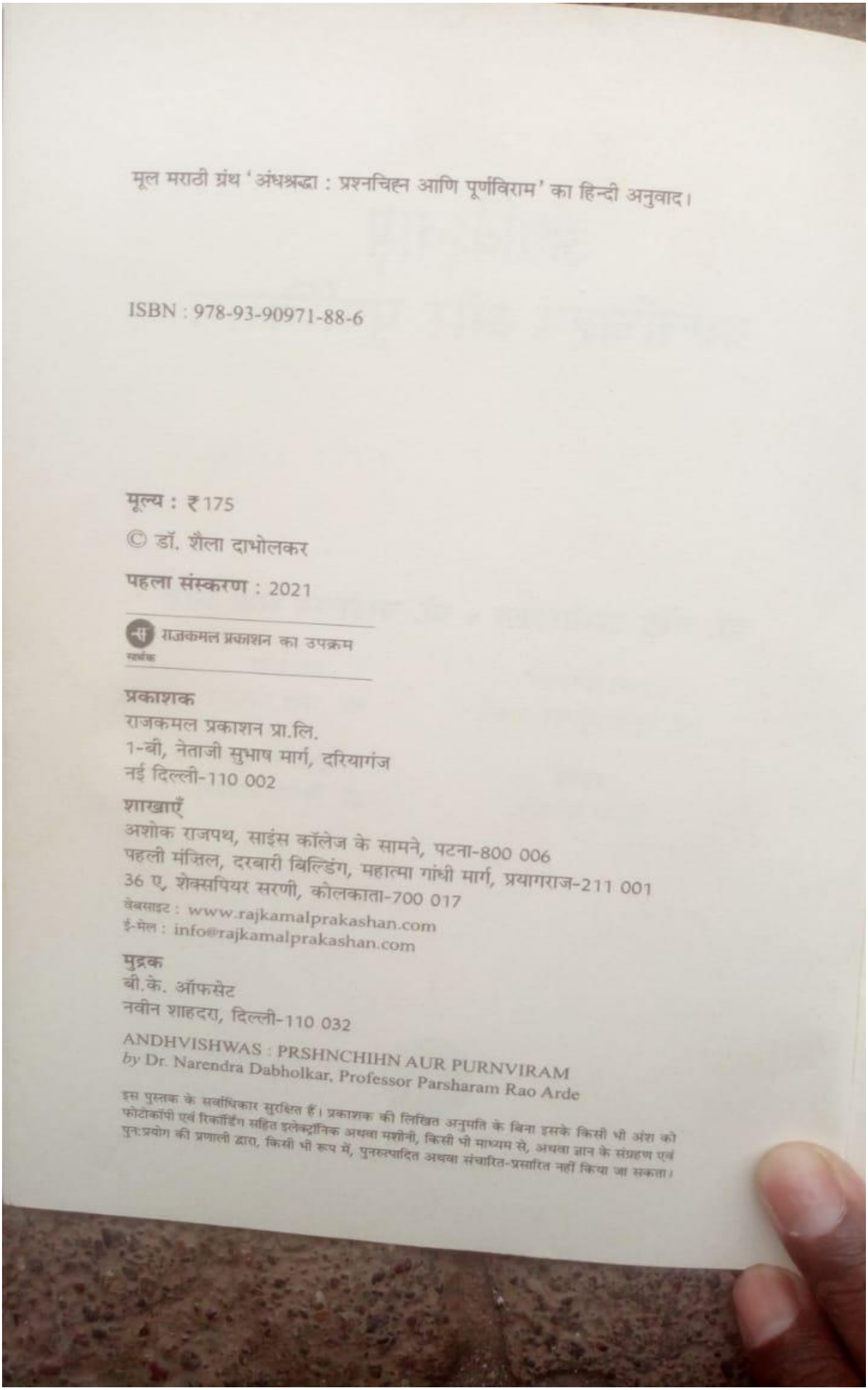

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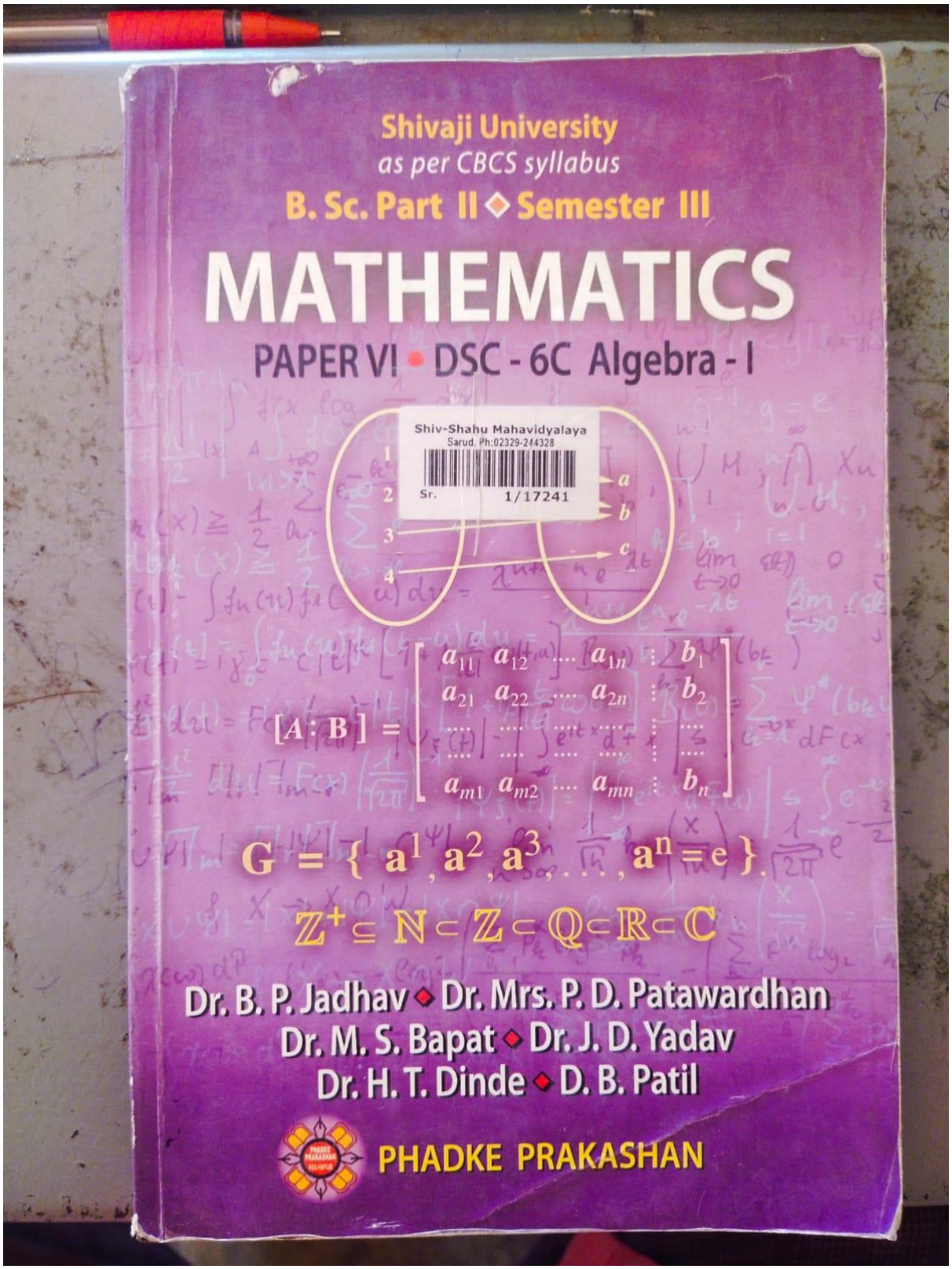

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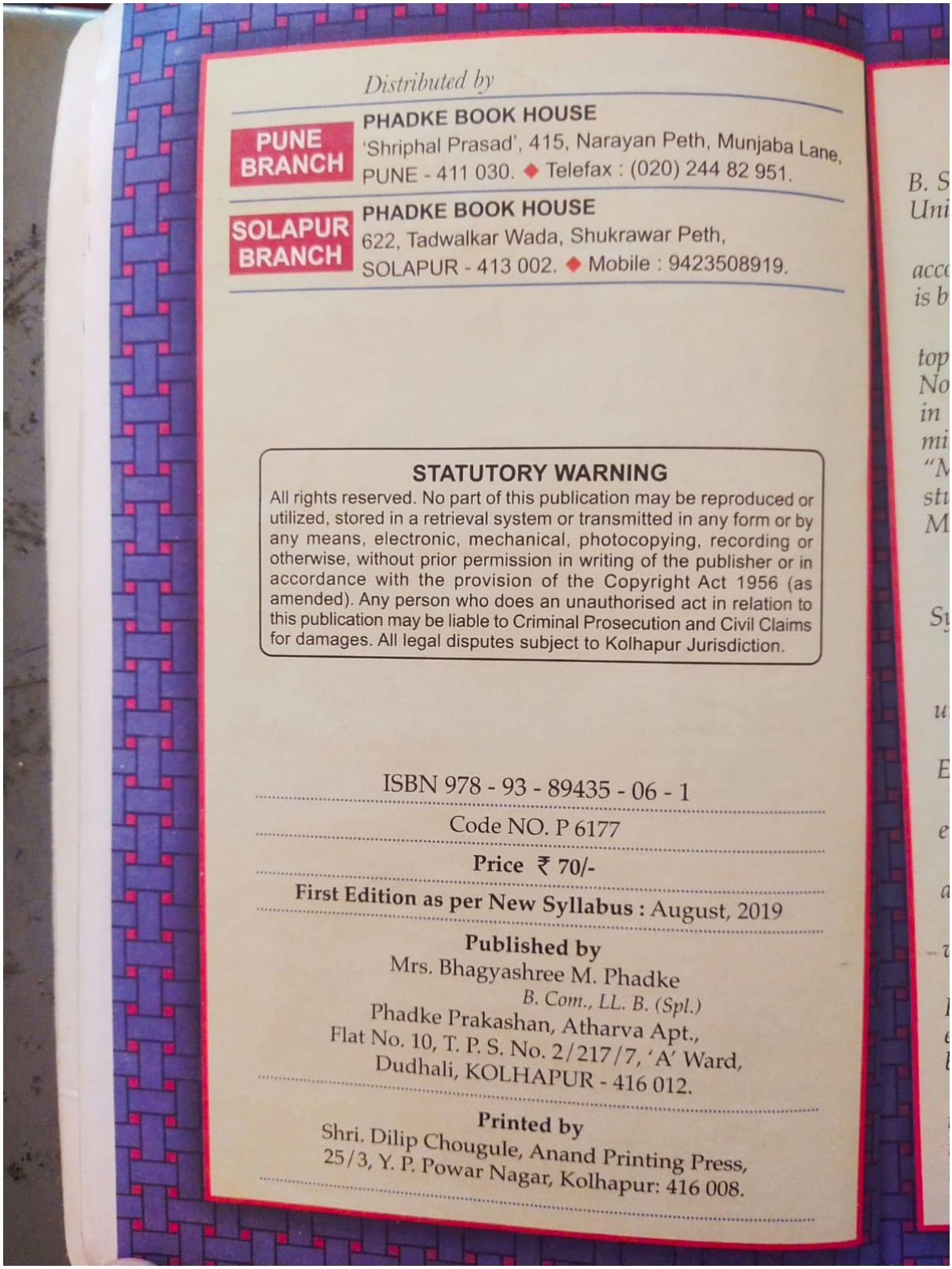

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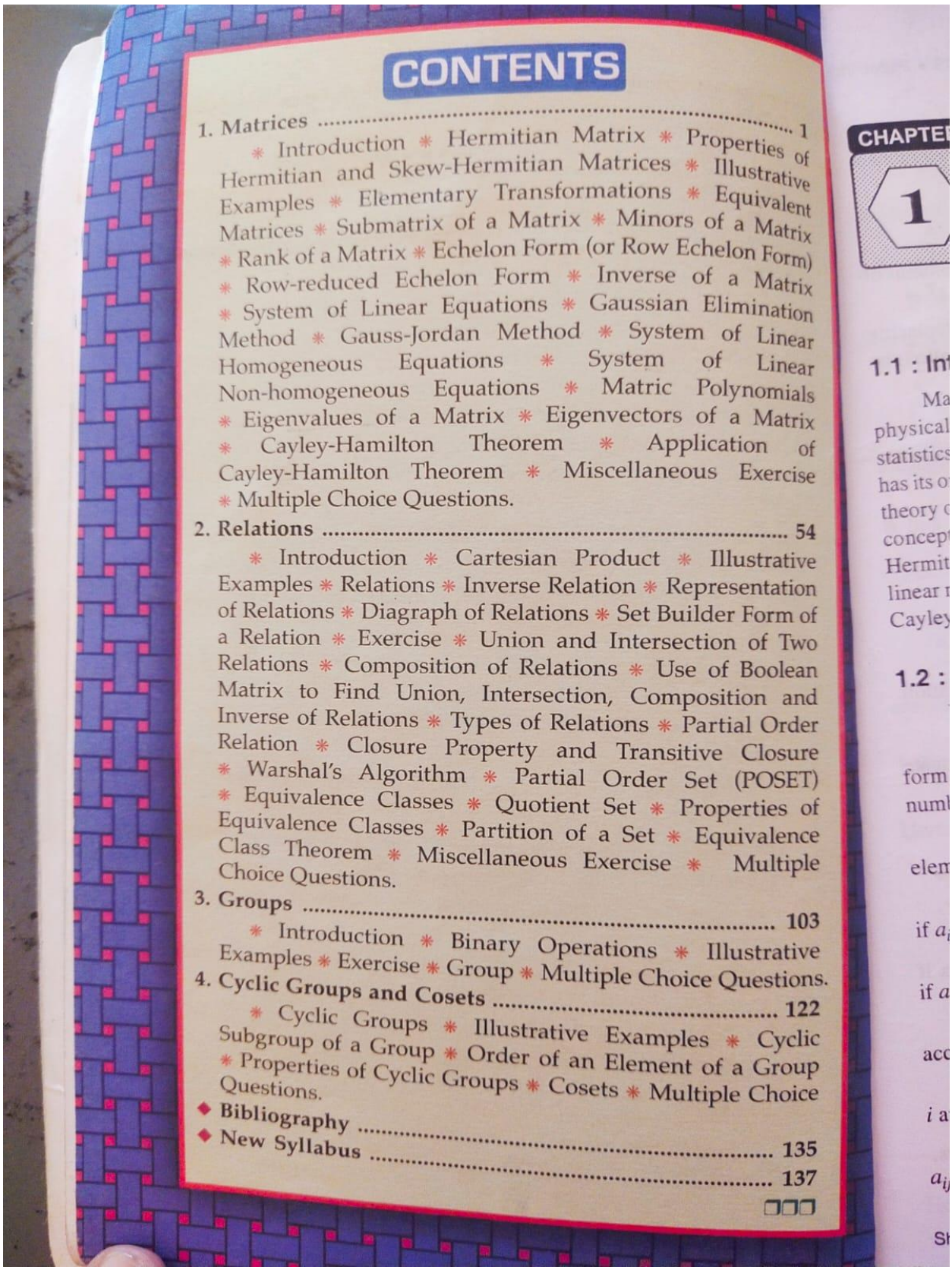

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CHAPTER 1

MATRICES

1.1 : Introduction

Matrix theory acts as a powerful tool in almost all branches of social and physical sciences. Matrices are used in engineering, linear programming, statistics, economics and also in industrial management. The subject of matrices has its origin in the solution of "linear problems". Cayley formulated the general theory of matrices. In standard XI and XII we have already studied some basic concepts of matrices. In this chapter, we shall study Hermitian and Skew-Hermitian matrices, system of linear homogeneous equations and system of linear non-homogeneous equations, eigenvalues and eigenvectors of matrices, Cayley-Hamilton theorem.

1.2 : Some Basic Definitions

First we shall revise some basic definitions:

Definition : A system of mn numbers (real or complex) arranged in the form of an ordered set of m rows, each row consisting of an ordered set of n numbers is called a matrix of order m by n, written as $m \times n$ matrix.

Definition : A square matrix is said to be a **triangular matrix** if the elements above or below the principal diagonal are zero.

Definition : A square matrix $A = [a_{ij}]$ is called an **upper triangular matrix,** if $a_{ij} = 0$, for $i > j$.

Definition : A square matrix $A = [a_{ij}]$ is called a **lower triangular matrix,** if $a_{ij} = 0$, for $i < j$.

Definition : A square matrix A is said to be singular or non-singular according as $|A| = 0$ or $|A| \neq 0$.

Definition : A square matrix $A = [a_{ij}]$ is called symmetric if $a_{ij} = a_{ji}$ for all i and j. $A^T = A$

Definition : A square matrix $A = [a_{ij}]$ is called skew-symmetric if $a_{ij} = -a_{ji}$ for all i and j. $A^T = -A$

Note : All the diagonal elements of a skew-symmetric matrix are zero.

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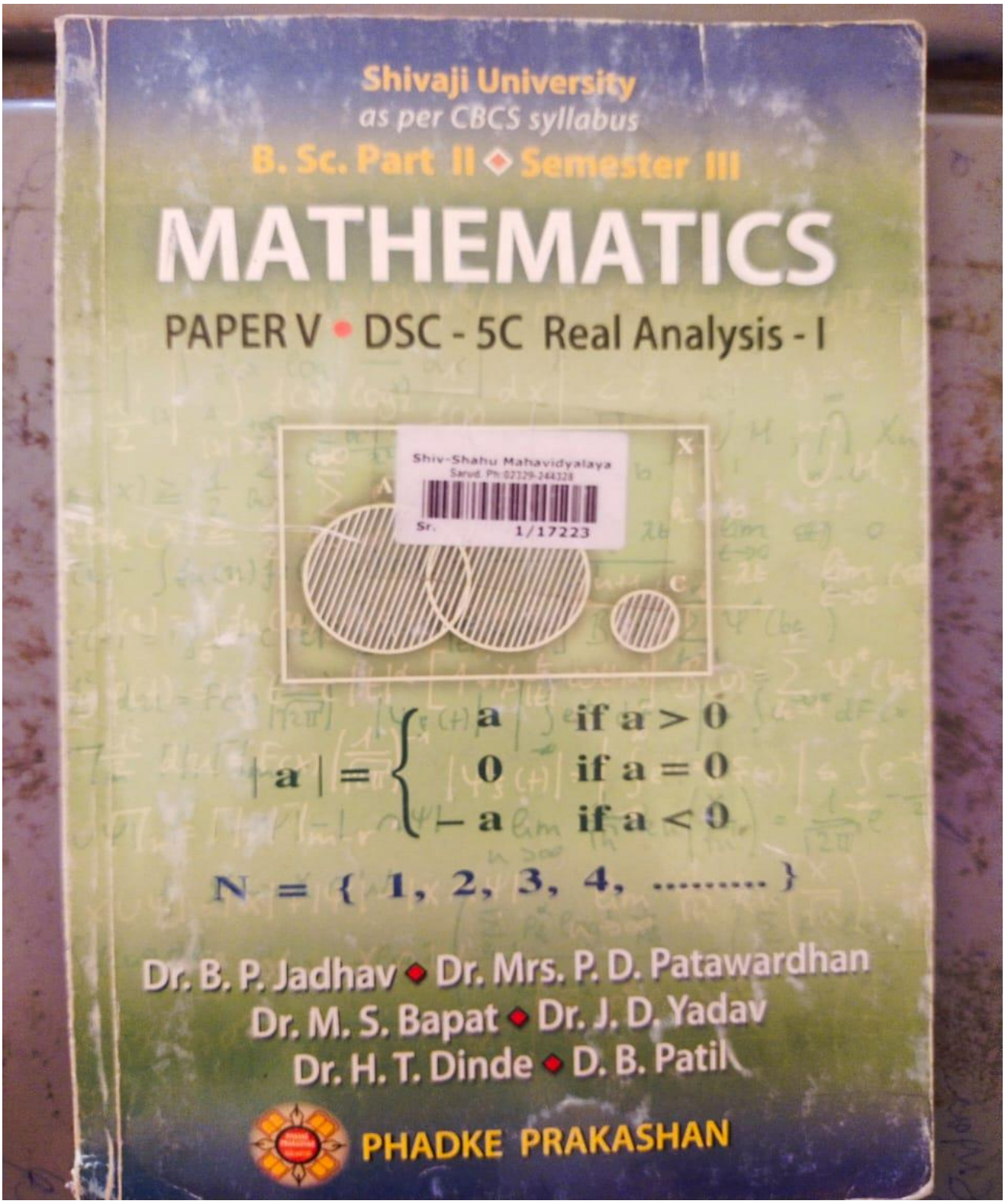

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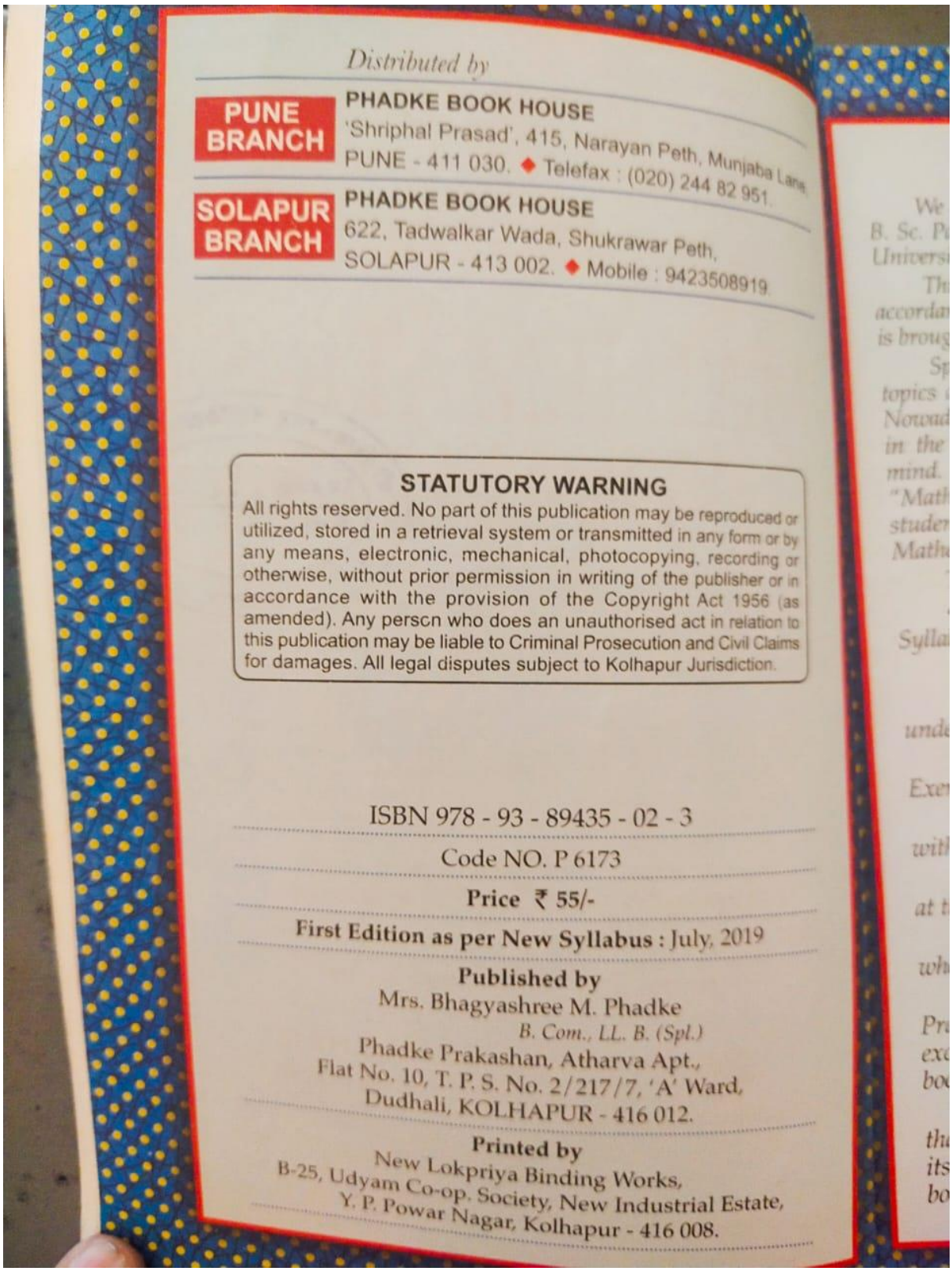

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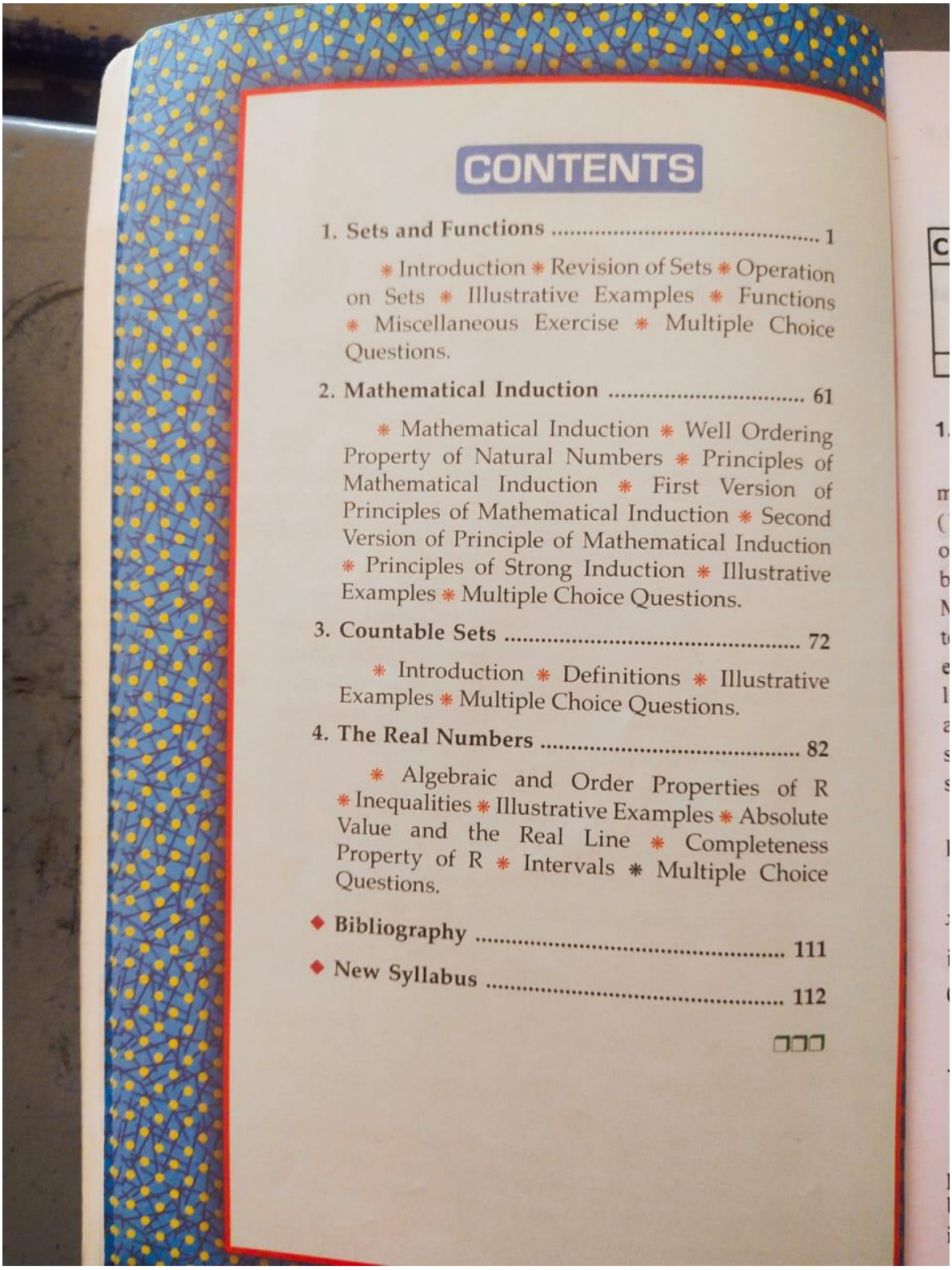

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UNIT-I

CHAPTER 1

Sets and Functions

1.1 Introduction

The theory of sets can be regarded as the foundation of modern mathematics. Set theory was founded by German Mathematician G. Cantor (1845-1918). Algebra and Analysis were formulated within a framework of set theory. A set is an intuitive notion on which all other notions will be based. It has been experienced that it is very difficult to define a set. The Mathematicians realised that there must be some undefined (or primitive) terms. Here we start with two undefined terms "element" and "set". By an element we mean an object or entity of some sort *e.g.* a point on the real line (= a real number). A set is a well-defined collection of objects taken as a whole. The words class, collection, family are synonyms of the word set. Given an object and a set we can say whether the object belongs to the set or does not belong to the set.

The idea of set is not new to us as it is commonly used in everyday life. *e.g.* (i) a bundle of news-papers (ii) a group of students.

Sets are usually denoted by capital letters A, B, C, X, Y..... etc. If x is an element of a set S, then we write this as $x \in S$ (x belongs to S) and if an object y is not an element of a set S, then we write it as $y \notin S$ (y does not belong to S)

If we write $A = \{1, 3, 5, 7, 9\}$ then $5 \in A$, $9 \in A$ but $10 \notin A$.

1.2 Revision of Sets

Finite Set and Infinite Set

If we start counting the number of elements in a given set and if this process of counting comes to an end at some stage, then the set is said to be finite set. If this process of counting does not stop at any stage then it is called an infinite set.

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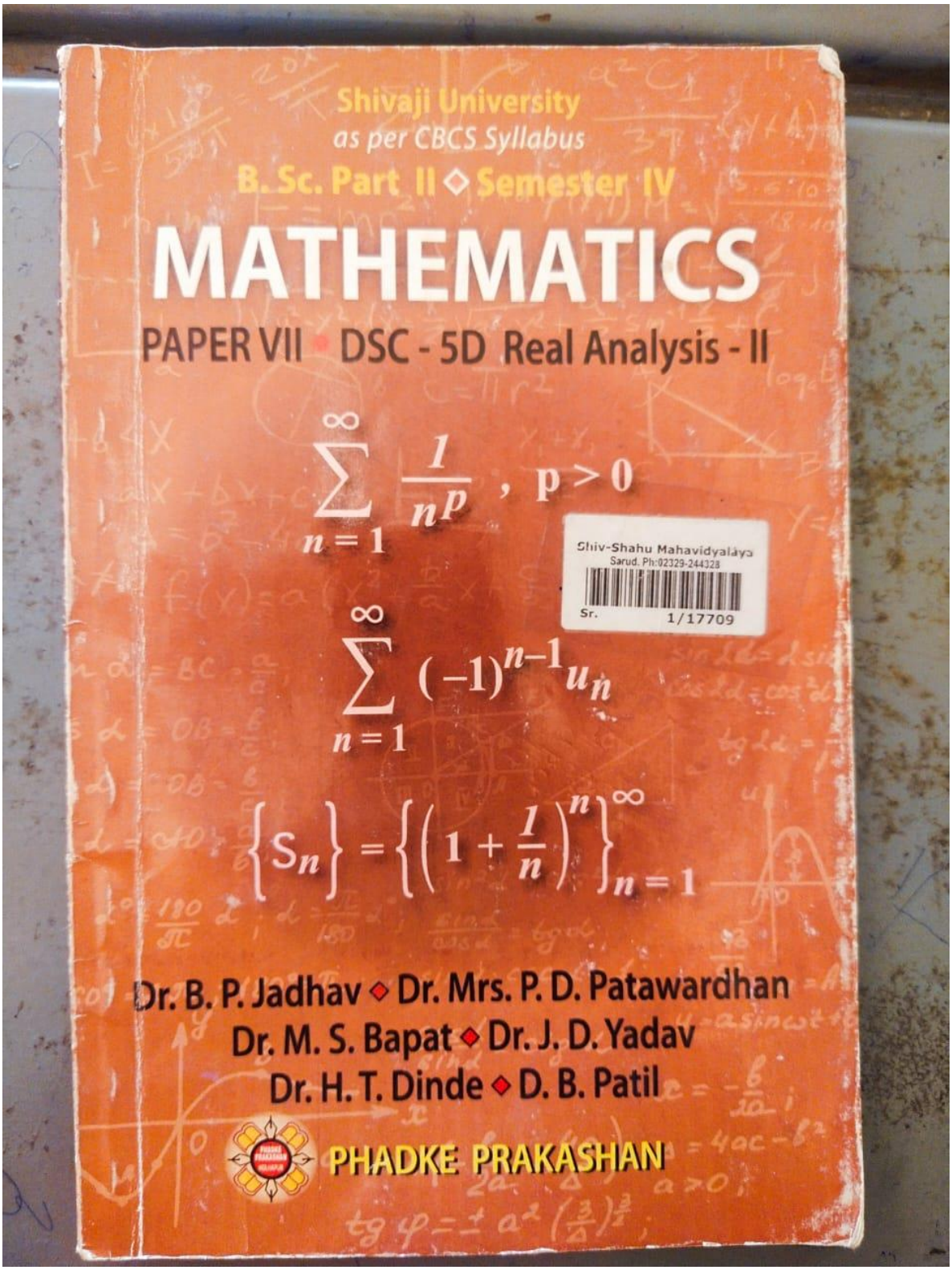

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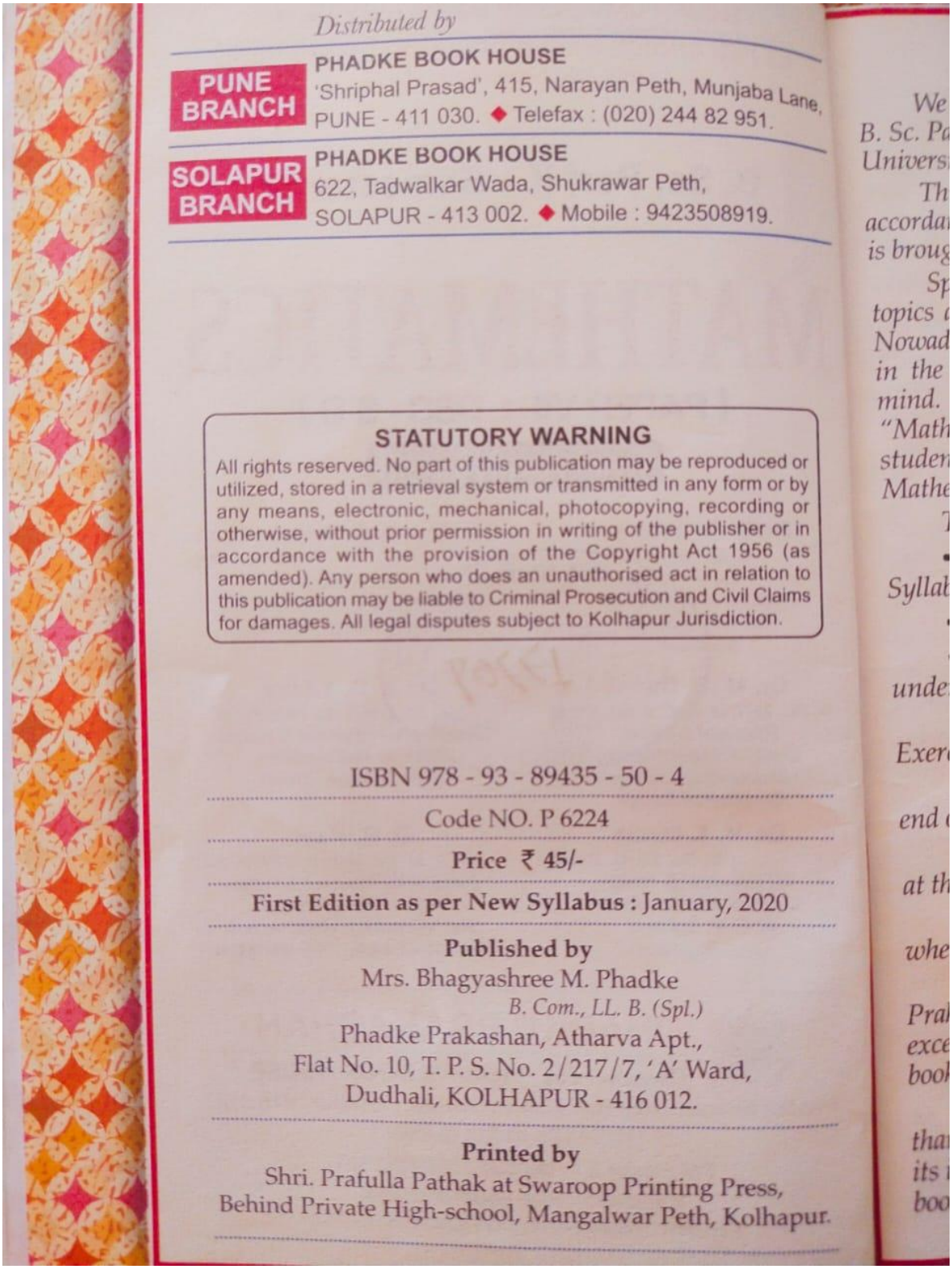

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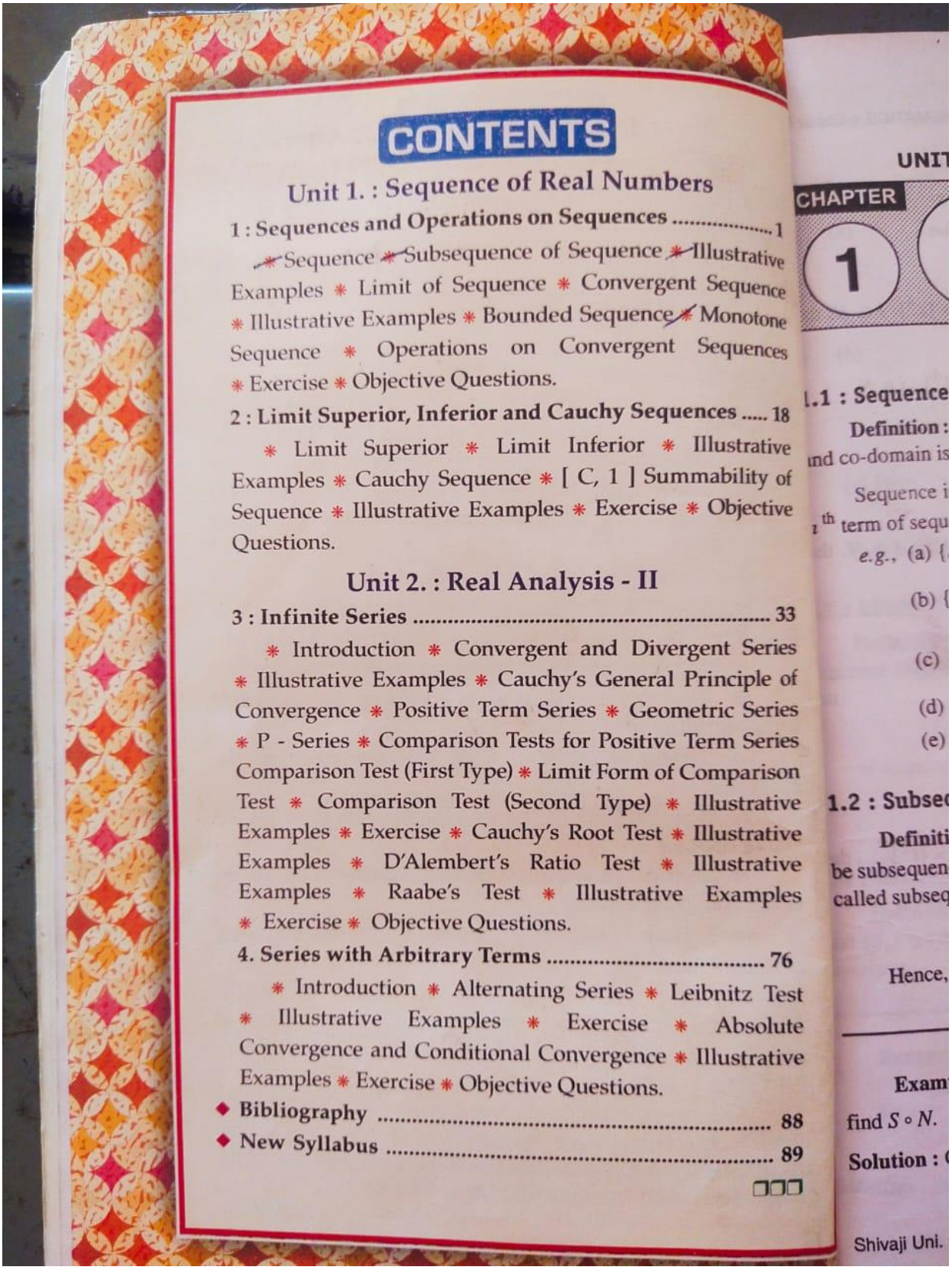

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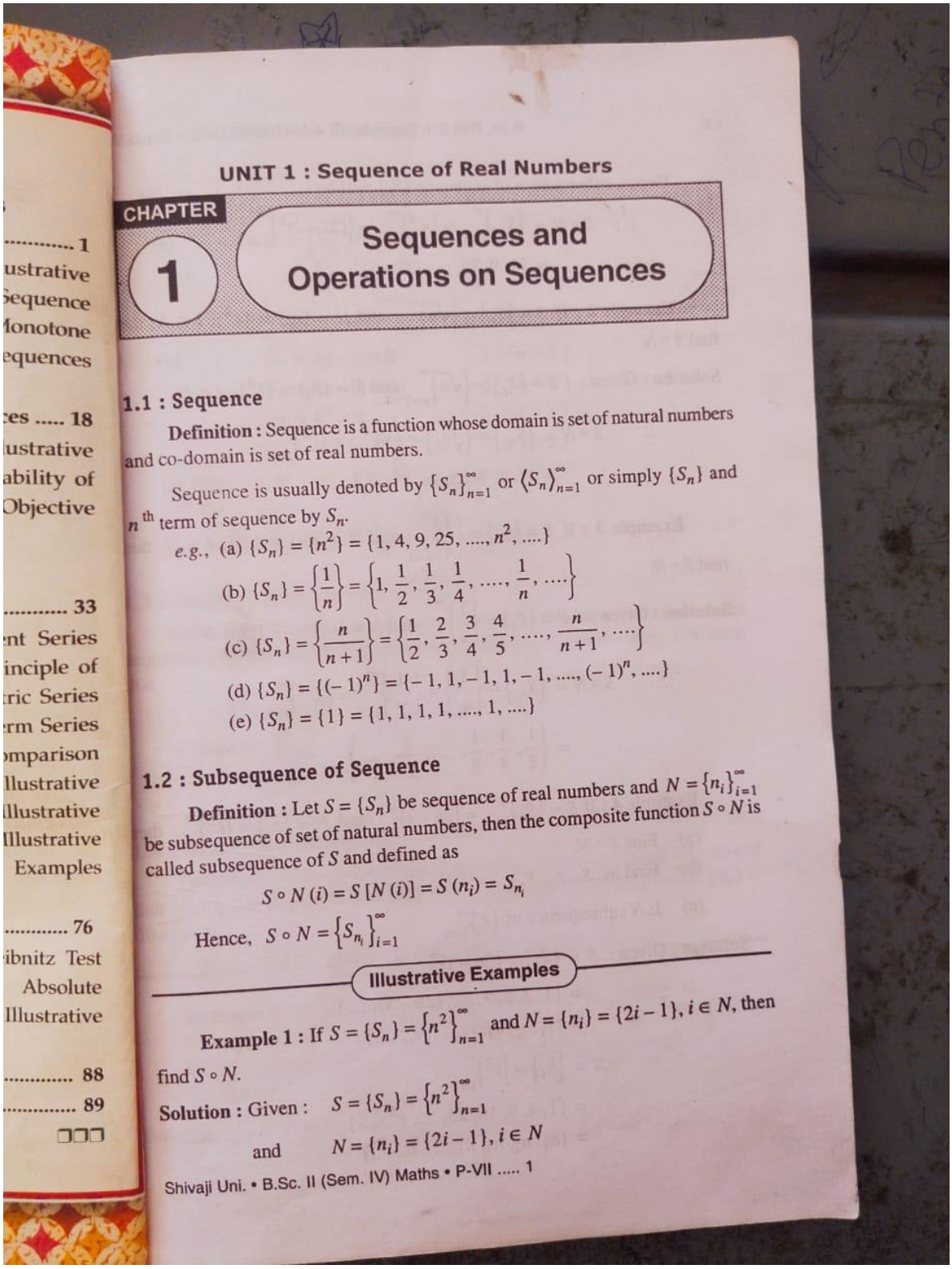

UNIT 1 : Sequence of Real Numbers

CHAPTER 1

Sequences and Operations on Sequences

1.1 : Sequence

Definition : Sequence is a function whose domain is set of natural numbers and co-domain is set of real numbers.

Sequence is usually denoted by $\{S_n\}_{n=1}^{\infty}$ or $\langle S_n \rangle_{n=1}^{\infty}$ or simply $\{S_n\}$ and n^{th} term of sequence by S_n.

e.g., (a) $\{S_n\} = \{n^2\} = \{1, 4, 9, 25, ..., n^2, ...\}$

(b) $\{S_n\} = \left\{\frac{1}{n}\right\} = \left\{1, \frac{1}{2}, \frac{1}{3}, \frac{1}{4}, ..., \frac{1}{n}, ...\right\}$

(c) $\{S_n\} = \left\{\frac{n}{n+1}\right\} = \left\{\frac{1}{2}, \frac{2}{3}, \frac{3}{4}, \frac{4}{5}, ..., \frac{n}{n+1}, ...\right\}$

(d) $\{S_n\} = \{(-1)^n\} = \{-1, 1, -1, 1, -1, ..., (-1)^n, ...\}$

(e) $\{S_n\} = \{1\} = \{1, 1, 1, 1, ..., 1, ...\}$

1.2 : Subsequence of Sequence

Definition : Let $S = \{S_n\}$ be sequence of real numbers and $N = \{n_i\}_{i=1}^{\infty}$ be subsequence of set of natural numbers, then the composite function $S \circ N$ is called subsequence of S and defined as

$$S \circ N(i) = S[N(i)] = S(n_i) = S_{n_i}$$

Hence, $S \circ N = \{S_{n_i}\}_{i=1}^{\infty}$

Illustrative Examples

Example 1 : If $S = \{S_n\} = \{n^2\}_{n=1}^{\infty}$ and $N = \{n_i\} = \{2i - 1\}, i \in N$, then find $S \circ N$.

Solution : Given : $S = \{S_n\} = \{n^2\}_{n=1}^{\infty}$

and $N = \{n_i\} = \{2i - 1\}, i \in N$

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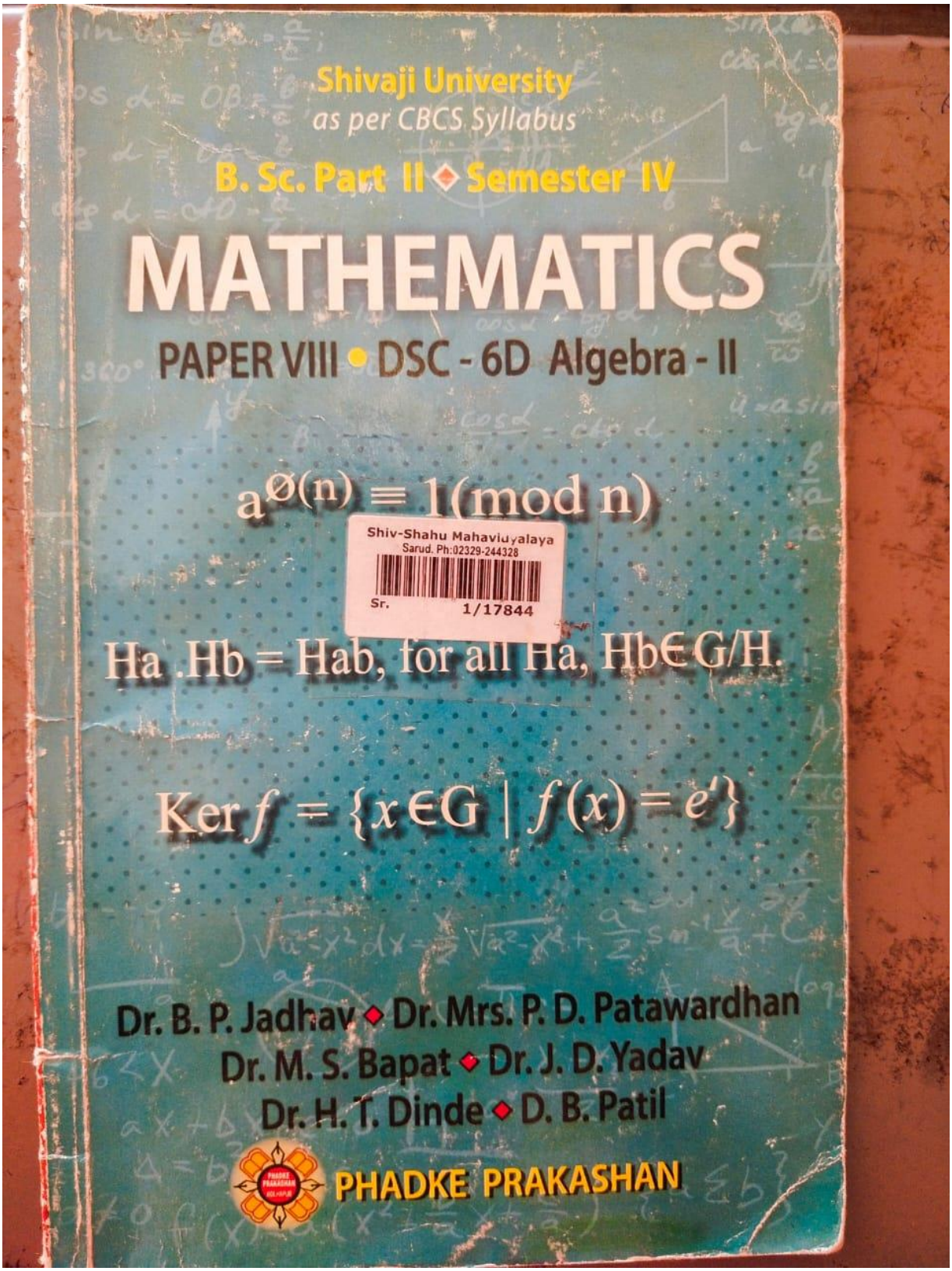

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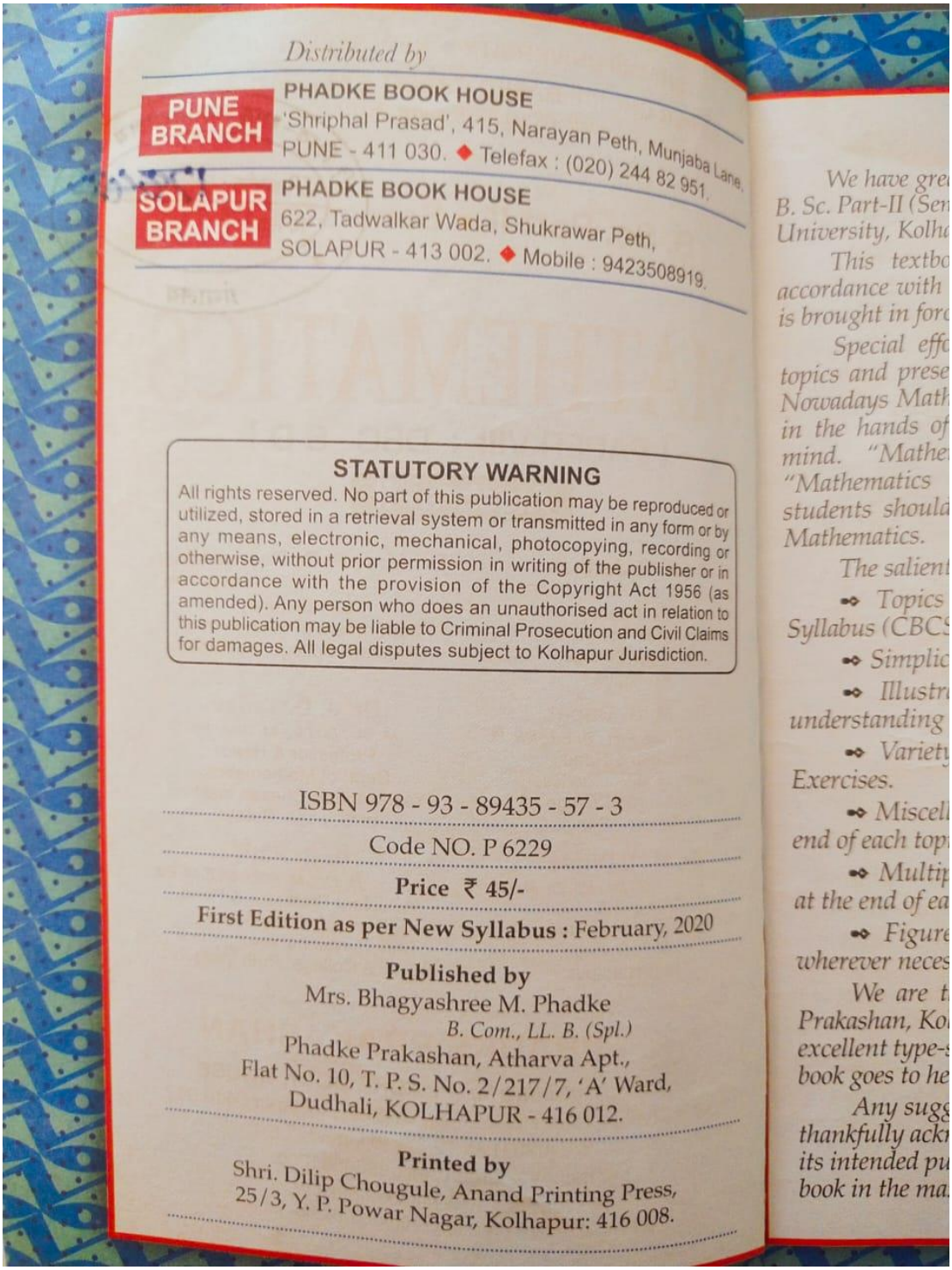

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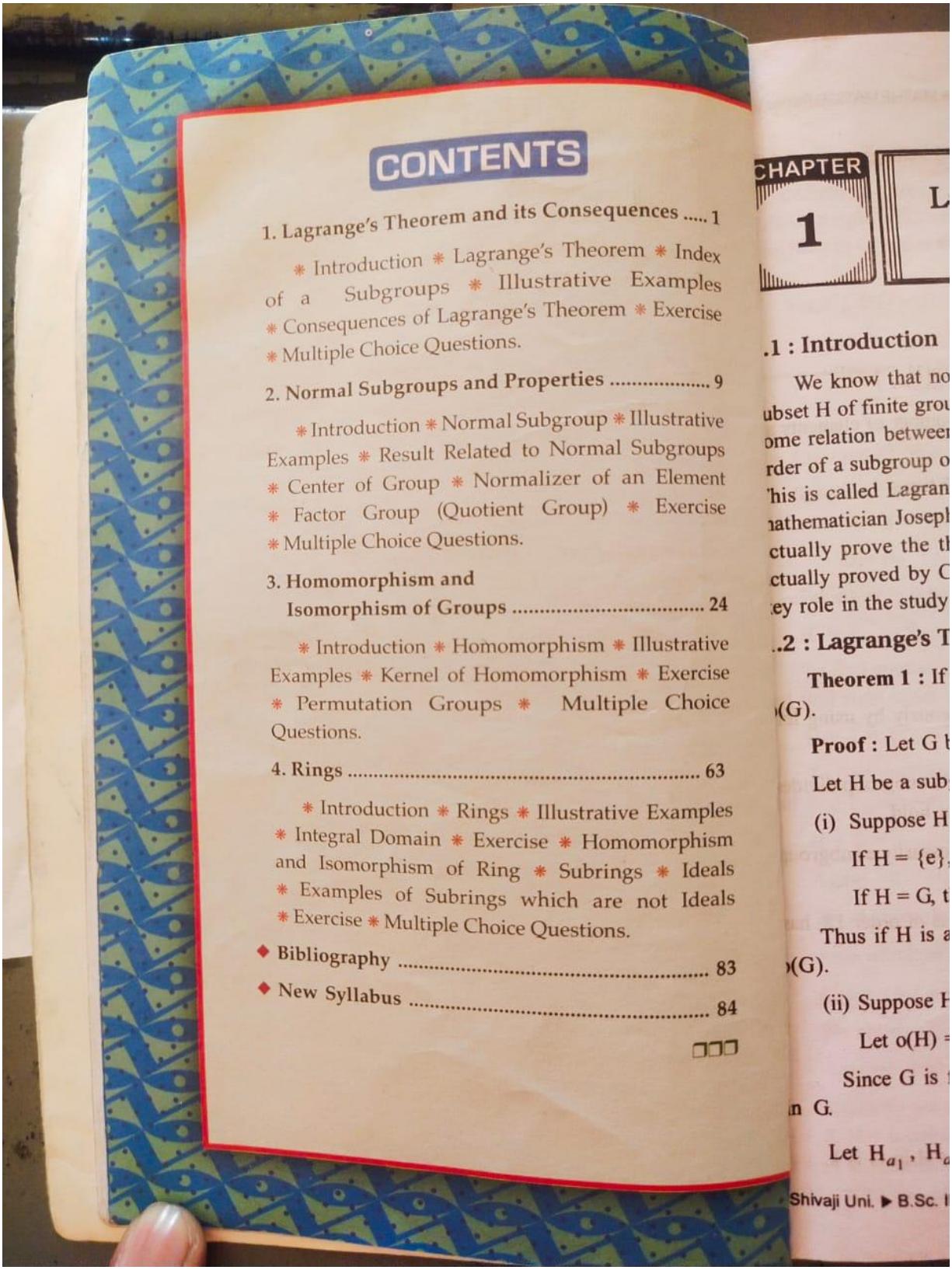

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CHAPTER 1

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.1 : Introduction

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..2 : Lagrange's T

Theorem 1 : If
(G).

Proof : Let G
Let H be a sub
(i) Suppose H
If H = {e}
If H = G, t
Thus if H is a
(G).
(ii) Suppose H
Let o(H) =
Since G is
n G.

Let H_{a_1}, H_{a_2}

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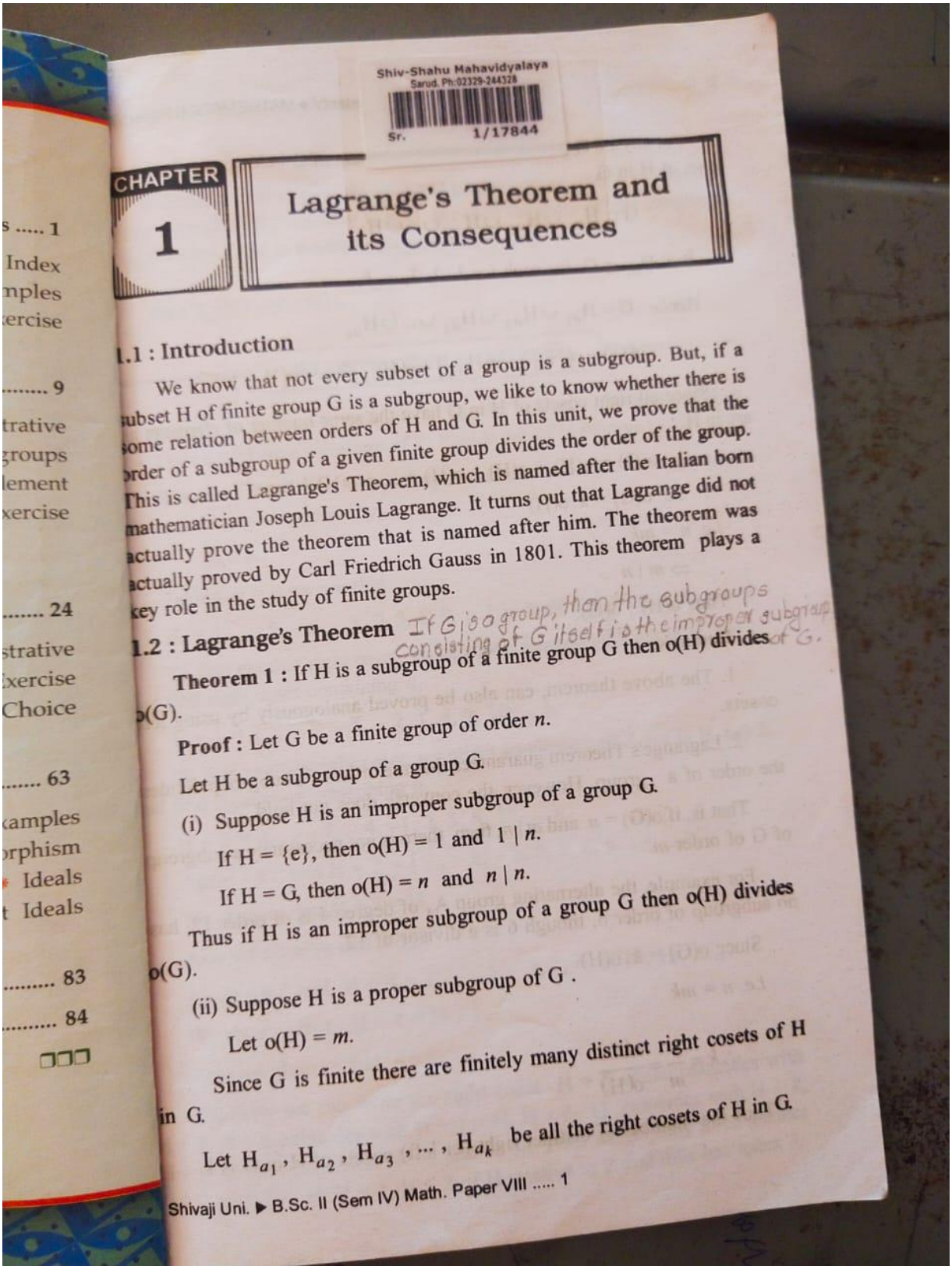

CHAPTER 1

Lagrange's Theorem and its Consequences

1.1 : Introduction

We know that not every subset of a group is a subgroup. But, if a subset H of finite group G is a subgroup, we like to know whether there is some relation between orders of H and G. In this unit, we prove that the order of a subgroup of a given finite group divides the order of the group. This is called Lagrange's Theorem, which is named after the Italian born mathematician Joseph Louis Lagrange. It turns out that Lagrange did not actually prove the theorem that is named after him. The theorem was actually proved by Carl Friedrich Gauss in 1801. This theorem plays a key role in the study of finite groups.

1.2 : Lagrange's Theorem

If G is a group, then the subgroups consisting of G itself is the improper subgroup of G.

Theorem 1 : If H is a subgroup of a finite group G then o(H) divides o(G).

Proof : Let G be a finite group of order n.

Let H be a subgroup of a group G.

(i) Suppose H is an improper subgroup of a group G.

If $H = \{e\}$, then $o(H) = 1$ and $1 \mid n$.

If $H = G$, then $o(H) = n$ and $n \mid n$.

Thus if H is an improper subgroup of a group G then o(H) divides o(G).

(ii) Suppose H is a proper subgroup of G .

Let $o(H) = m$.

Since G is finite there are finitely many distinct right cosets of H in G.

Let $H_{a_1}, H_{a_2}, H_{a_3}, \ldots, H_{a_k}$ be all the right cosets of H in G.