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**CRITERION 3**

**3.3.2 NUMBER OF BOOKS AND CHAPTERS IN EDITED VOLUMES/BOOKS PUBLISHED AND PAPERS PUBLISHED IN NATIONAL/ INTERNATIONAL CONFERENCE PROCEEDINGS PER TEACHER (2018-2023)**

<b>COVER PAGE, CONTENT PAGE AND FIRST PAGE OF THE SELECTED PUBLICATION (2018-2023)</b>	
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2019-2020	34-57
2020-2021	58-61
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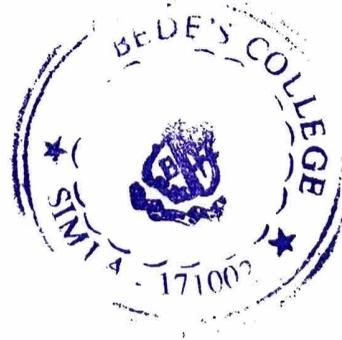
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I hereby affirm that the accuracy of the count of books, chapters in edited volumes/books published, and papers published in national/international conference proceedings per teacher over the last five years is certified to the best of my knowledge.

Year	2018-2019	2019-2020	2020-21	2021-2022	2022-2023
Number	7	5	1	6	0
Total number of Books					19



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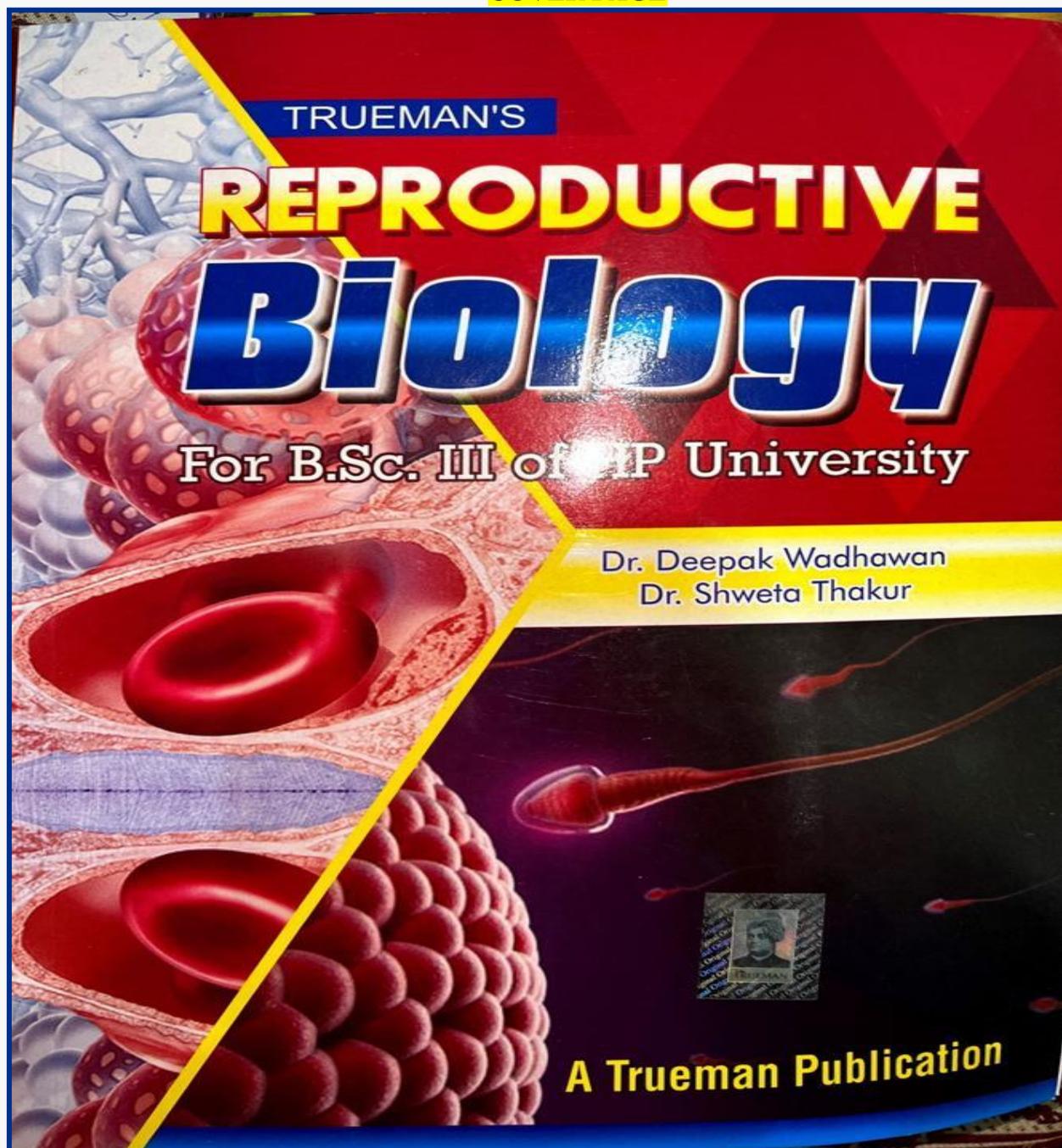


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2018-19

1. **Dr. Shweta Thakur**- Department of Zoology  
Title of Book: Reproductive Biology  
Year: 2019  
ISBN: 81-87223-83-9

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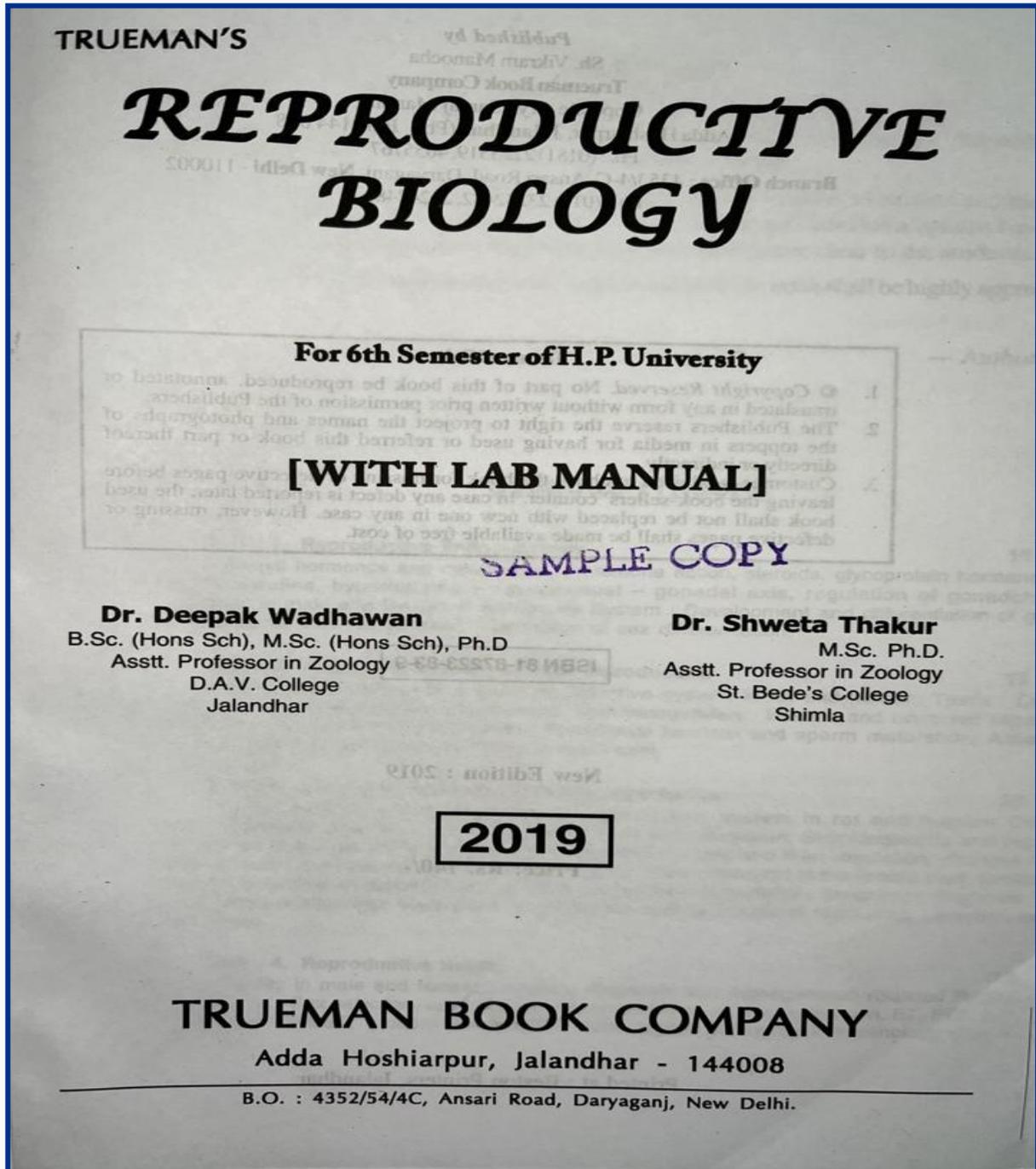
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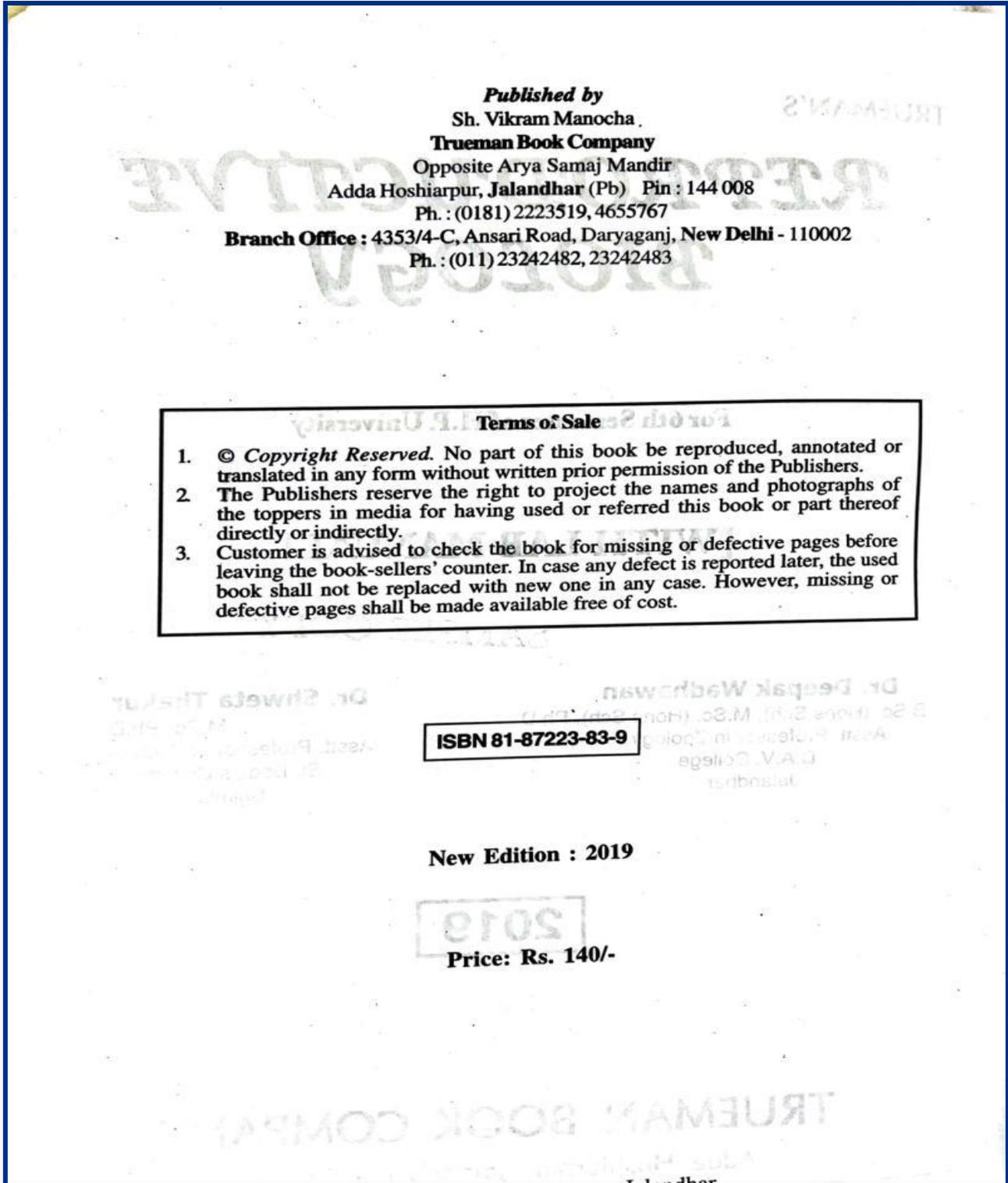
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1. Study of animal house : set up and maintenance of animal house, breeding techniques, care of normal and experimental animals.
2. Examination of vaginal smear rats from live animals.
3. Surgical techniques : principles of surgery in endocrinology. Ovariectomy, hysterectomy, castration and vasectomy in rats.
4. Examination of histological sections from photomicrographs/permanent slides of rat human : testis, epididymis and accessory glands of male reproductive systems; Section of ovary, fallopian tube, uterus (proliferative and secretory stages), cervix and vagina.
5. Human vaginal exfoliate cytology.
6. Sperm count and sperm motility in rat.
7. Study of modern contraceptive devices.

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change in LH release is apparent eight to nine days before the first proestrus, and this period of change in mode of LH release is considered anestrus. On this basis it is stated that, first proestrus occurs later on followed by estrus, and diestrus periods.

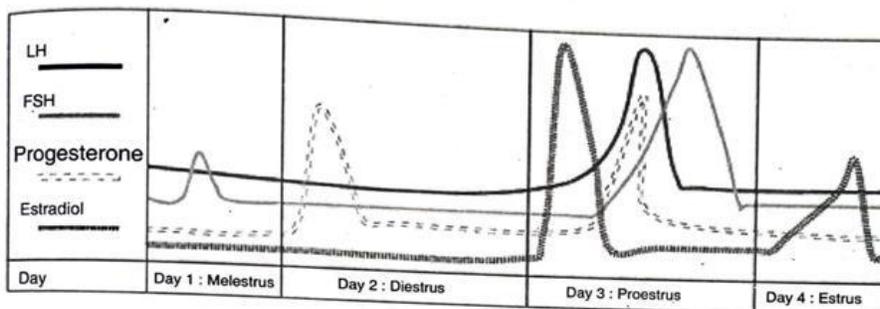


Fig. 3.7. Rat Reproductive Menstrual Cycle.

**Length of cycle.** Ovulation occurs in the young adult laboratory rat every four to five days throughout the year. Intra-individual variations in cycle lengths are also seen from three to thirty-eight days, but, excluding those of more than eight days, the average was 4 – 8 days, and this duration is reasonably consistent with findings from various investigators. Based on vaginal smears, the duration of the individual component stages of the four or five-day estrous cycle for rats has been worked out by different scientists (Astwood, 1939; Hartman 1944; Long and Evans 1922; Mandl 1951) which are as follows :

1. Proestrus, twelve to fourteen hours.
2. Estrus, twenty-five to twenty-seven hours.
3. Metestrus, six to eight hours.
4. Diestrus, fifty-five to fifty-seven hours.

The vaginal smears are useful in demarcating the various stages, however, complete longitudinal sections of the vagina and cervix, transverse sections of the mid portion of both uterine horns, and medial sections of both ovaries are the minimal requirement for an adequate evaluation. The stage of the reproductive cycle cannot easily be determined from the appearance of the ovarian follicles in a species like the rat, which has a short estrous cycle. Follicles in virtually all stages of development are generally present within the ovaries at all phases of the cycle. The presence of particular morphologies of corpora lutea can be used to support staging, even though this is not. The four stages of estrus cycle and characteristics of the vaginal, uterine, and ovarian morphology during these stages are described below.

#### **1. Diestrus**

**Vagina.** At the start of diestrus, the vaginal epithelium is at its lowest level of approximately three to seven cells thick consisting simply of the stratum germinativum. The stratum germinativum consists of stratum basale as a single



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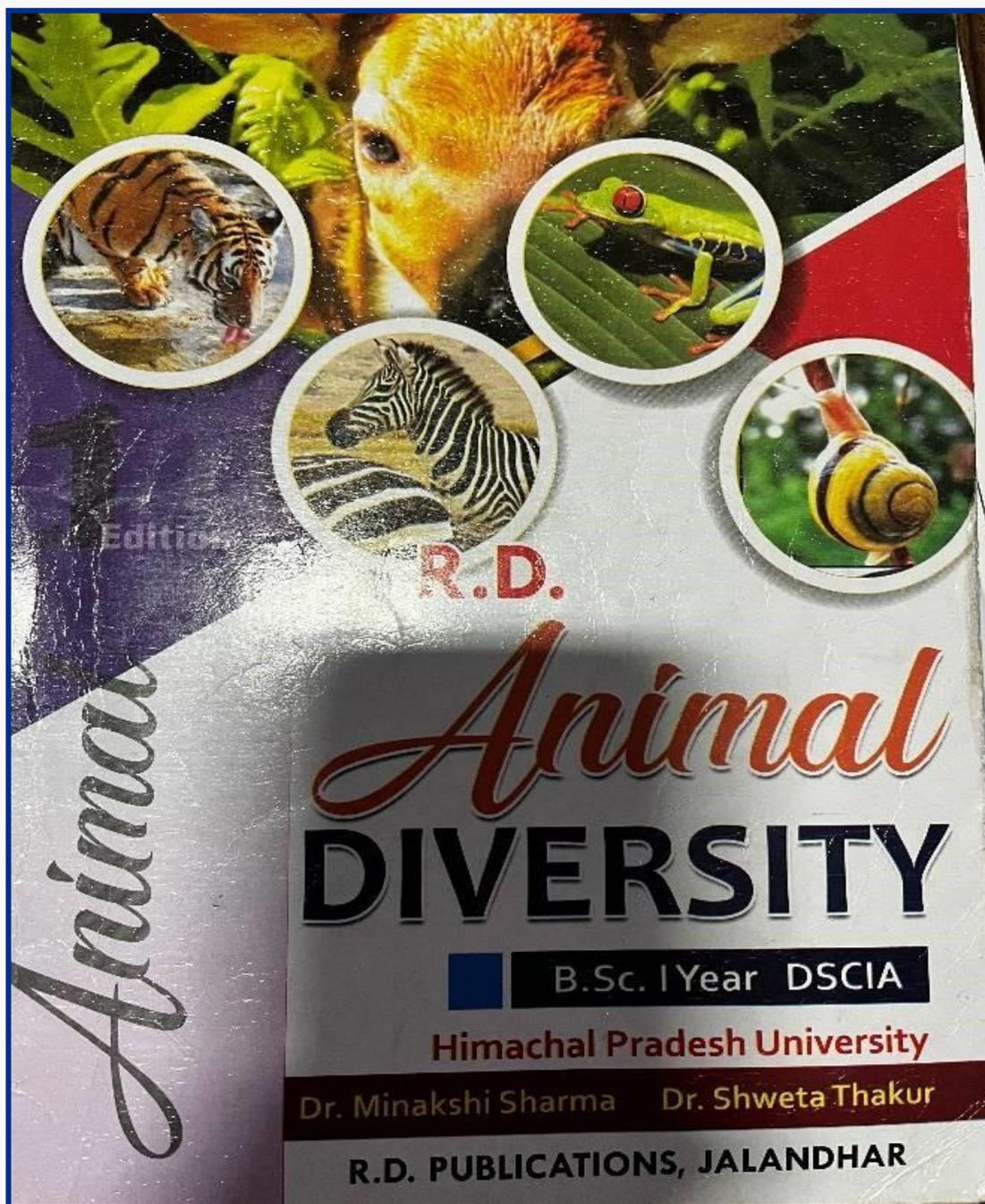
2. **Dr. Shweta Thakur**- Department of Zoology

Title of Book: Animal Diversity

Year: 2018

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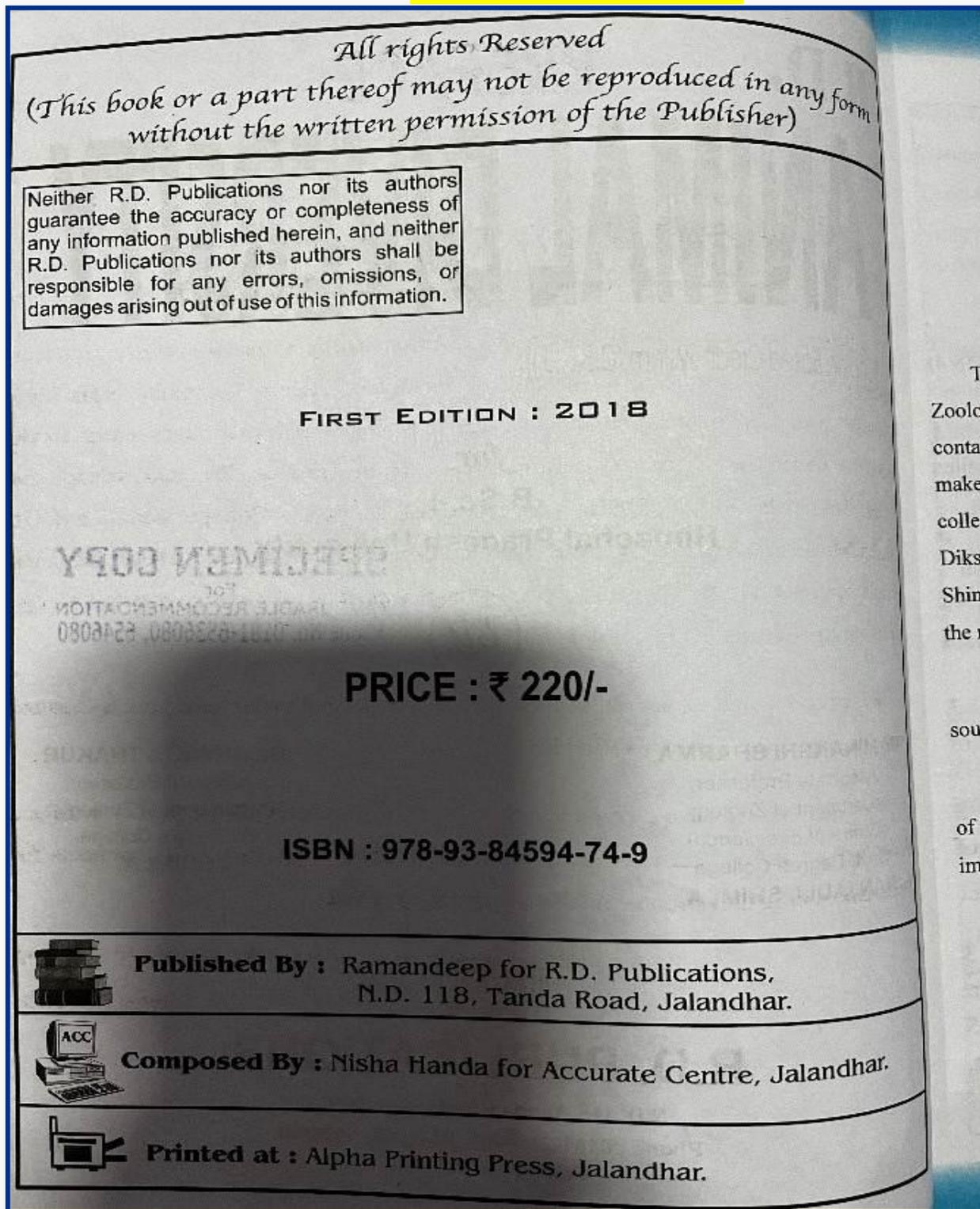
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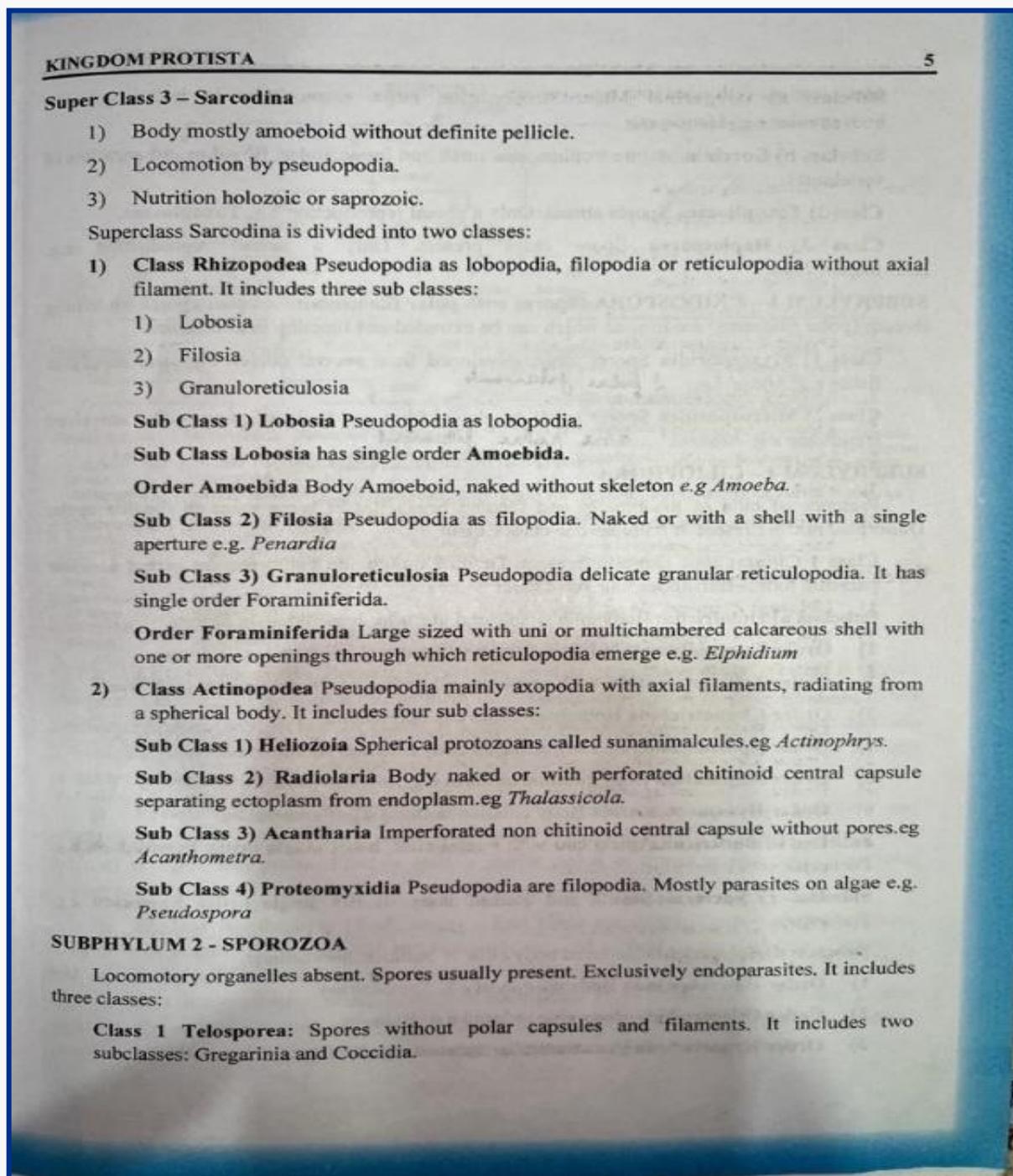
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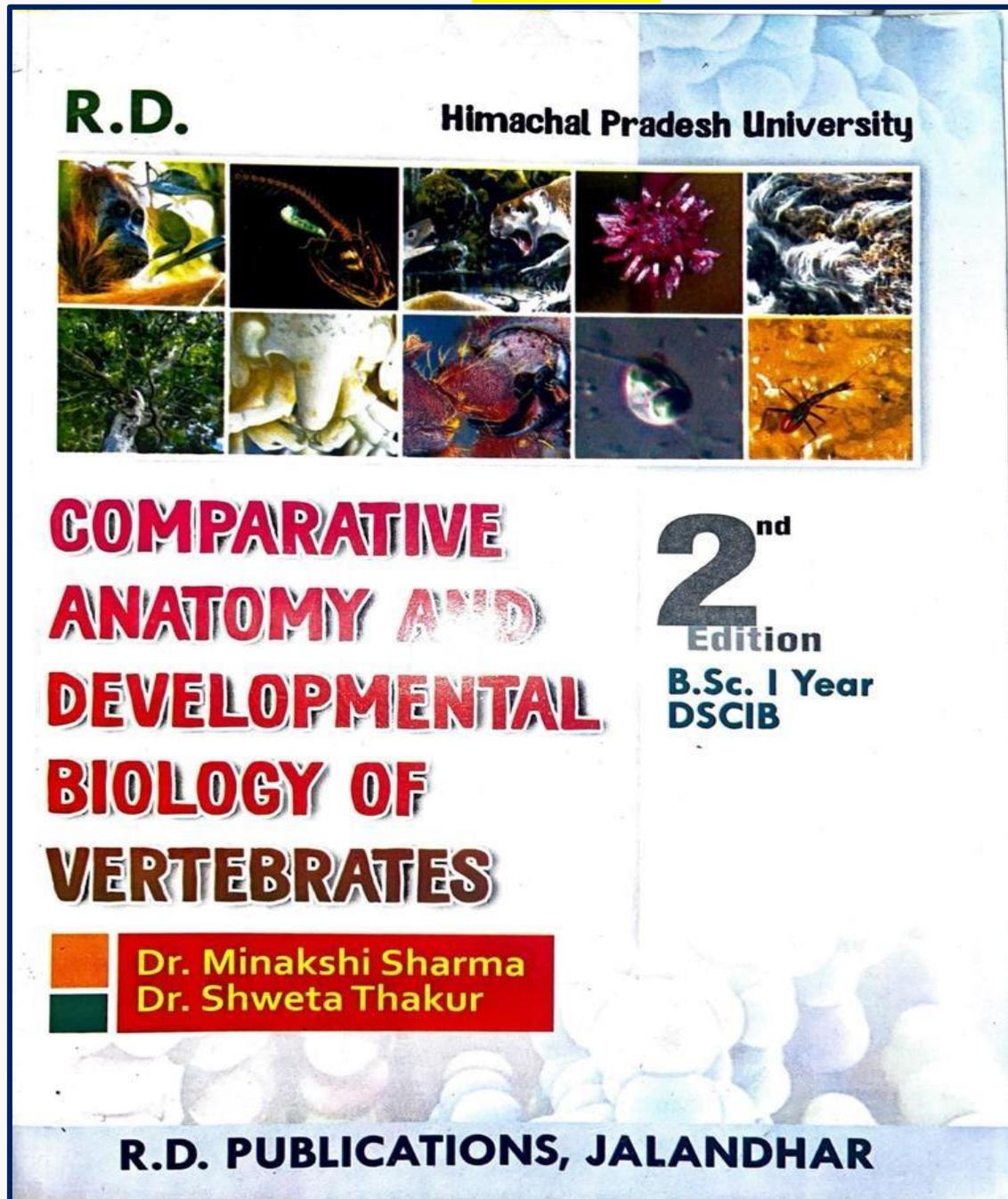
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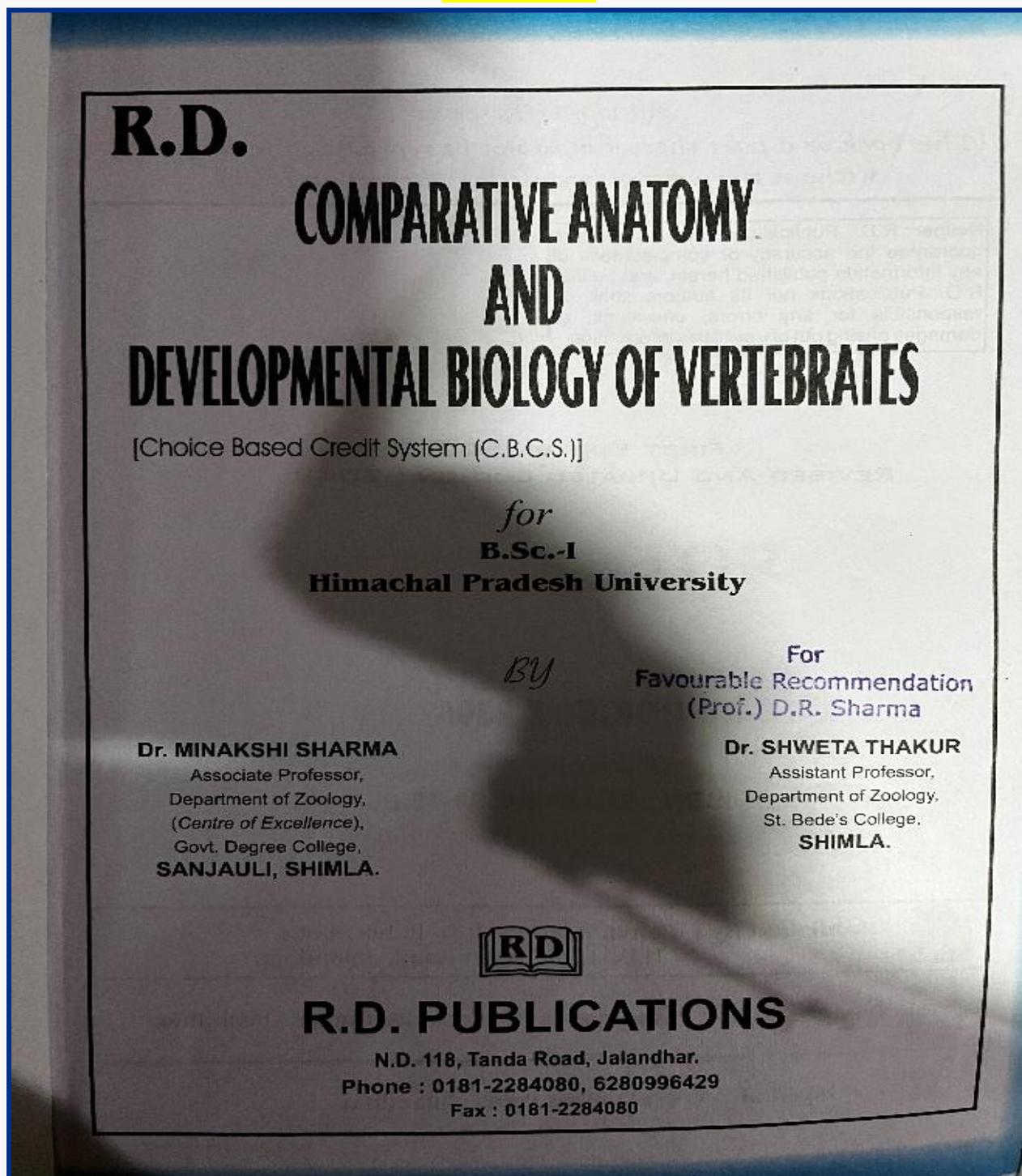
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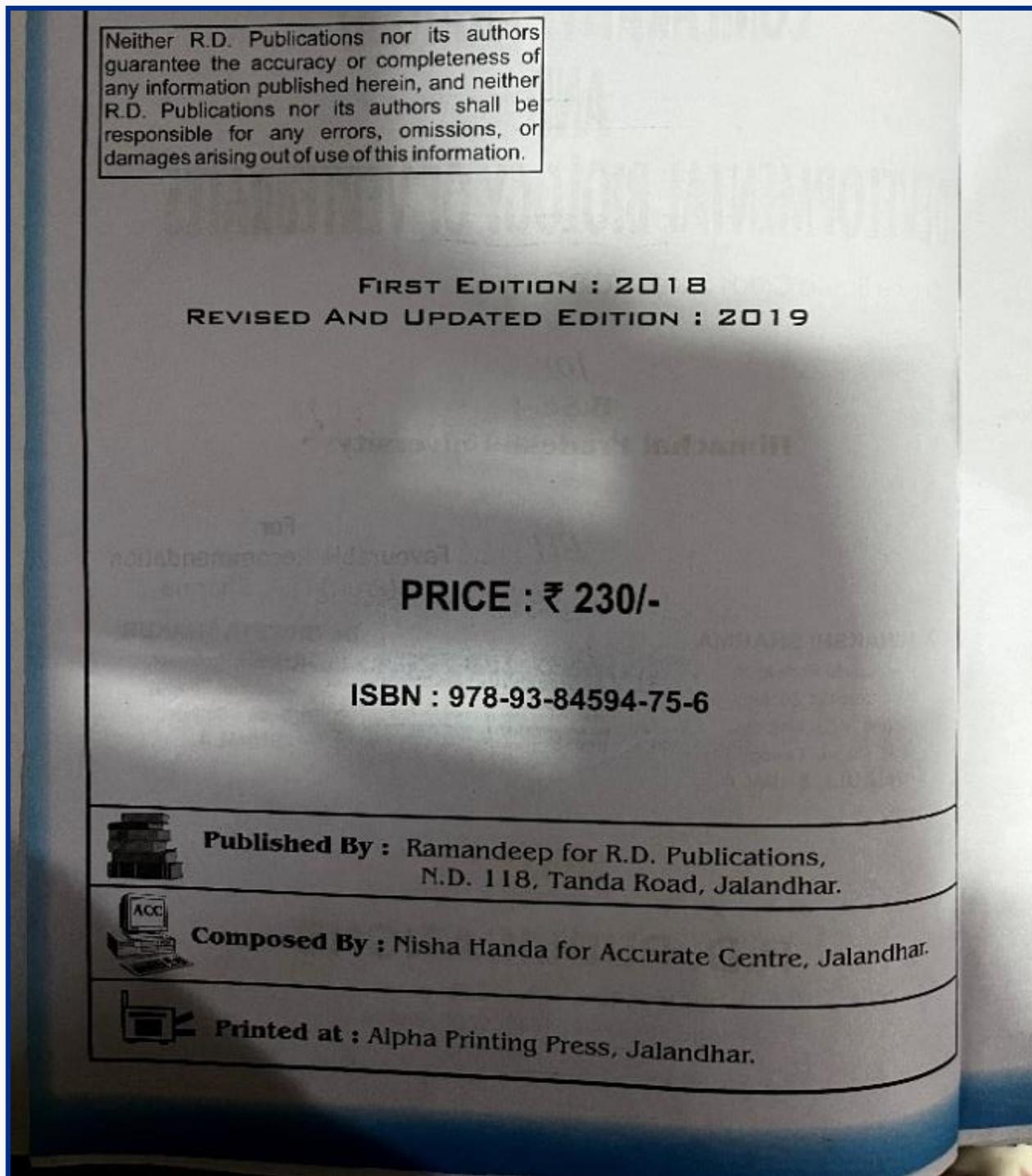
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INTEGUMENTARY SYSTEM 13

**Figure showing sex attractant glands in male salamander**

**5. Reptiles:** It has rough, scaly skin without skin glands which prevents evaporation of water from the body. It includes femoral glands, hedonic glands and stink glands.

**(i) Femoral glands:** Femoral glands are a component of a holocrine secretory gland found on the inside of the thighs of certain lizards which releases pheromones to attract mates or mark territory. In certain species only the male has these glands and in other species, both sexes have them, male being the larger. Femoral glands appear as a series of pits or holes within a row of scales on the ventral portion of the animal's thigh.

**Figure showing femoral glands of lizards**

**(ii) Hedonic glands:** In salamanders and reptiles these glands produce a secretion which helps in sexual attraction and stimulation. They function during the season of sexual activity. Two pairs of musk glands in both the sexes of crocodiles: one pair in the throat and the other just within the cloacal aperture. Musk glands for sexual allurements are present in the throat of turtles and in the skin where carapace and plastron meet.

**(iii) Stink Glands:** In the cloaca of some snakes are present stink gland which secretes a milky secretion from these glands having a nauseating smell, and is defensive in its function.

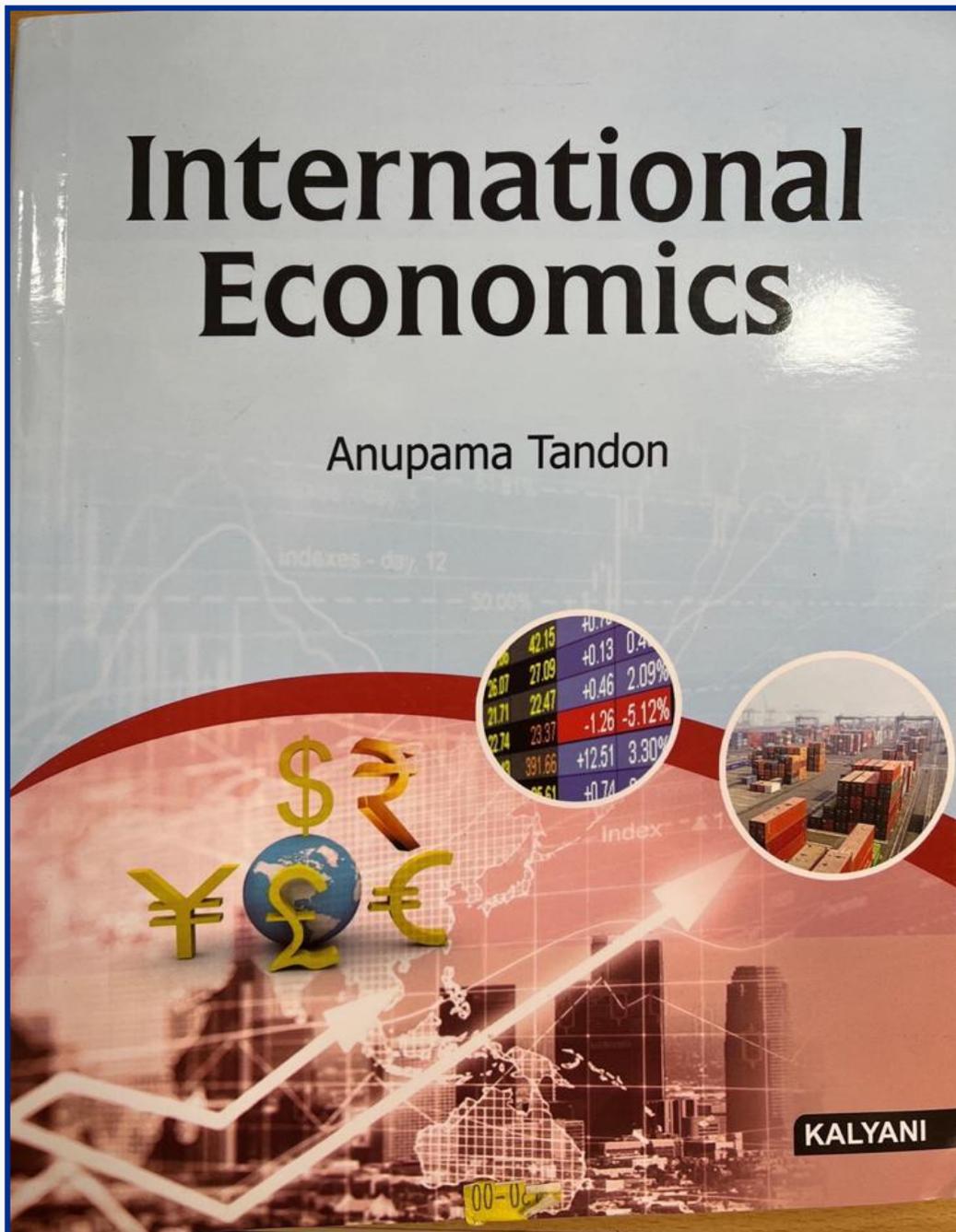
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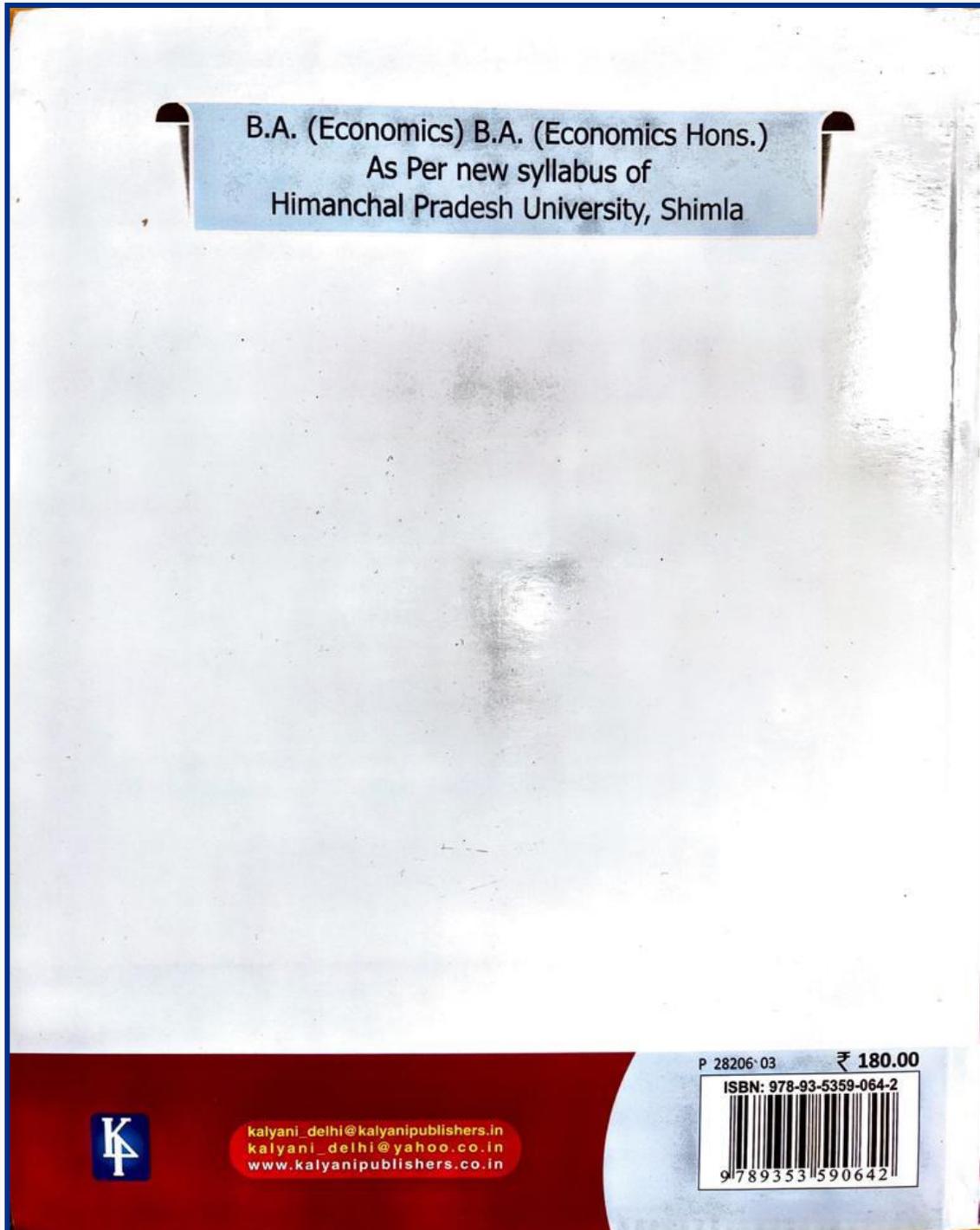
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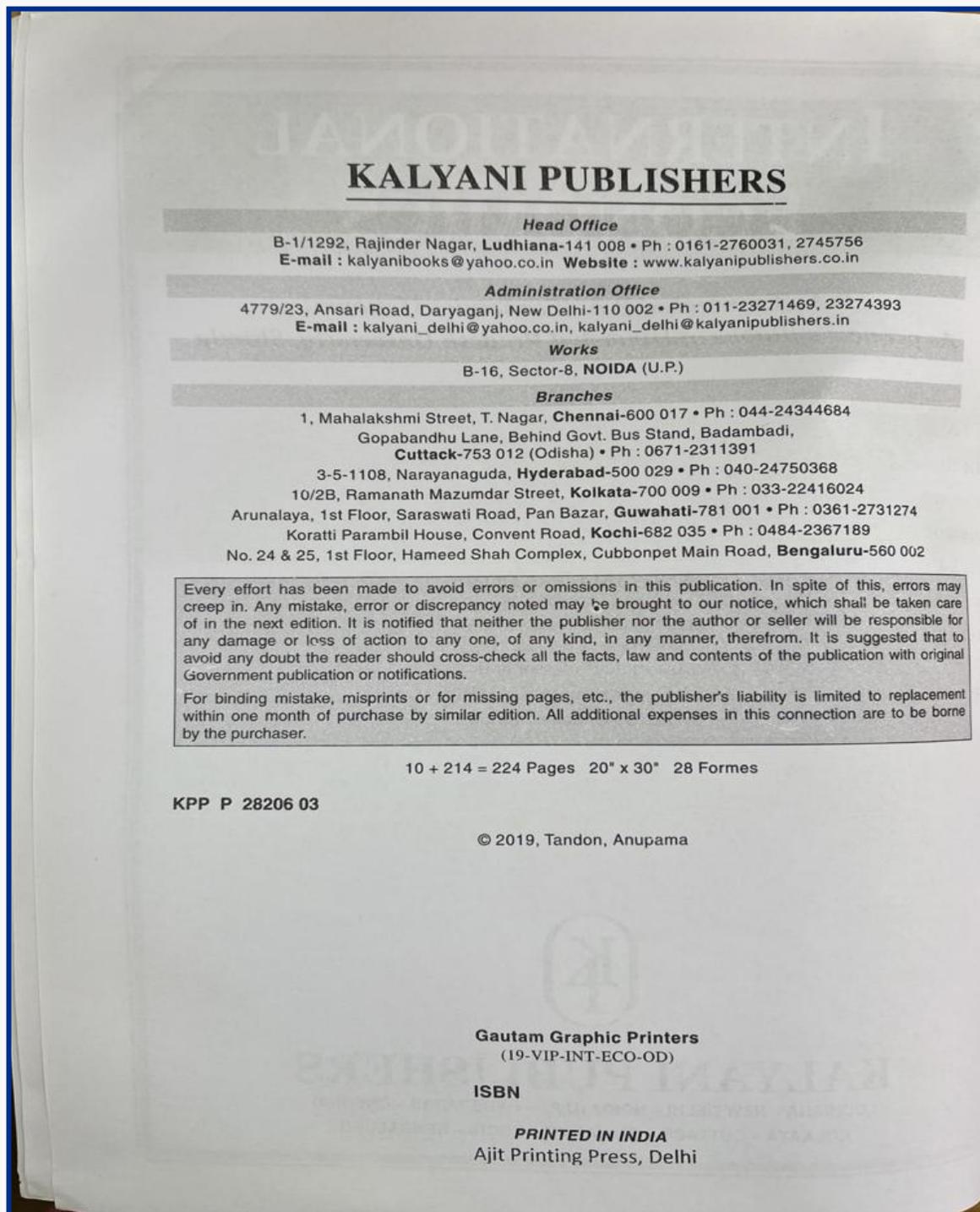
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# INTERNATIONAL ECONOMICS

*B.A. (Economics) B.A. (Economics Honours)  
As per new syllabus of Himachal Pradesh University, Shimla*

**ANUPAMA TANDON**

*M.A. [Economics] Gold Medallist,  
M.Phil. [Economics] Gold Medallist,  
Ph.D. Economics, UGC-NET-JRF  
Associate Professor and  
Head, Department of Economics  
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3.	THE THEORY OF OPPORTUNITY COST	3.1 – 3.8
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6. ✓	THEORY OF RECIPROCAL DEMAND	6.1 – 6.6
7. ✓	GAINS FROM TRADE	7.1 – 7.12
8.	INTERNATIONAL TRADE AND GROWTH	8.1 – 8.14
9.	TRADE BARRIERS– TARIFFS AND QUOTAS	9.1 – 9.11
10. ✓	FREE TRADE AND POLICY OF TARIFFS	10.1 – 10.9
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12.	FIXED VERSUS FLEXIBLE EXCHANGE RATE	12.1 – 12.10

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5. **Dr. Anjali Dewan**- Department of Home Science

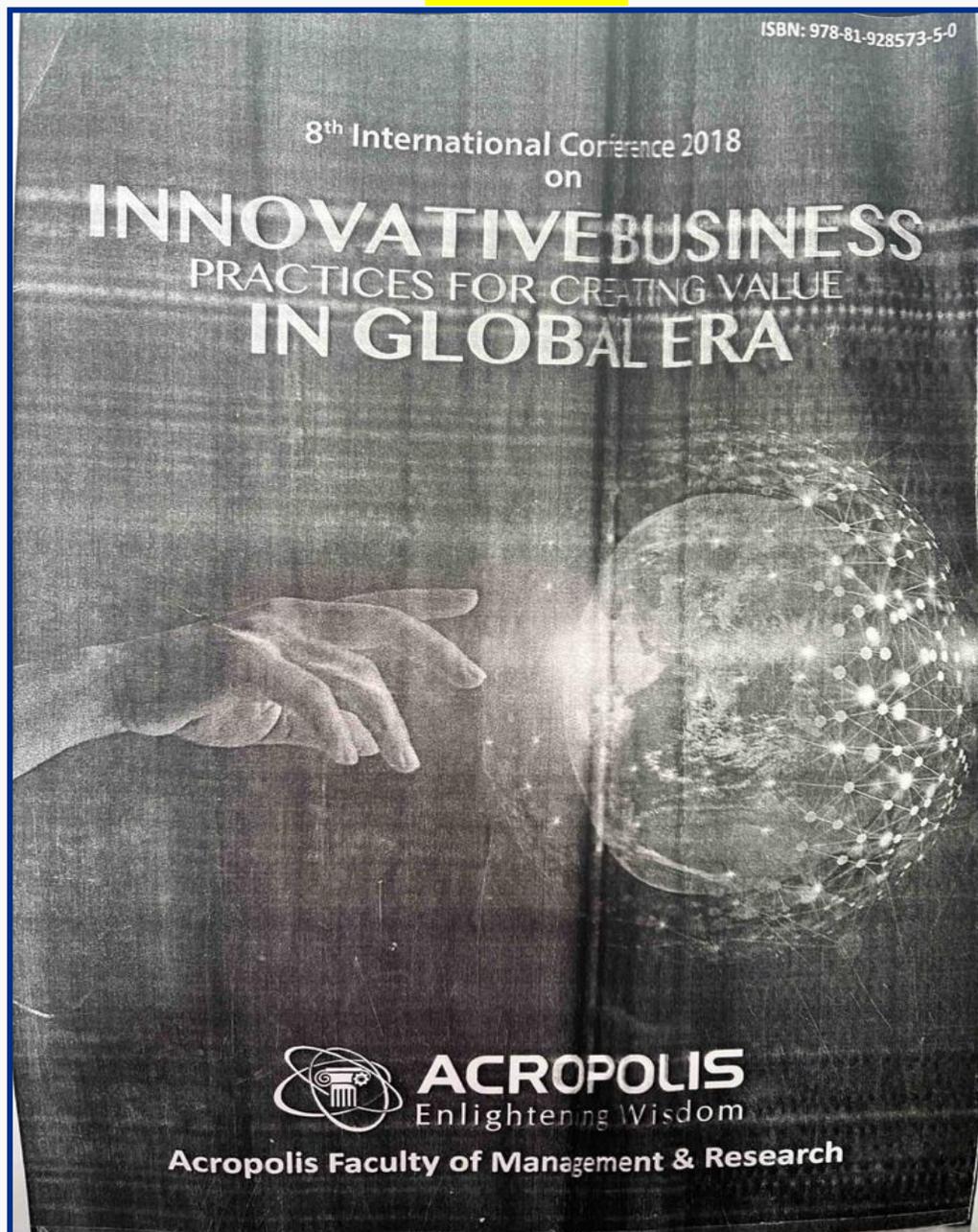
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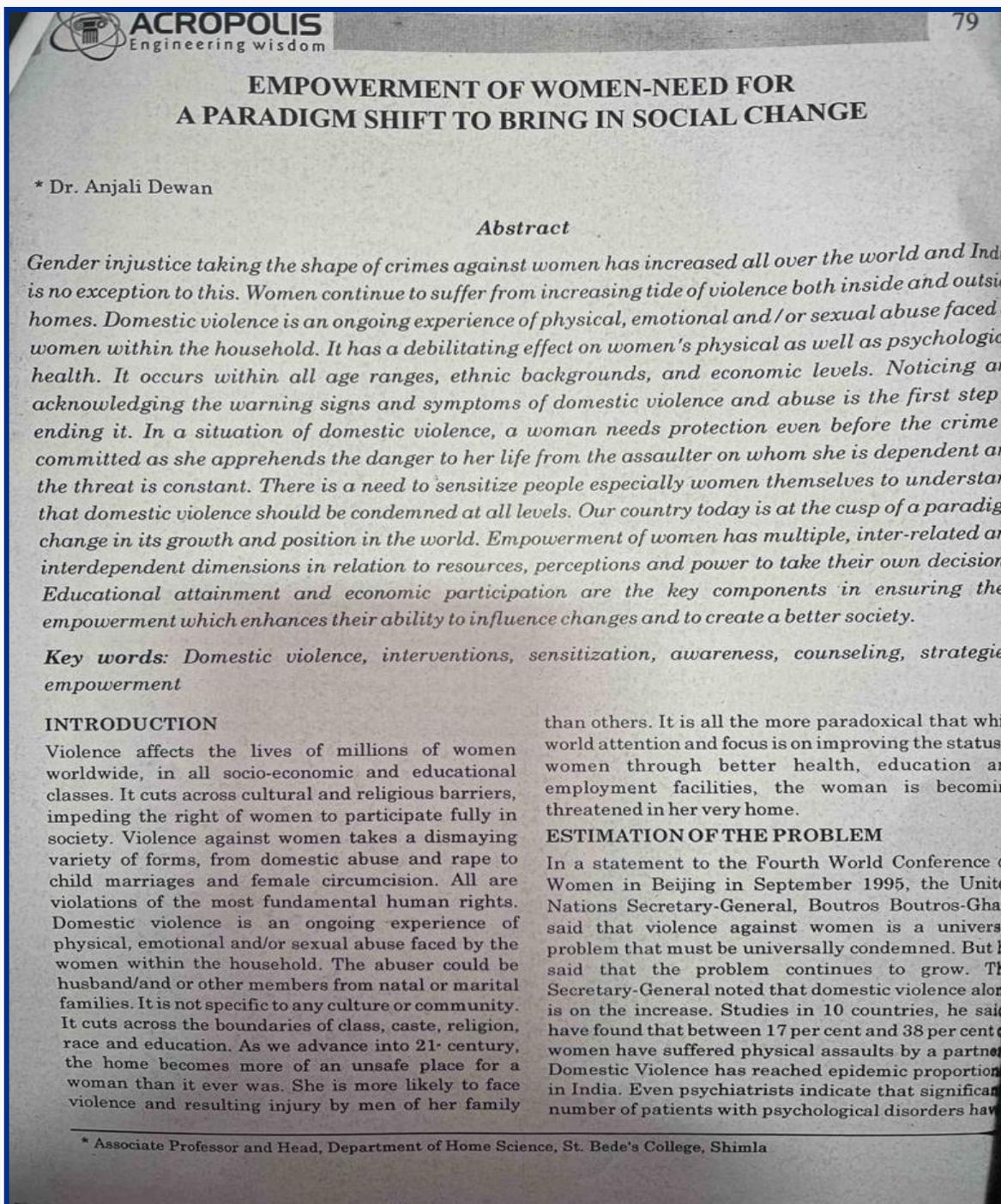
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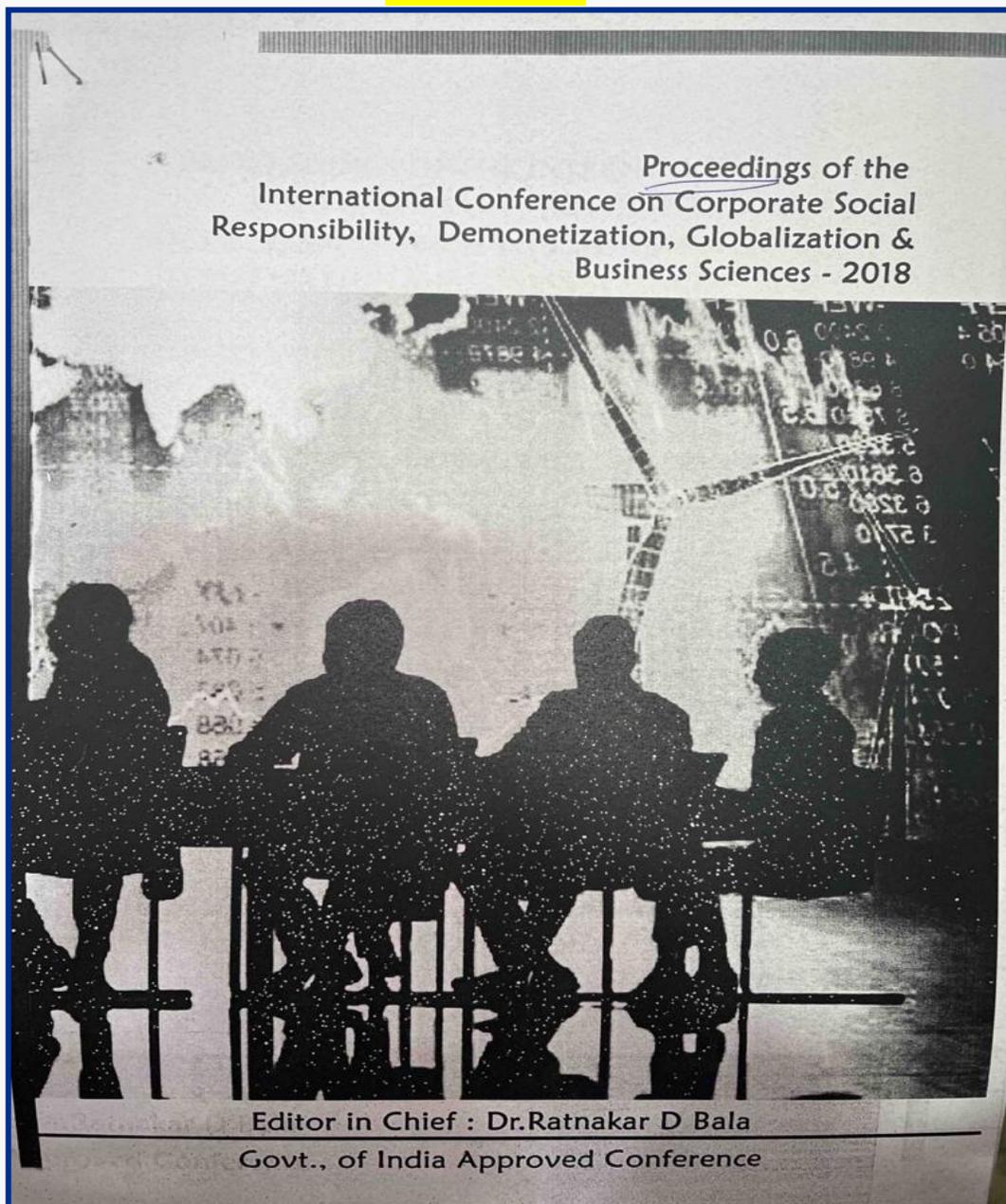
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6. **Dr. Anjali Dewan** - Department of Home Science  
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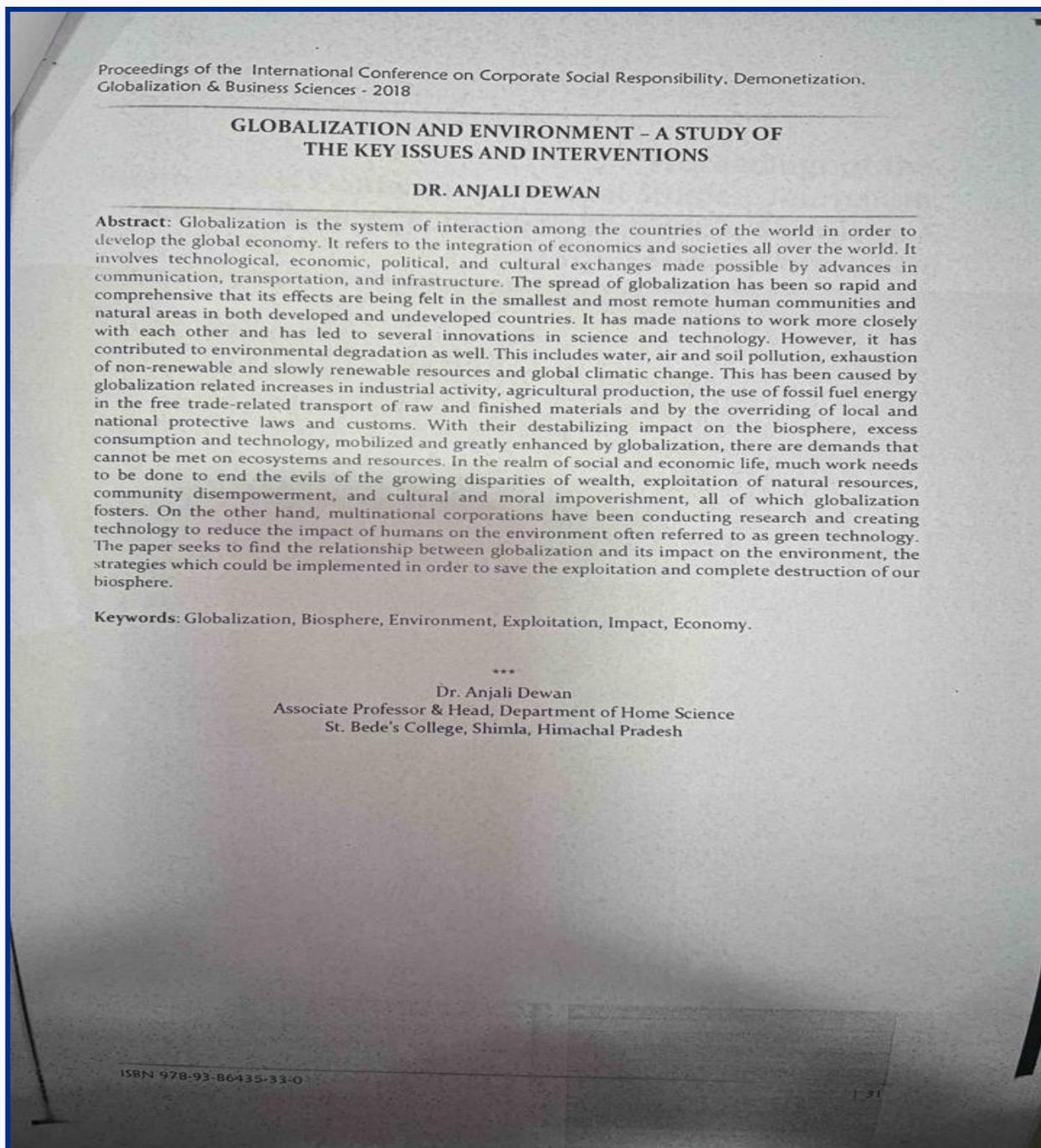
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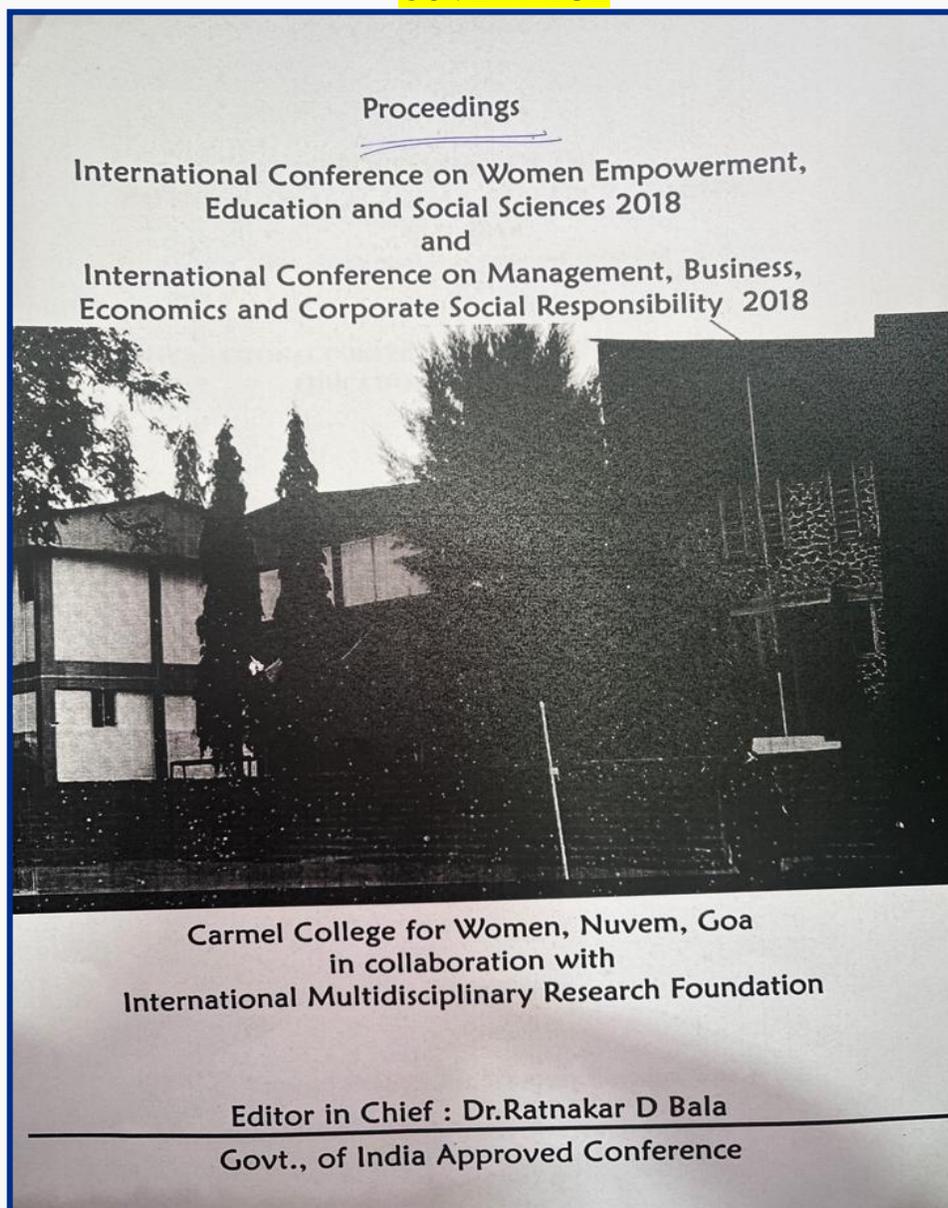
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7. **Dr. Anjali Dewan**- Department of Home Science  
Title of the Paper: A Study on Gender Violence: Issues and Interventions  
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**AN ASSESSMENT OF THE SOCIO-ECONOMIC AND CULTURAL DIMENSIONS OF FEMALE FOETICIDE AND INFANTICIDE**

DR. (SR.) BEENA, T.L

**Abstract:** It is a disgrace for the Indian society, which considers the birth of a girl child as a bad investment in future. Women who live in societies where they are made miserable through injustice and inequality may not want to raise daughters who will live lives as unhappy as their own. Women have used this excuse as a rationale for killing their girl children. Many women in feudal areas of India don't want to have a daughter who would go through the same misery, humiliation and dependence that seemed to define their own lives. The cultural and economic factors that lead to female infanticide and selective abortion are part of the vicious cycle of discrimination against women and their devaluation. The socioeconomic pressures favoring sons are so strong that women undergo female foeticide despite possible health problems resulting from an abortion and their belief that abortion is a sin. Improving women's status in society will reduce social prejudices which, in turn, will decrease female foeticide. The suggestive measures include strict implementation of laws banning female foeticide and dowry, providing old age pension for parents who have no son, free and compulsory education for girl and job reservation for women in specific occupations and giving them an equal share in the property. The present study deals with analysis of incidence of foeticide, infanticide its causes, intervention steps taken by the government and the remedial measures to eliminate the menace.

**Keywords:** Infanticide, Foeticide, Girl Child, Socio-Economic, Education.

\*\*\*

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**A STUDY ON GENDER VIOLENCE – ISSUES AND INTERVENTIONS**

DR. ANJALI DEWAN

**Abstract:** Gender injustice taking shape of crimes against women has increased all over the world and India is no exception to this. The Indian mythology placed women on a very high pedestal but deterioration in their glorious status suffered a socio-cultural setback resulting in loss of their freedom. Women continue to suffer from increasing tide of violence both inside and outside homes. Domestic violence is an ongoing experience of physical, emotional and/or sexual abuse faced by women within the household. Our country today is at the cusp of a paradigm change in its growth and position in the world. Empowerment of women has multiple, inter-related and interdependent dimensions in relation to resources, perceptions and power to take their own decisions. Educational attainment and economic participation are the key components in ensuring their empowerment which enhances their ability to influence changes and to create a better society. Empowerment of women has multiple, inter-related and interdependent dimensions in relation to resources, perceptions and power to take their own decisions. Educational attainment and economic participation are the key components in ensuring their empowerment which enhances their ability to influence changes and to create a better society.

**Keywords:** Gender Violence, Sensitization, Counseling, Indian Penal Code, Women Empowerment.

\*\*\*

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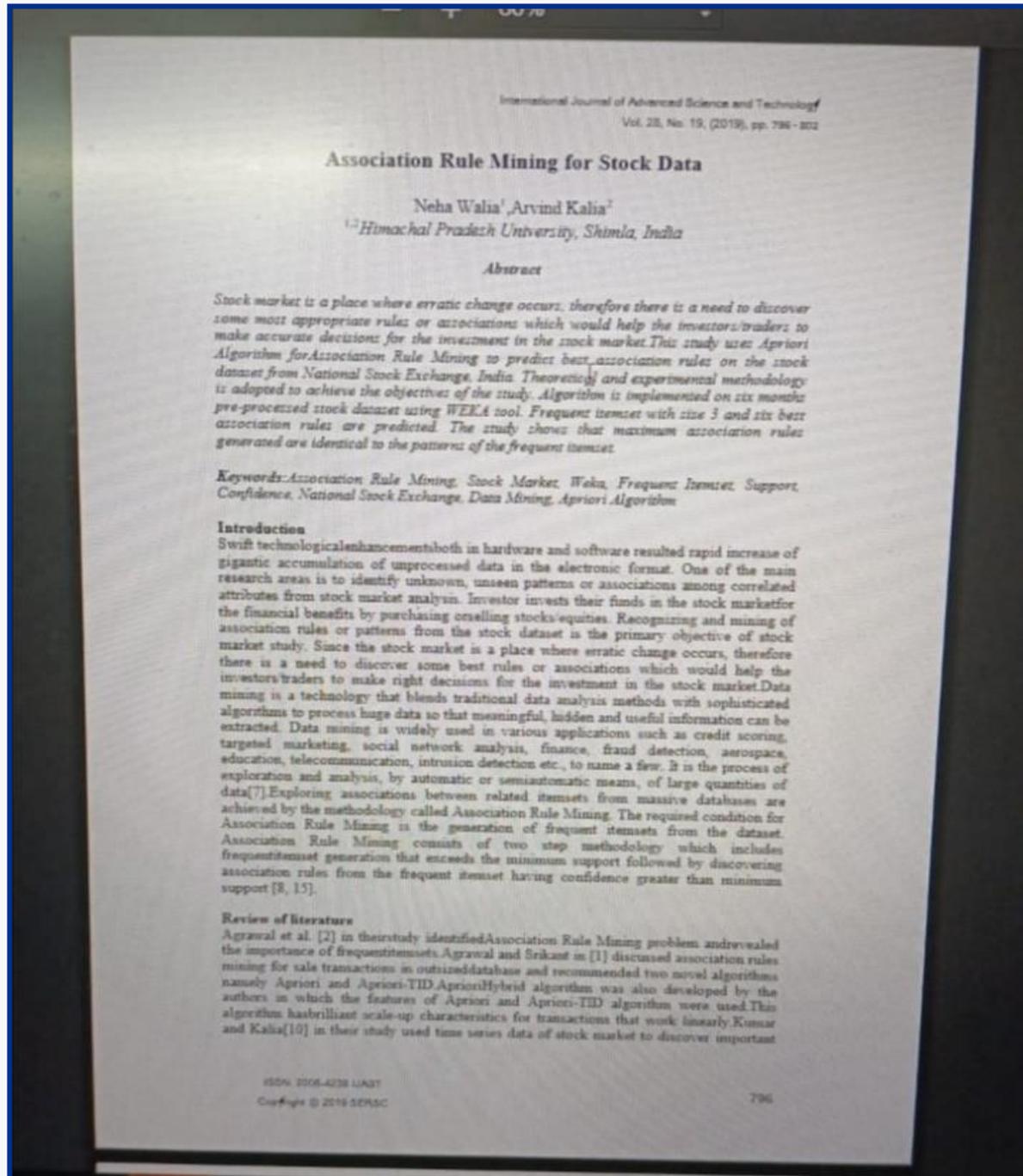


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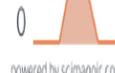
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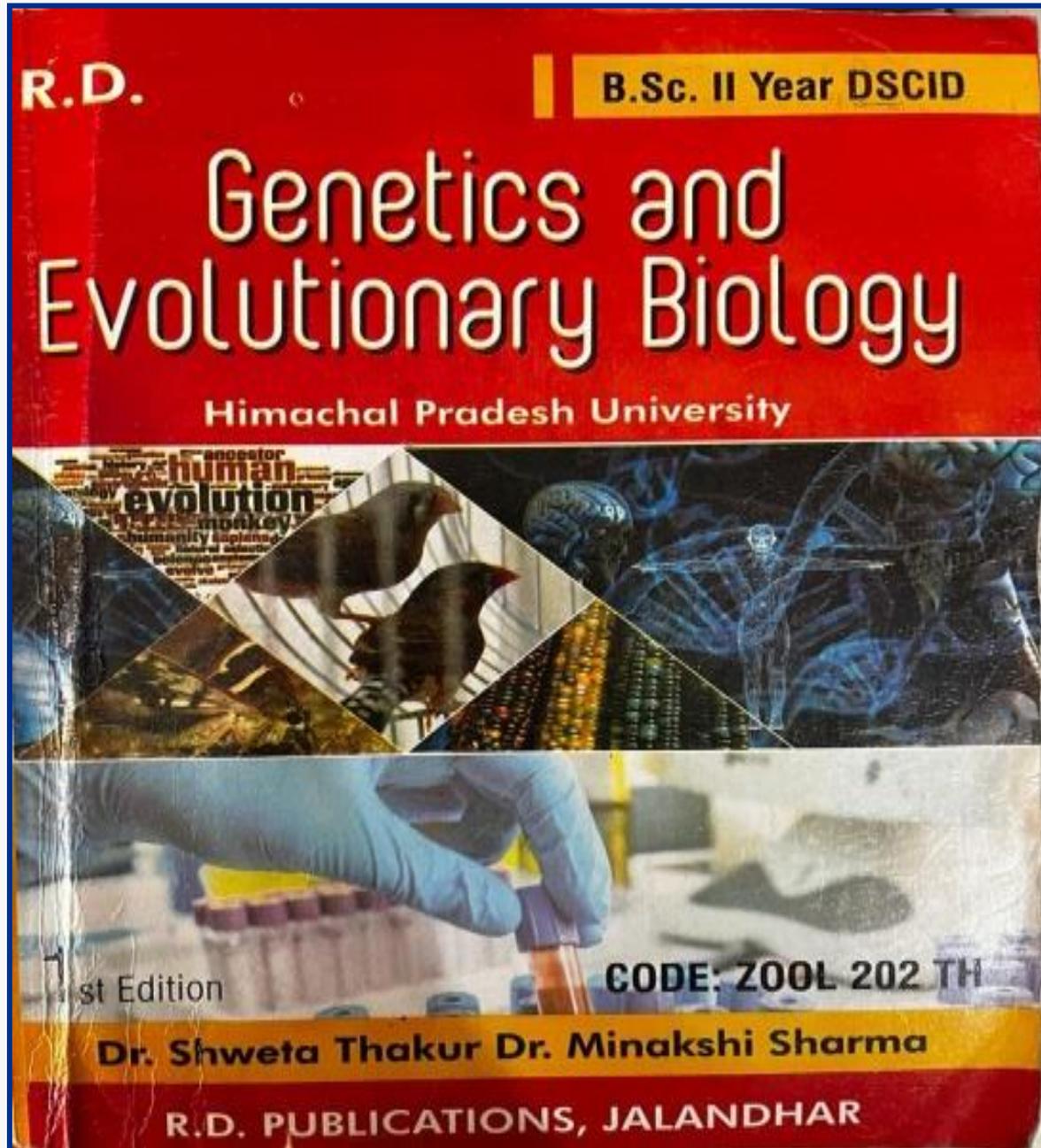
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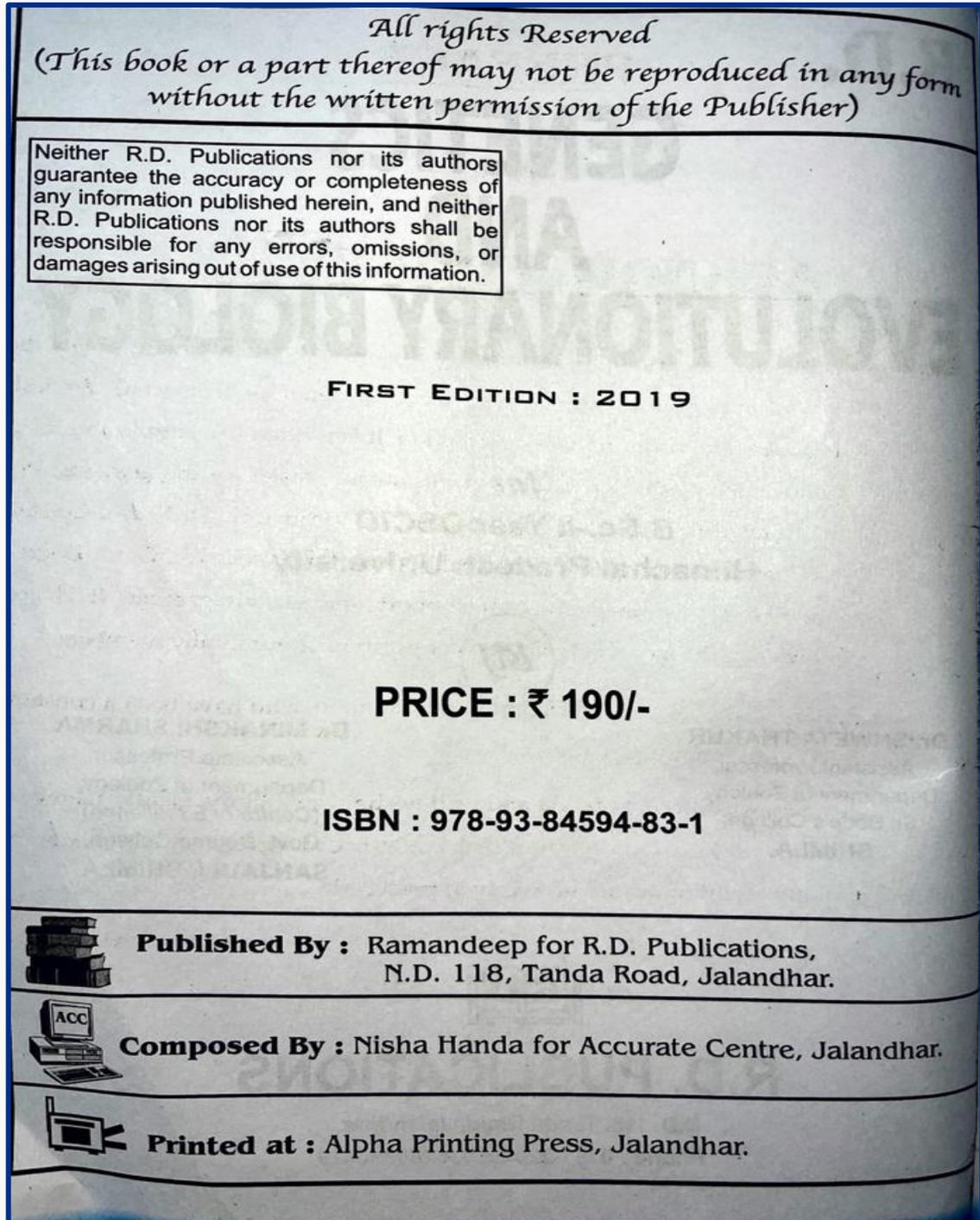
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<b>SECTION-A</b>	
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Mendel's work on transmission of traits, Genetic Variation, Molecular basis of Genetic Information.	
<b>Unit 2: Mendelian Genetics and Its Extension</b>	<b>8 LECTURES</b>
Principles of Inheritance, Chromosome theory of inheritance, Incomplete dominance and co-dominance, Multiple alleles, Lethal alleles, Epistasis, Pleiotropy, sex linkage inheritance, extra-chromosomal inheritance.	
<b>SECTION-B</b>	
<b>Unit 3: Linkage, Crossing Over and Chromosomal Mapping</b>	<b>9 LECTURES</b>
Linkage and crossing over, Recombination frequency as a measure of linkage intensity, two factor and three factor crosses, Interference and coincidence	
<b>Unit 4: Mutations</b>	<b>7 LECTURES</b>
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<b>Unit 5: Sex Determination</b>	<b>2 LECTURES</b>
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MENDELIAN GENETICS AND ITS APPLICATIONS

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**Plastid inheritance in *Mirabilis jalapa***

1. It was studied by Correns (1909). *Mirabilis jalapa* has three types of branches: variegated and white. All have green branch and green leaves. The only difference is the amount of chloroplast and leucoplast.

S. No.	Green	Variegated	White
1.	Chloroplast present throughout	Chloroplast and leucoplast in patches	Chloroplast absent replaced by leucoplast
2.	Autotrophic	Partially autotrophic	It obtains food from branches as they have photosynthetic plastids.

- Pollen grains of the plant and their male gametes have little cytoplasm. Plastids are absent.
- Female gamete/eggs are quite large and possess a large amount of cytoplasm.
- Depending upon the branch on which female gametes are formed, their cytoplasm contains abundant chloroplast, patches of chloroplast and leucoplast or only leucoplasts.
- These plastids are capable of self duplication independent of nucleus. Therefore only female gamete contributes to the colour of offspring.
- Thus phenotype of the offspring in *Mirabilis jalapa* depends upon the phenotype of the branch which provides female gamete.
- Flowers of pale branch will always form seeds that give rise to whitish seedlings. The pollen grain is contributed by green, variegated and pale branch. Such seedlings do not have the chloroplasts to perform photosynthesis.
- Flowers of green branch produce seeds which give rise to green plant irrespective of the branch that provides pollen.
- Flowers of variegated branch form seeds which give rise to three types of seedlings: green and variegated. This type of branch giving pollen grain is immaterial. From a variegated branch, three types of seeds by variegated branch is possible by the random distribution of colourless plastids at the time of egg formation.
- The egg may have only green plastids, both green and colourless plastids or only colourless plastids. Accordingly three types of seeds are formed which give rise to three types of seedlings: pale/ white, green and variegated.
- The ratio of three types is highly variable due to randomness of distribution of plastids in female gamete at the time of gametogenesis.

S.No.	Branch yielding male gamete	Branch yielding female gamete	Progeny
1.	Green, Variegated, Pale	Green	Green
2.	Green, Variegated, Pale	Variegated	Green, Variegated
3.	Green, Variegated, Pale	Pale	Pale

**Fig.2.38: Chloroplast inheritance in four O' clock plant**

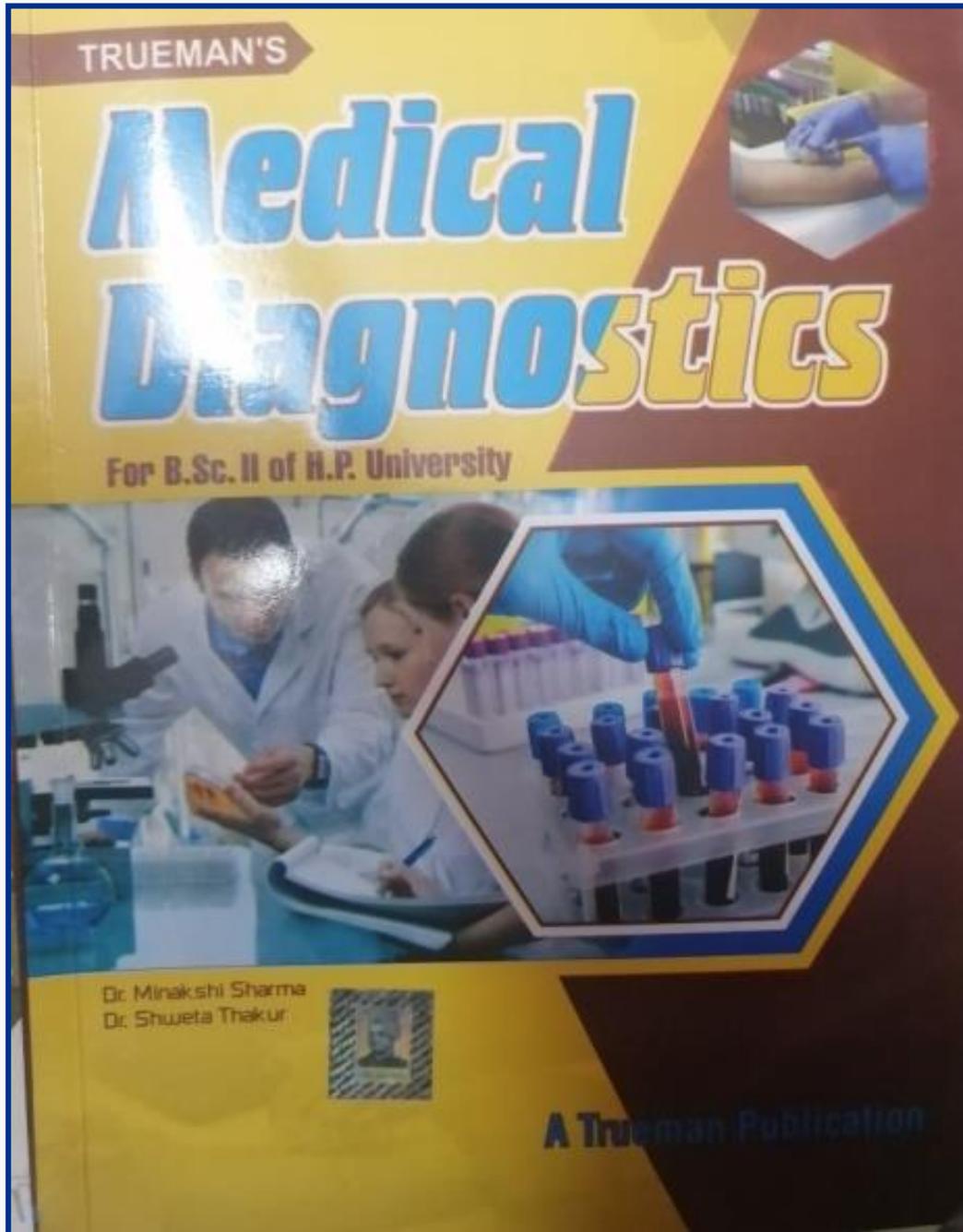
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We feel pleasure in presenting before you this book on "Medical Diagnostics" for Skill Enhancement Course of H.P. University under CBCS system.

We have tried to cover the whole syllabus systematically and unit wise. The matter is written in a very lucid manner so that the teachers and the taught can understand it easily. Various pictures of test and the machines used are given chapterwise in mulicolour at the end of the book so as to make the students to grasp the same and make clear the concepts.

We hope that the book will prove very useful for teachers as well as the students.

Any further suggestions to improve the book shall be thankfully acknowledged.

— Authors

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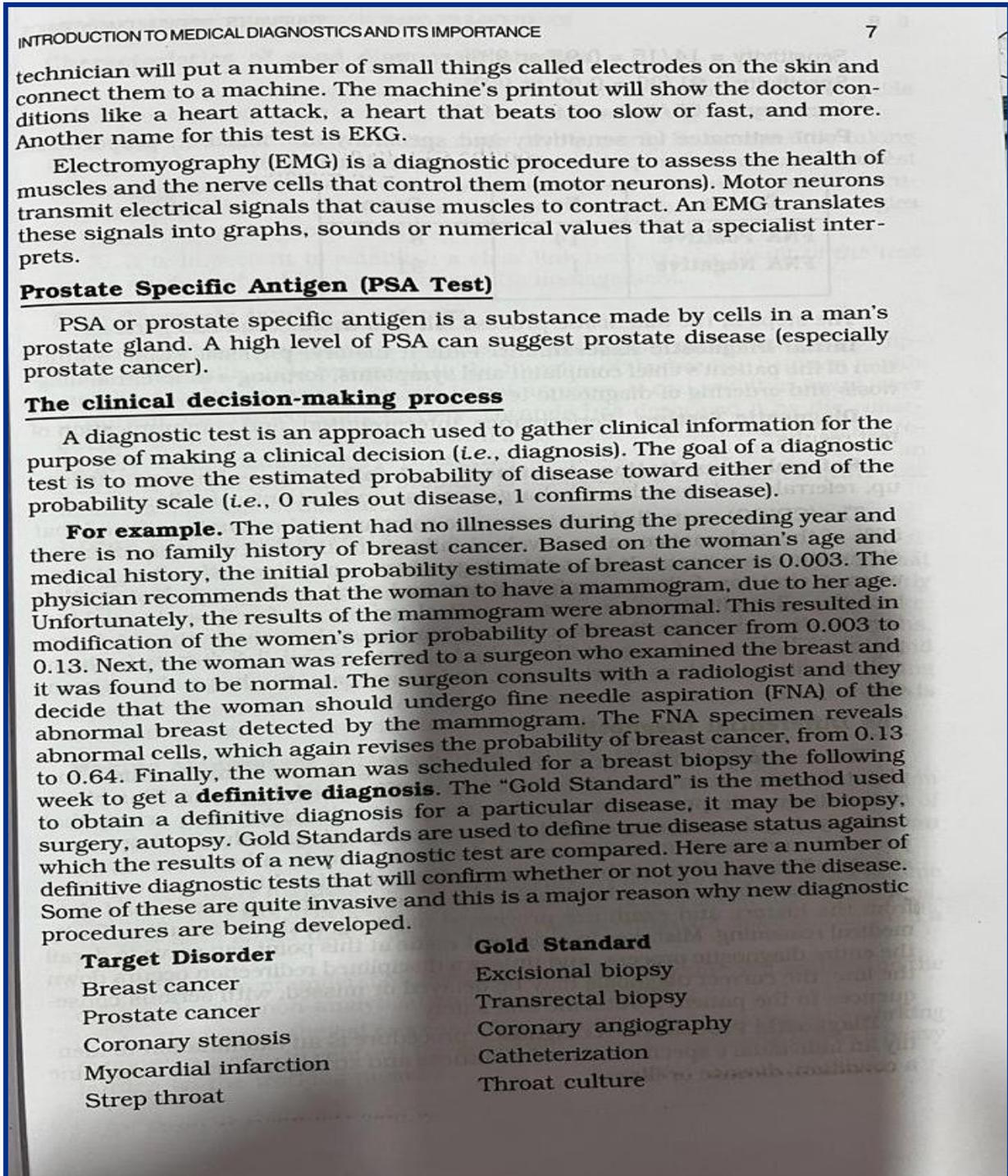
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Urine Analysis: Physical characteristics; Abnormal constituents	
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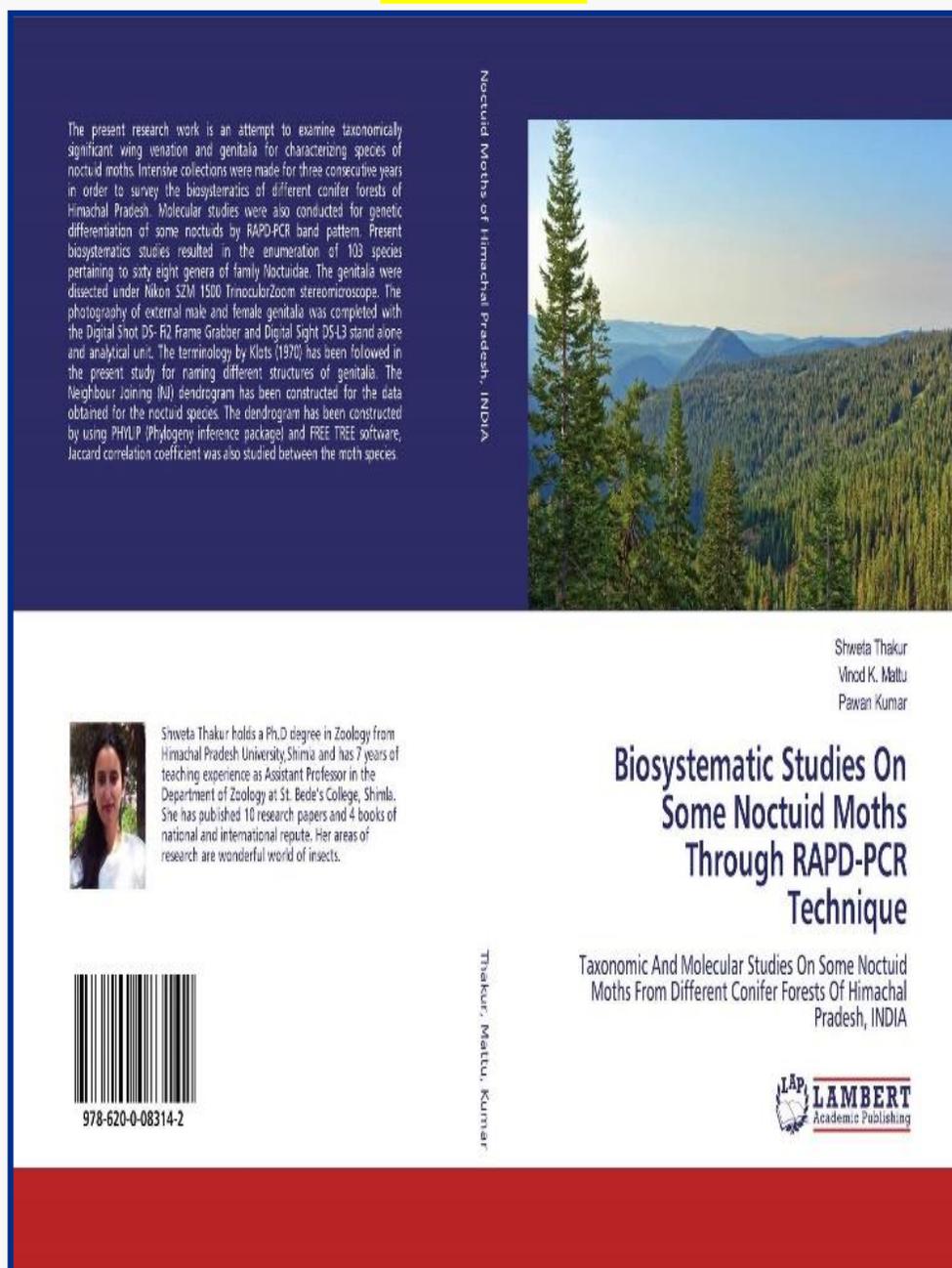
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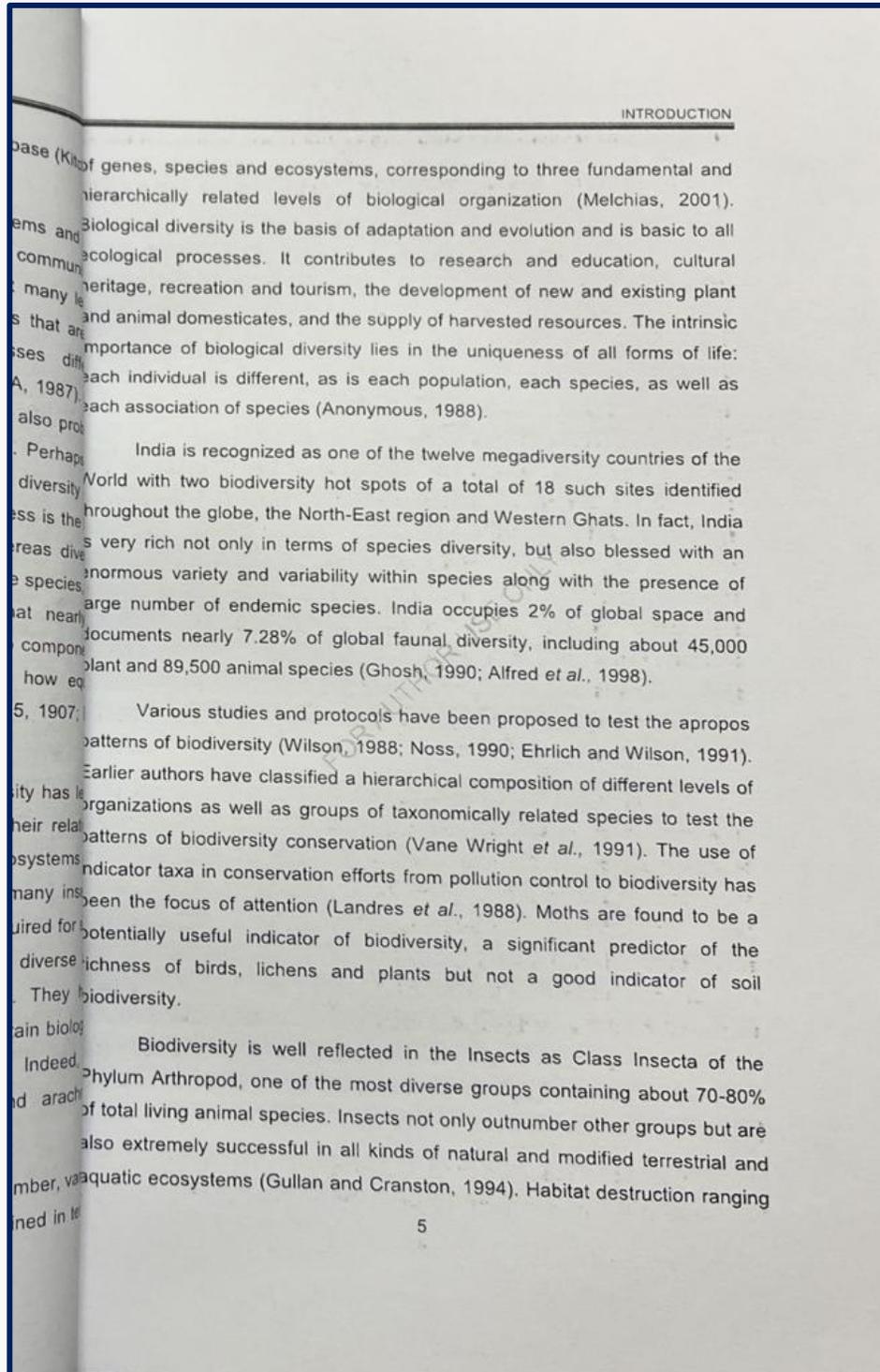
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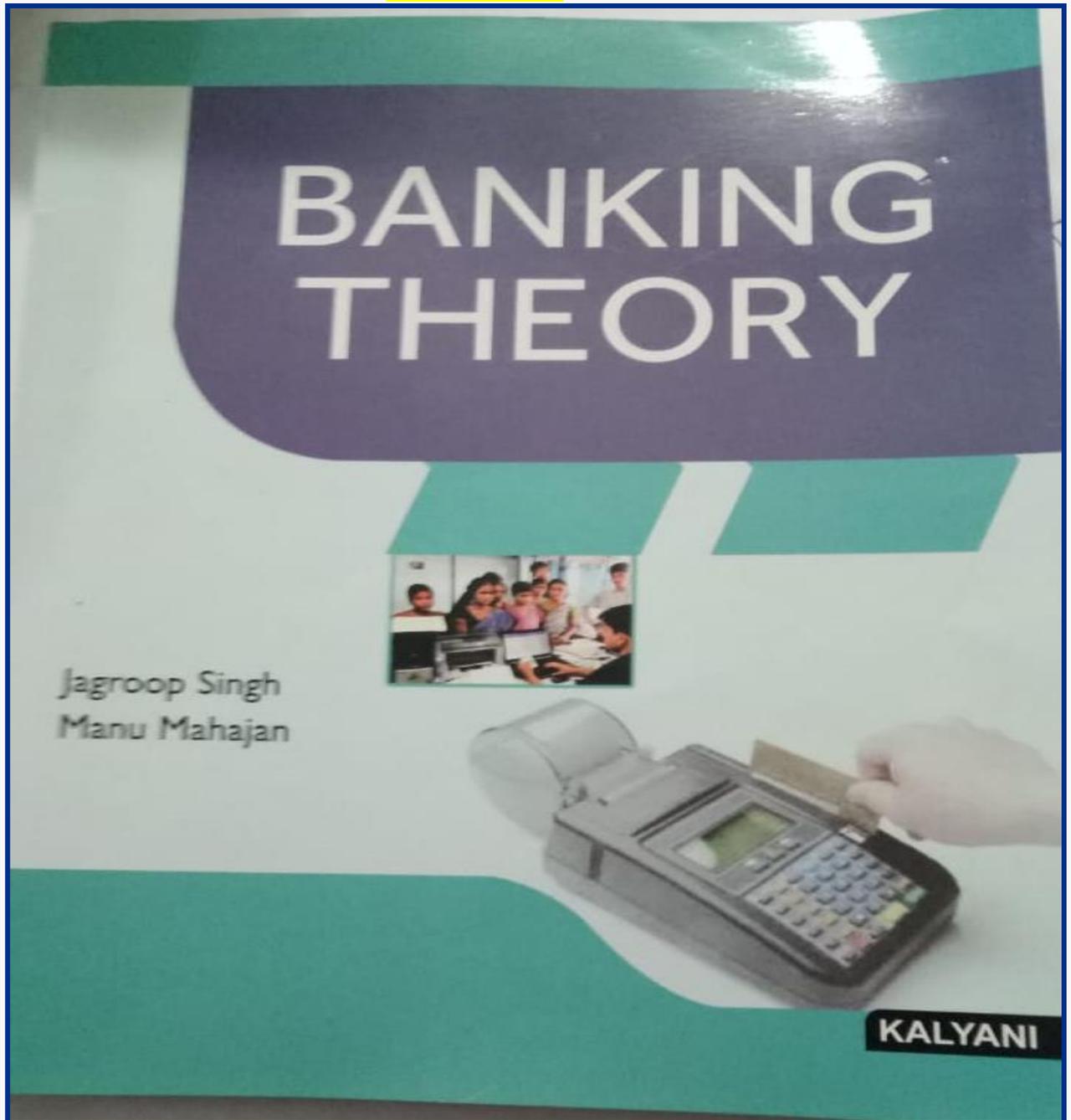
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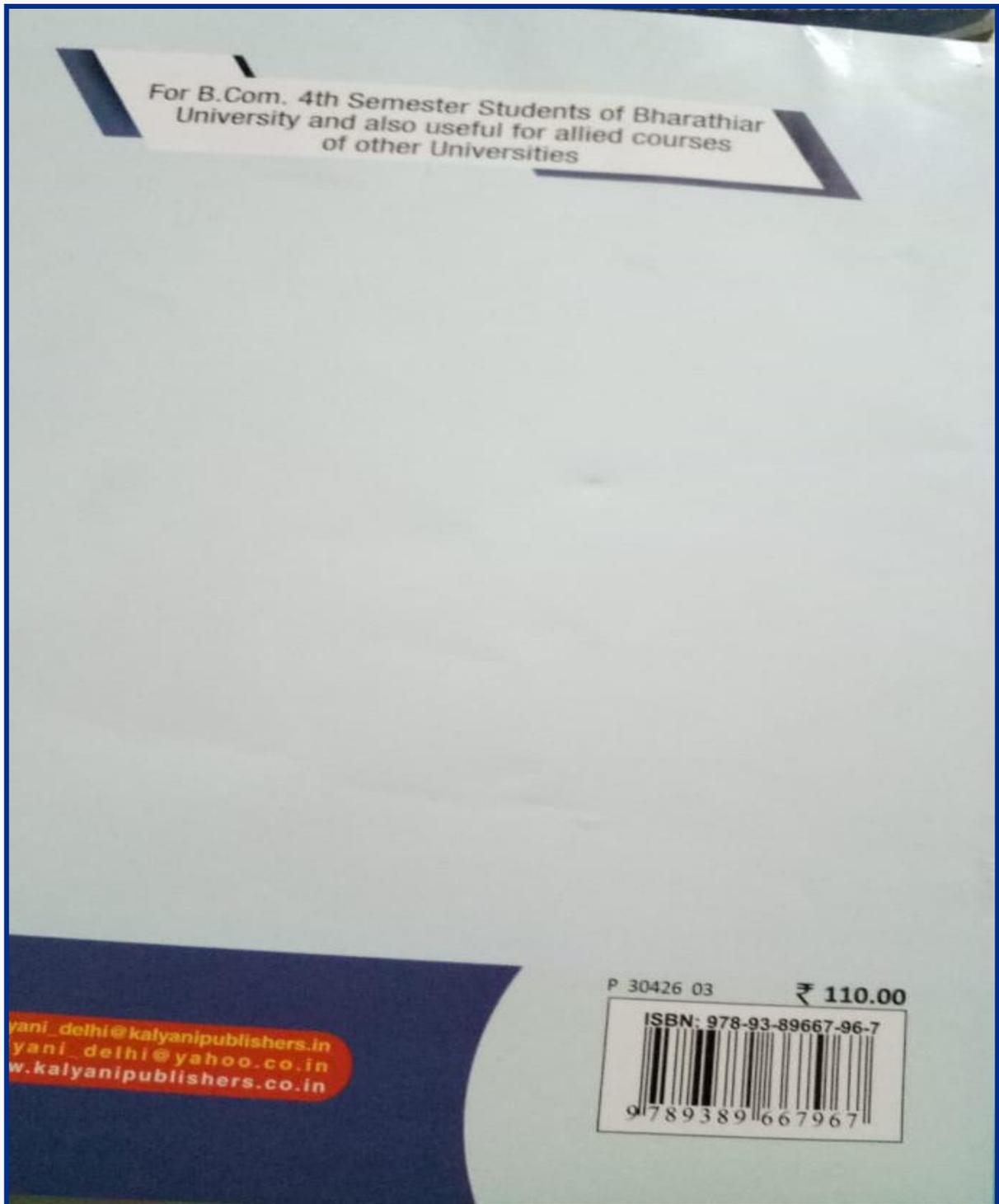
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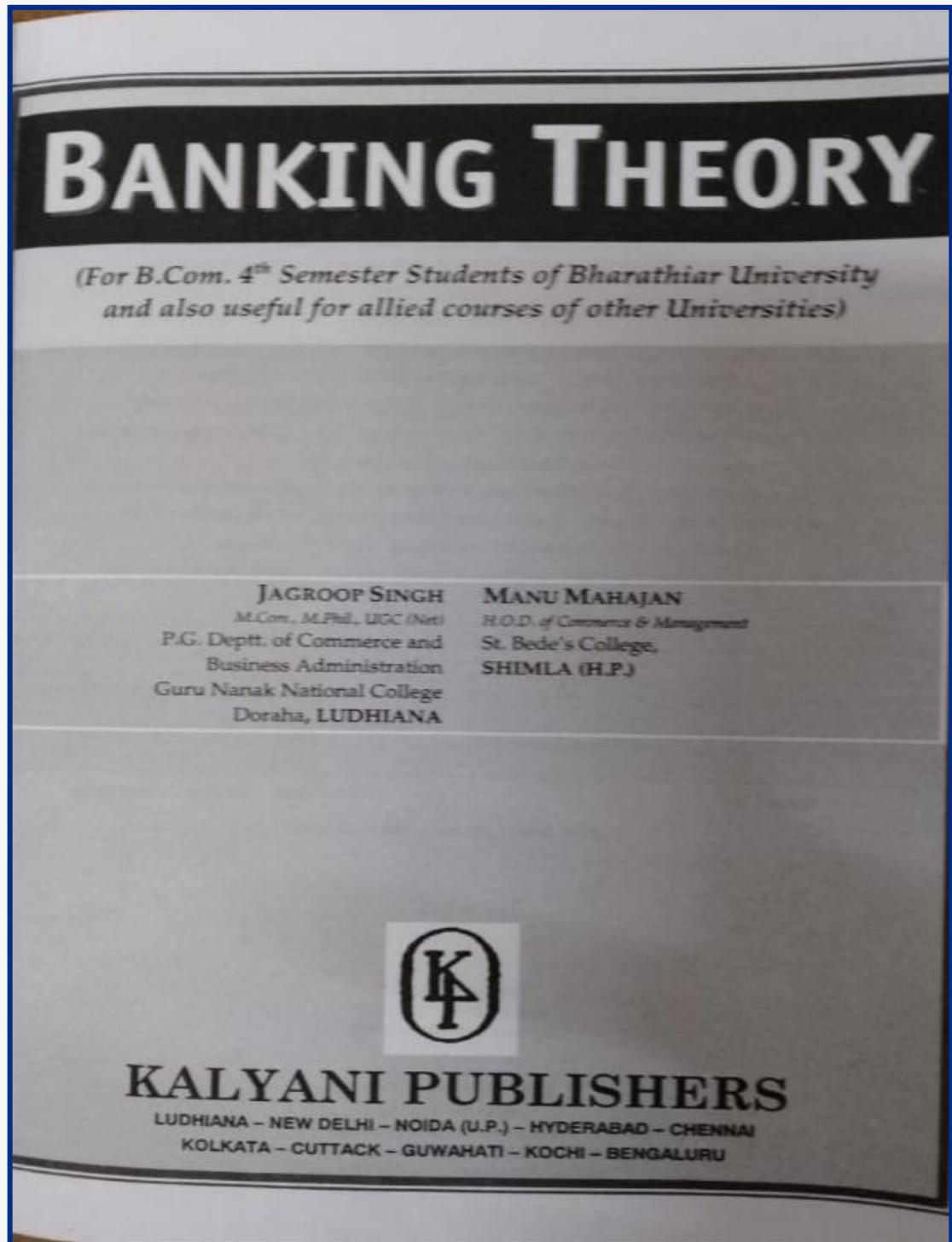
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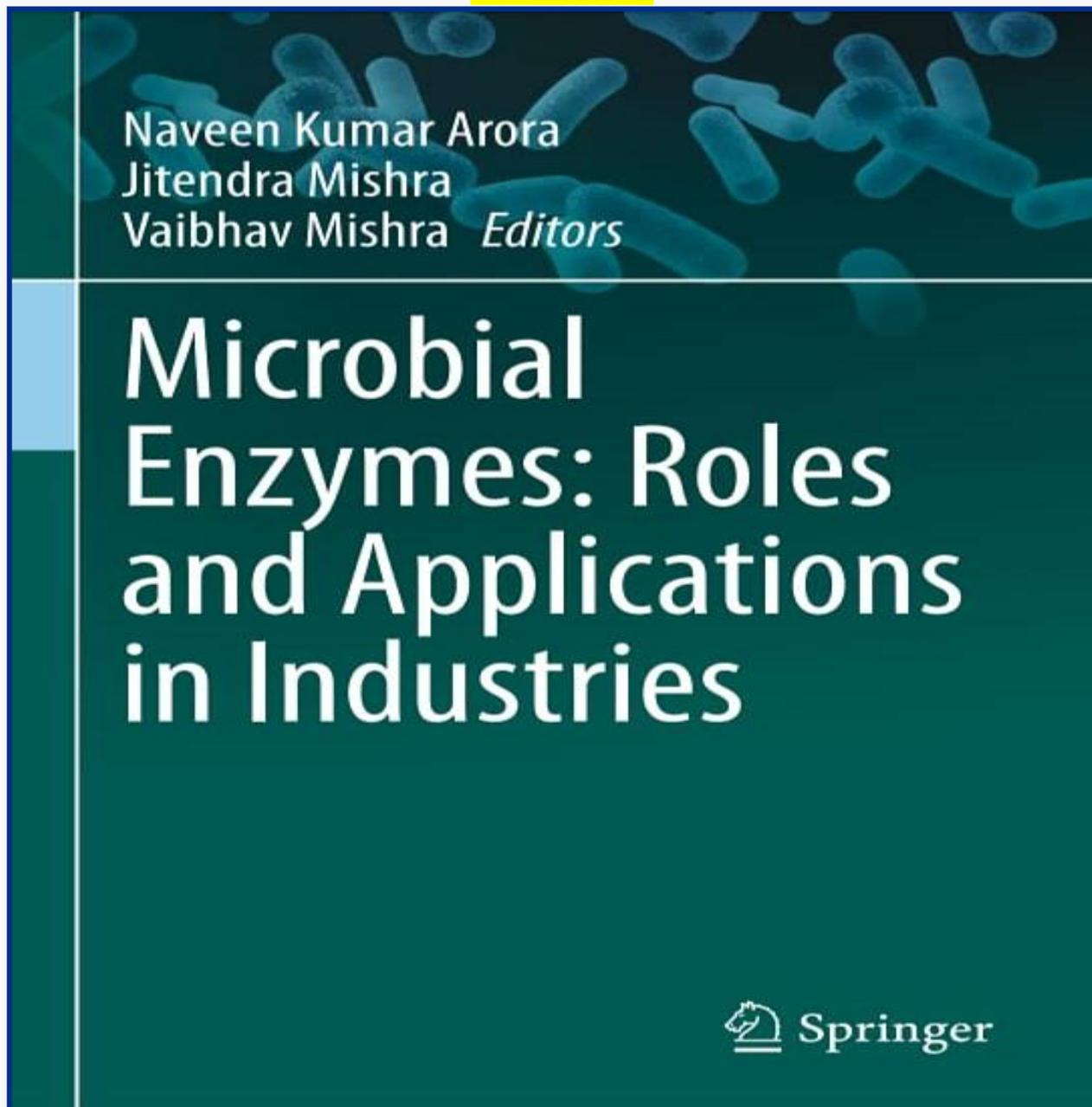


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## Therapeutic Applications of Microbial Enzymes in the Management of Kidney Stone Diseases

# 13

Shruti Gupta and Shamsheer Singh Kanwar

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**Abstract**

Nephrolithiasis is a terrible pathological condition marked by the presence and formation of kidney stones. It affects around 3–20% of the community in the world. Several environmental, physiological, and nutritional conditions contribute to this disease. Not only the food sources but also the body's own metabolism add up oxalate content in the human body. The increased intake of oxalate leads to hyperoxaluria, which often results in the formation of calcium oxalate stones, commonly known as kidney stones. The incidences of kidney stone are very common, and the current therapeutic measure of its cure is not much effective. Therefore, new therapeutic approaches are needed. In the last few years, the use of gut microbiome with oxalate-degrading activity has emerged as an excellent therapeutic approach to treat kidney stones. As the genes responsible for oxalate-degrading enzymes are not found in humans, use of bacterial enzymes with the ability to degrade oxalate in intestinal digestion has a significant therapeutic impact. This chapter summarizes the roles of microbial enzymes produced by gut microflora involved in the solubilization of the dietary oxalates, and their potential applications in kidney stone diseases.

---

### 13.1 Introduction

Kidney stone or urolithiasis is a condition primarily attributed to the deposition of an enhanced level of calcium oxalate in the form of crystals due to supersaturation (of calcium oxalate) during removal of water from urine (Peck et al. 2016). Although oxalic acid is a general component present in human diets, it is also endogenous:

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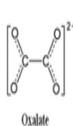
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produced during amino acid metabolism. Moreover, oxalic acid is absorbed in the stomach, small bowel, and colon from the dietary sources (Nazari et al. 2016). Binding with different cations such as sodium, potassium, magnesium, and calcium results in the formation of different oxalate salts but mostly calcium oxalate (Mogza et al. 2014). Ingestion and exposure of a high amount of oxalate lead to building up of oxalate crystals in the kidneys, which might be lethal and cause hypocalcemia, azotemia, and hemorrhage in the visceral organs (Aslami et al. 2011). Oxalates of calcium and phosphate are the main constituents of kidney stones (Rupasingh et al. 2011). Apart from the formation of stones in the kidney, oxalate crystals can destruct epithelium in the oral cavity and gastrointestinal tract, causing inflammation, dysuria, and gastric hemorrhage which indirectly becomes a cause of death (Ellis et al. 2015).

As humans lack the enzyme for directly metabolizing oxalate, alternate pathways are used to regulate this potentially toxic compound (Mogza et al. 2014). Current remedial strategies which are used for kidney stones are inefficient and have been proven to be unsuccessful in preventing the recurrence of the disease (Sutherland et al. 1985). However, therapeutic measures such as allopurinol, thiazide, potassium alkali, and topiramone along with dietary modifications and intake of adequate fluids have been used for a long time to limit urolithiasis (Toussaint 2013). Hence the evolution of new therapeutic strategies aiming to prevent recurrent stone formation has become the need of the hour. Since a decade, attempts have been made to use plants and oxalate-degrading microbial enzymes to solubilize oxalate kidney stones, and some success has been achieved (Peck et al. 2016). The roles of gut enzymes produced through microflora in the solubilization of the dietary oxalates are a new frontier area for treating kidney stone disease. This chapter provides a brief insight into current research and the roles of gut microbial enzymes for the treatment of kidney diseases (Fig. 13.1).



Oxalate decarboxylase  
→ CO<sub>2</sub> + Formate

Oxalate oxidase  
→ CO<sub>2</sub> + H<sub>2</sub>O<sub>2</sub>

Oxalyl-CoA decarboxylase  
→ CO<sub>2</sub> + Formyl-CoA

Fig. 13.1 Enzymatic degradation of oxalate

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13 Therapeutic Applications of Microbial Enzymes in the Management of Kidney...

### 13.2 Role of the Gut Microbiome in Oxalate Degradation

Formation of oxalate stones in humans may be prevented by two symbiotically existing bacterial genera, *Oxalobacter* and *Lactobacillus*, in the gut. Both bacterial genera have been found to act on some biochemical pathways by the intervention of their oxalate-degrading enzymes (Sadaf et al. 2017). It has also been hypothesized that the *Oxalobacter formigenes*, a Gram-negative, obligate anaerobe found in the gastrointestinal tract and in humans, performs a significant role in mediating mammalian oxalate homeostasis (Steedman et al. 2005). The bacterium *O. formigenes* colonizes the gut in nearly 70–80% of the healthy population and utilizes oxalate as the sole material for energy and carbon source. Formyl-CoA transferase and oxalyl-CoA decarboxylase are the two enzymes from *O. formigenes*, which catalyze oxalate for biosynthesis (Hoppe et al. 2005). By transferring the coenzyme-A moiety to lactic acid and oxalic acid that is connected with calcium oxalate and calcium phosphate, degradation reaction occurs which results in elevation of oxalate and lactate level (Salminen et al. 2010).

Further, oxalate is broken down into CO<sub>2</sub> and formate, which is further metabolized and excreted via the feces (Hoppe et al. 2005). It has been found that in standard colonization conditions *O. formigenes* can degrade more than 1 g of oxalate per day. However, attempts to culture this bacterium out of fecal specimens have given low colony counts, i.e., up to 10<sup>6</sup> CFU per gram of wet sample (Allison and Cook 1981). As investigated by Peck et al. (2016) in most of the cases gut of children between the age of 1 and 6 years is more naturally colonized by *O. formigenes*, while 20–25% of the colonization is lost during early adulthood and adolescence in healthy populations (Peck et al. 2016). In addition to *O. formigenes*, other oxalate-degrading bacterial genera are *Lactobacillus*, *Enterococcus*, *Eubacterium*, and *Bifidobacterium*. Amongst them, *Enterococcus faecalis* uses oxalate as a sole carbon and energy source in a nutrient-deficient environment; otherwise it can also consume other substrates for growth (Miller and Dearing 2013). In some circumstances, along with other microflora, natural colonization of *O. formigenes* in the gut is affected. However, continuous use of antibiotics, e.g., in patients with cystic fibrosis, or therapeutic use in diseases such as Crohn's disease also exacerbates kidney stone formation (Kumar et al. 2004; Hatch 2014).

---

### 13.3 Probiotic Therapies for the Treatment of Kidney Stones

Use of probiotics as a therapeutic and preventive measure in kidney stone and hyperoxaluria has gained much attention. It has been found that in the form of probiotics, aerotolerant *Lactobacillus* and obligate anaerobe *Bifidobacterium* present in the intestine show oxalate-degrading activity, which is considered useful for the prevention of stone formation (Abuata and Reid 2010). Studies confirmed that through treatment with *Bifidobacterium lactis* DSM 10114, *Bifidobacterium longum* NB 111, and *Bifidobacterium adolescentis* MB 238 strains, the degradation of oxalate could be achieved up to 61%, 55.2%, and 57%, respectively (Turroni et al. 2007; Abuata and

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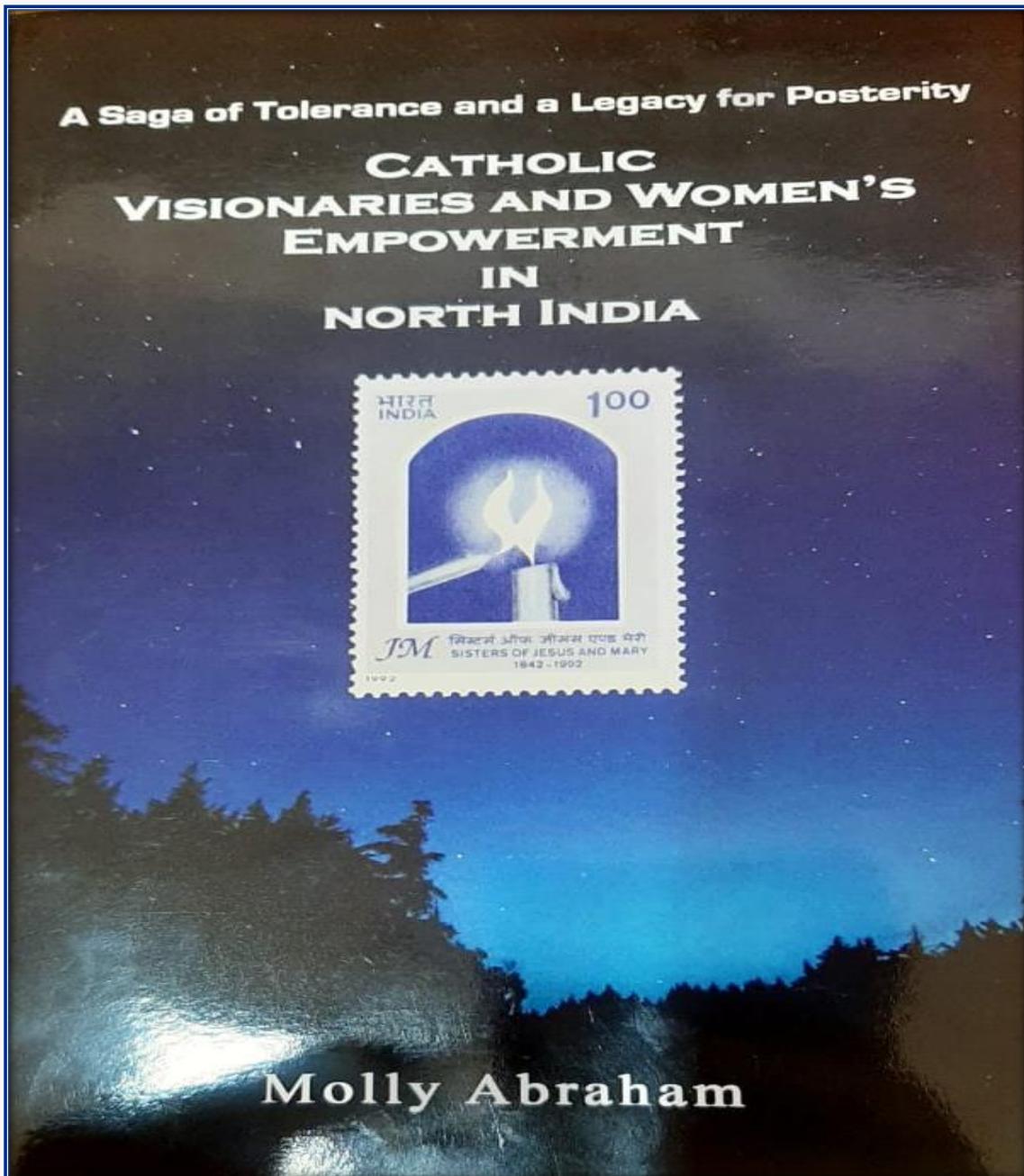
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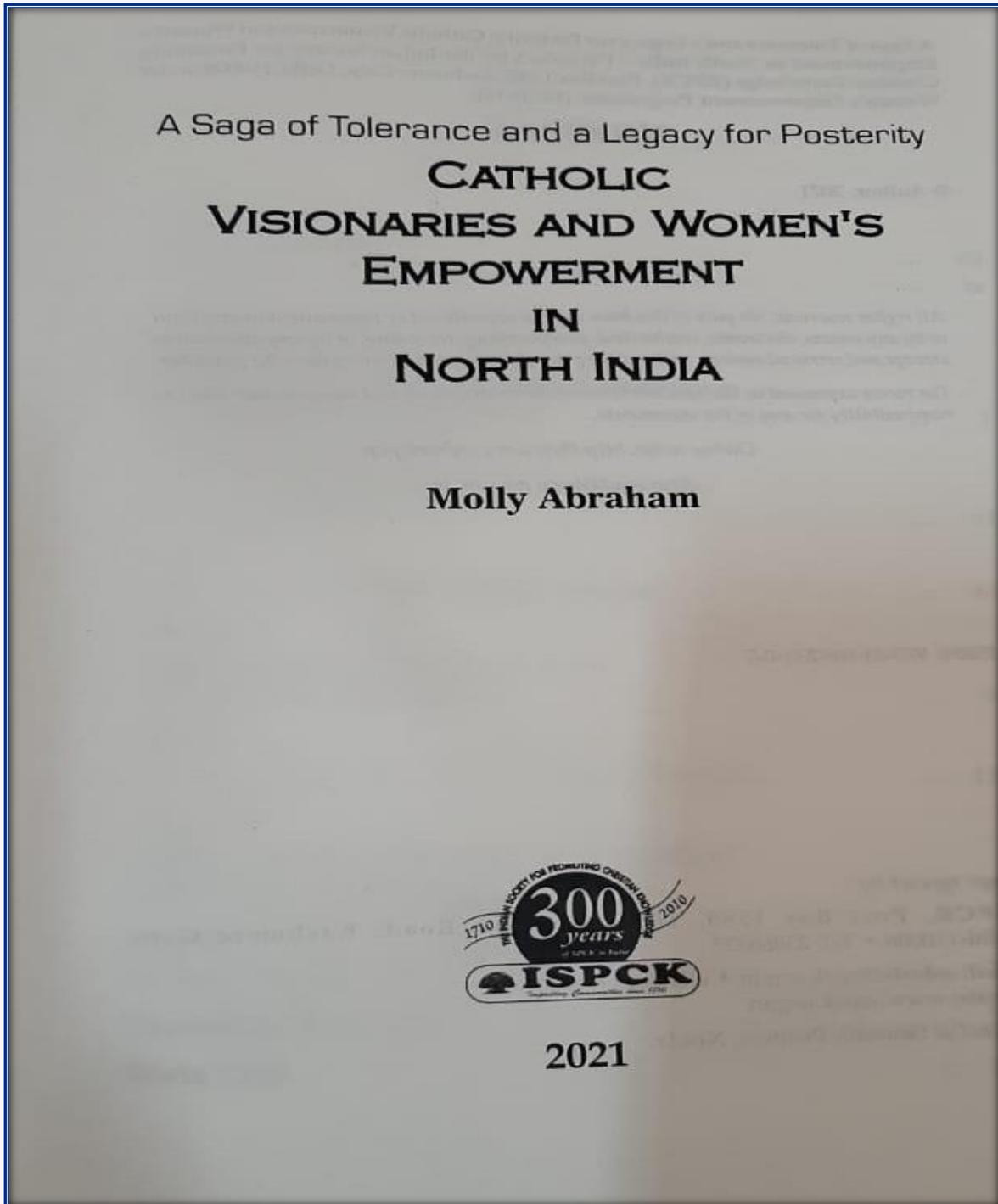
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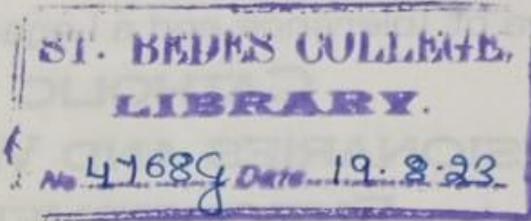


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awareness of living things in the environment along with sensitivity to the feelings of others, an altruistic attitude, honesty and humility are the basic qualities of a person formed through a quality education. This is what Claudine dreamed of, and for which she opened her educational institutions. These educational institutions aim to instruct young girls and to lead them into the path of eternal truth and the Christian values that often find its expression in love of God and respect for the others. She went out in love and service to the poor in the society and demanded that her Sisters in the Congregation should continue to do the same till the very end through Christian education.

#### **Founding Vision of JM Education**

Claudine considered that education is the only potential means to attain the ultimate purpose in lives. Imbued with the Spirit of Christ, she hoped that the students would act as Leaven and Salt<sup>2</sup> (Matt5:13) in their own social milieu. This is quite evident that those who have studied in JM institutions learnt to cater to the socio-economic needs of the family and society, as responsible citizens by setting themselves as examples in various walks of life. If this were to be done effectively, students would need a strong intellectual, moral and emotional formation. She chose the best elements from the educational systems of her time and added her own ideas to it, adopted them and organized them into a whole, so as to achieve inclusive and transformative education for the empowerment of young women.

Her system of education had a scientifically tempered Christian outlook. To act as an influence in the social structure and in such a milieu, the students were required to be proficient in their skills. In her educational vision Claudine combined two ideals, namely, good life based on Christian values and the means to earn a decent livelihood. She offered subjects that helped them to become good citizens, leaders, mothers, wives, and teachers, within their families, society, and nation at large. Hence her liberal and innovative ideas already foreseen at that time were duly converted into vocational studies and preparations. One can see how Claudine's vision foresaw Gandhiji's own Wardha Scheme

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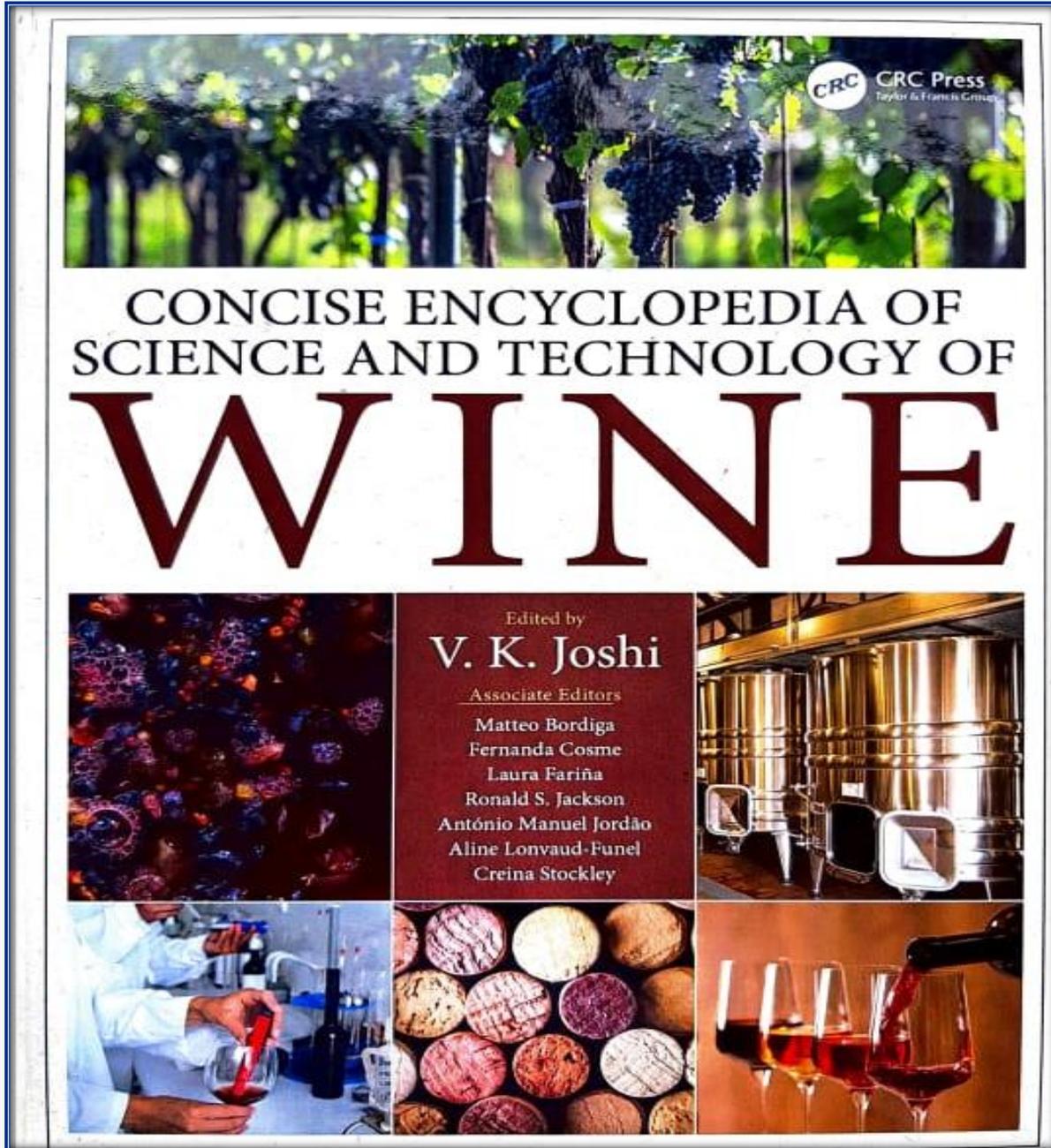
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# 26 Culture of Wine Yeast and Bacteria

Tek Chand Bhalla, Navdeep Thakur and Savitri Kapoor

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### 26.1 INTRODUCTION

The species and strains of *Saccharomyces* specific to wine, apple and pear cider production were first reported by Müller-Thurgauand referred to the addition of yeast cells to beer and bread for enhancing the rate of fermentation. The developments in areas of microbial physiology, biochemistry, genetics, molecular biology, ecology and biochemical engineering have greatly contributed in understanding the extent and behaviour of yeast as a fermentation agent and thus, transforming the art of wine making into a science and technology of wine production. The starter culture or inoculum for conducting wine fermentation may comprise: i) indigenous microfloral yeasts present on the grapes, ii) dry wine yeast, iii) wet yeast (*i.e.* yeast on slants or petri plates), iv) lyophilised yeast, and v) immobilized yeast (entrapped in gels). Besides yeast, lactic acid bacteria, generally *Leuconostoc oenos* is used by wine

producers for induction of malolactic fermentation. Here in this chapter, some aspects of the cultivation of wine yeast and lactic acid bacteria have been discussed.

### 26.2 WINE YEAST: CHARACTERISTICS AND ESTIMATED DEMAND

It often becomes difficult to select a yeast strain from commercial sources for wine fermentation. Wine yeast strains exhibit a lot of variation in their physiology and biochemical characteristics. Some desirable properties of wine yeast important in the selection of a suitable yeast strain for wine production include: (a) fermentation properties: rapid initiation of fermentation; fermentation of variety of carbohydrates; high osmo-tolerance; high ethanol tolerance (up to 15% v/v or more); ability to ferment at low temperature and under pressure; moderate biomass production; (b) flavor characteristics:

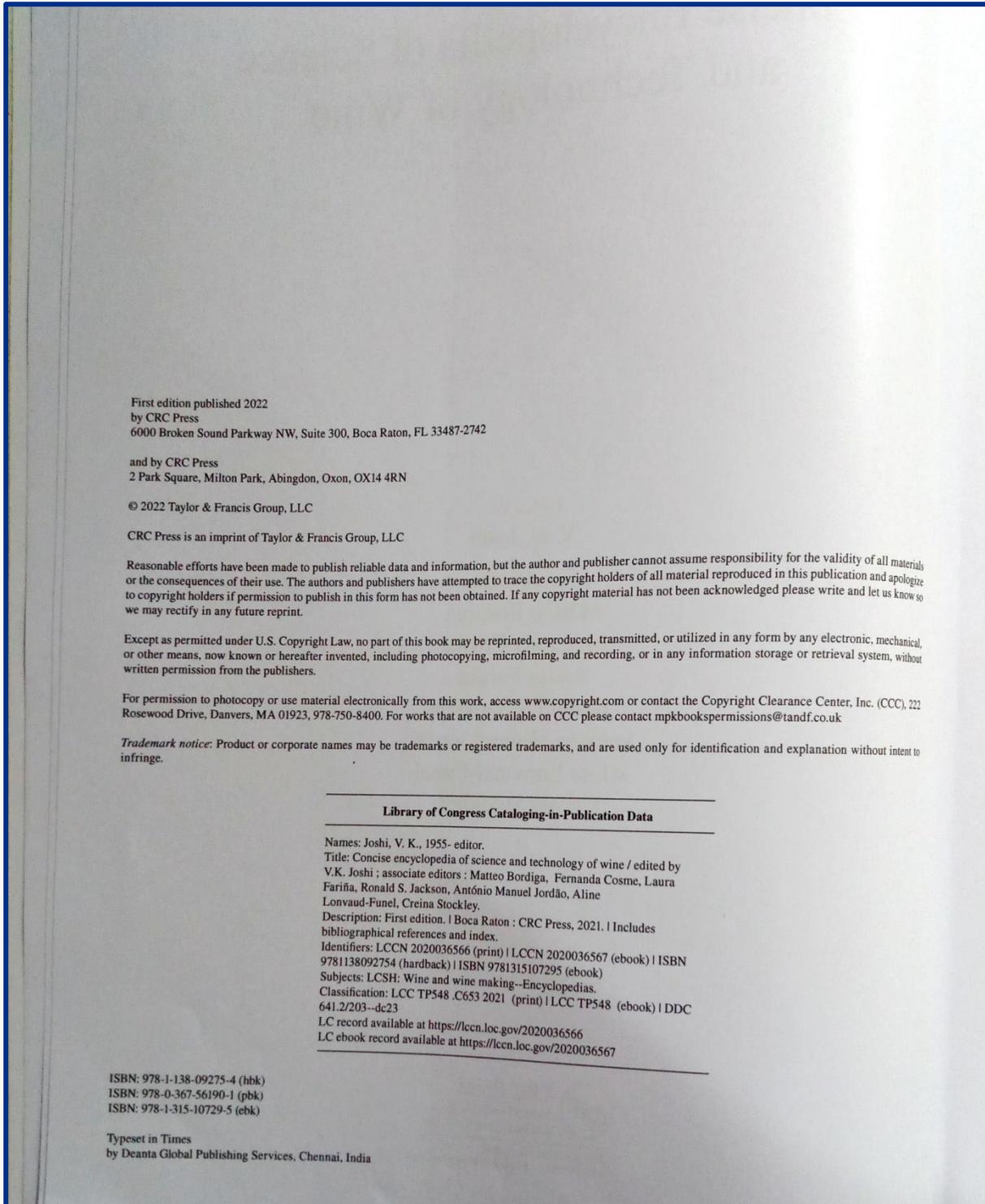
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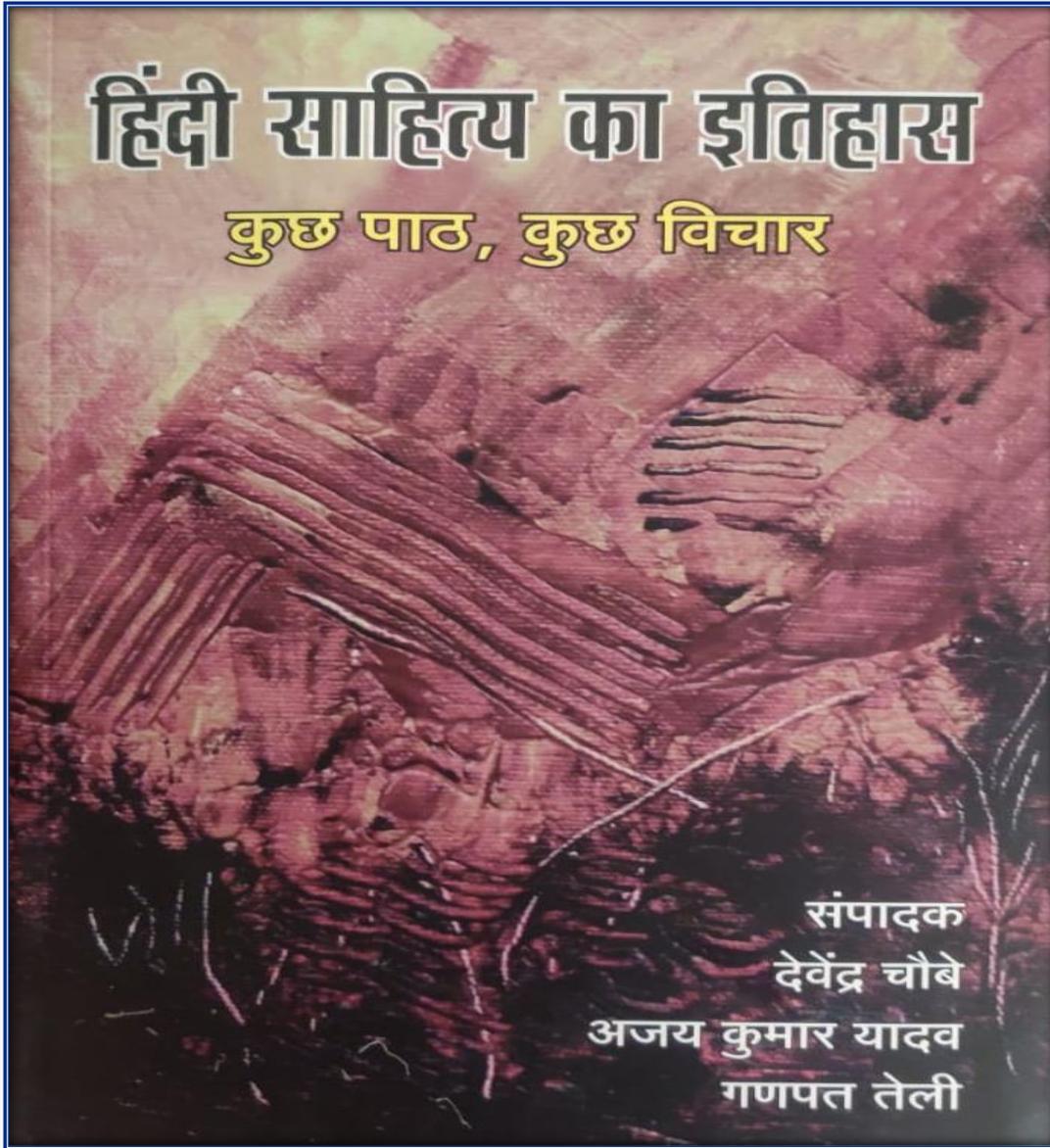
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अजय कुमार यादव  
गणपत तेली

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मधुलिका बेन पटेल  
प्रदीप कुमार  
संजय कुमार

आधार प्रकाशन  
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**'हम प्रवासी' की कथा-कला, भाषा और जिन्दगी का  
यथार्थ**

❖ देविना अक्षयवर

साहित्यकार की साहित्यिक मान्यताएँ उसके रचना-सृजन के स्वरूप को निर्धारित करती हैं, इसी से उसके साहित्य-दर्शन का परिचय भी मिलता है। अभिमन्यु अनत केवल कथाकार ही नहीं, बल्कि, कवि, नाटककार, कहानीकार तथा सम्पादक के रूप में विचारक भी रहे हैं। लेकिन जिस प्रकार भारत का हिन्दी साहित्य रूसी तथा पश्चिमी विचारधाराओं से प्रभावित, कई 'वादों' के संवाहक के रूप में दिखाई देता है, उस से भिन्न मॉरीशस का हिन्दी साहित्य किसी भी 'वाद' के खेमें में बँटा हुआ नहीं दिखाई देता। साहित्य की परिभाषा पर विचार करते हुए प्रेमचन्द ने अपने 'साहित्य का उद्देश्य' नामक निबन्ध में लिखा है—

“साहित्य उसी रचना को कहेंगे, जिसमें कोई सच्चाई प्रकट की गई हो, जिसकी भाषा प्रौढ़, परिमार्जित एवं सुन्दर हो और जिसमें दिल और दिमाग पर असर डालने का गुण हो और साहित्य में वह गुण पूर्ण रूप से उसी अवस्था में उत्पन्न होता है, जब उसमें जीवन की सच्चाइयाँ और अनुभूतियाँ व्यक्त की गई हों।”

अभिमन्यु अनत ने अपनी प्रस्तुत रचना में मॉरीशस में जा बसे भारतीय प्रवासियों के संघर्षमय जीवन की सच्चाइयों को जिस मार्मिकता के साथ साहित्य-रूप देकर उन्हें ऐतिहासिक दस्तावेज के रूप में प्रस्तुत किया है, उस से साफ पता चलता है कि वस्तुतः उन्होंने 'वादों के जंगल' में न खोकर मानव-समाज के उस वंचित तबके के जीवन की सच्चाइयों और अनुभूतियों की अभिव्यक्ति की है, जिनका इतिहास कागजों पर लिखे जाने से पहले, कोड़ों चाबुकों तथा बांसों से सबसे पहले उनके शरीर पर लिखा गया था। अफ्रीकी दासों और भारतीय बन्धुआ मजदूरों की पीठ पर दर्ज, मानव-दमन के इसी इतिहास के कथाकार हैं अभिमन्यु अनत। उन्होंने कथाकार के रूप में हिन्दी की मुख्यधारा के साहित्य के बरअक्स, प्रवासी साहित्य, को एक

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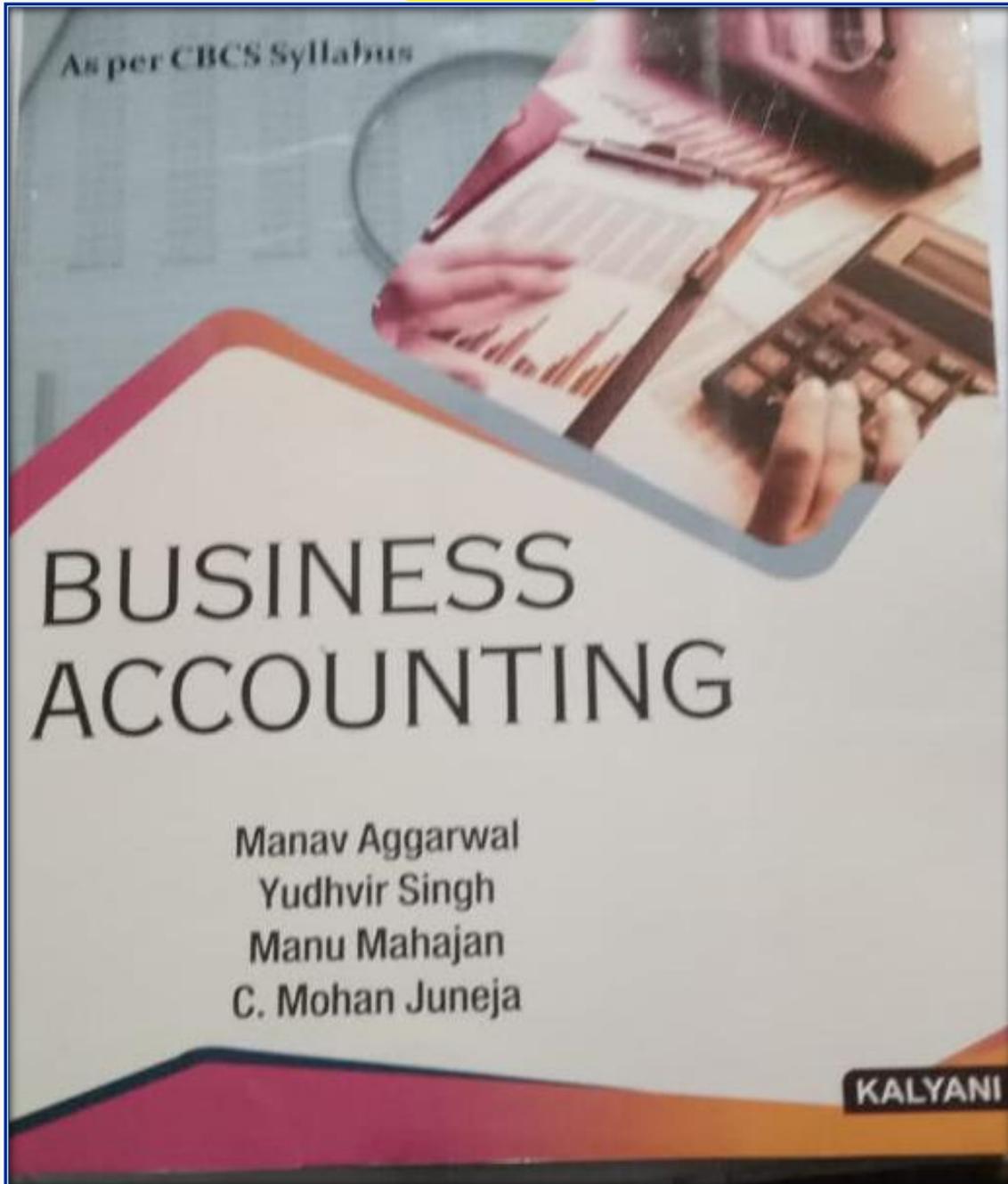
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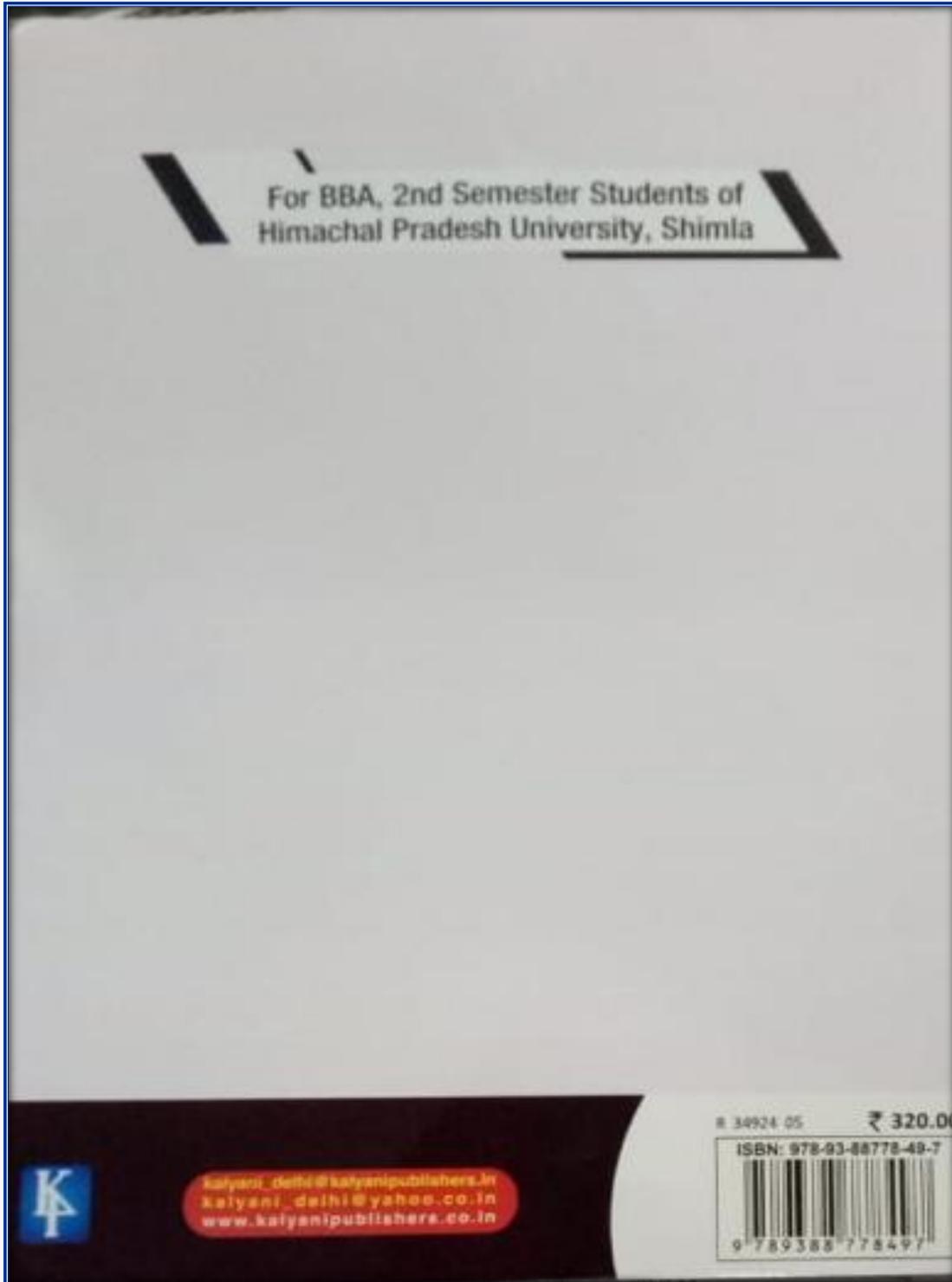
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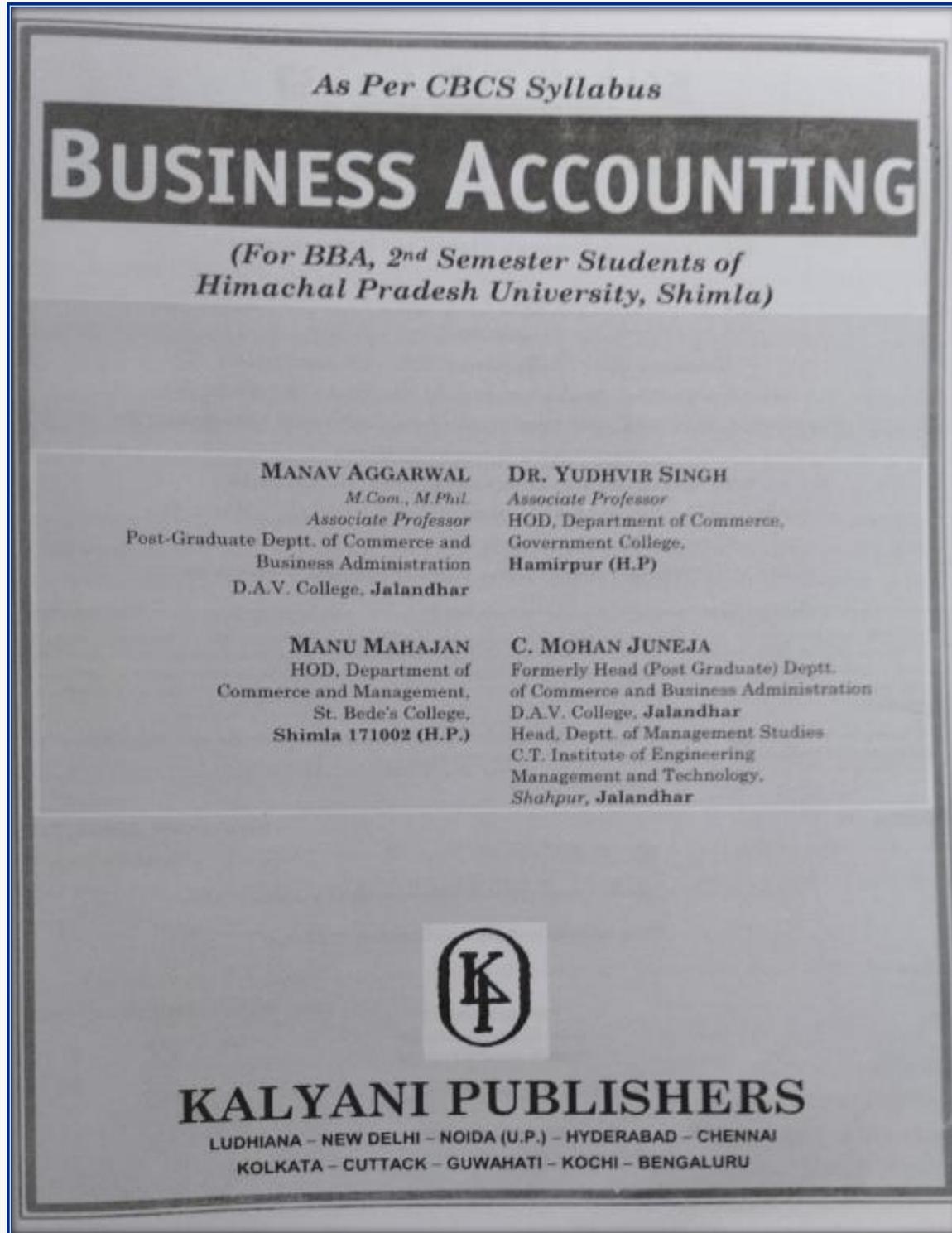
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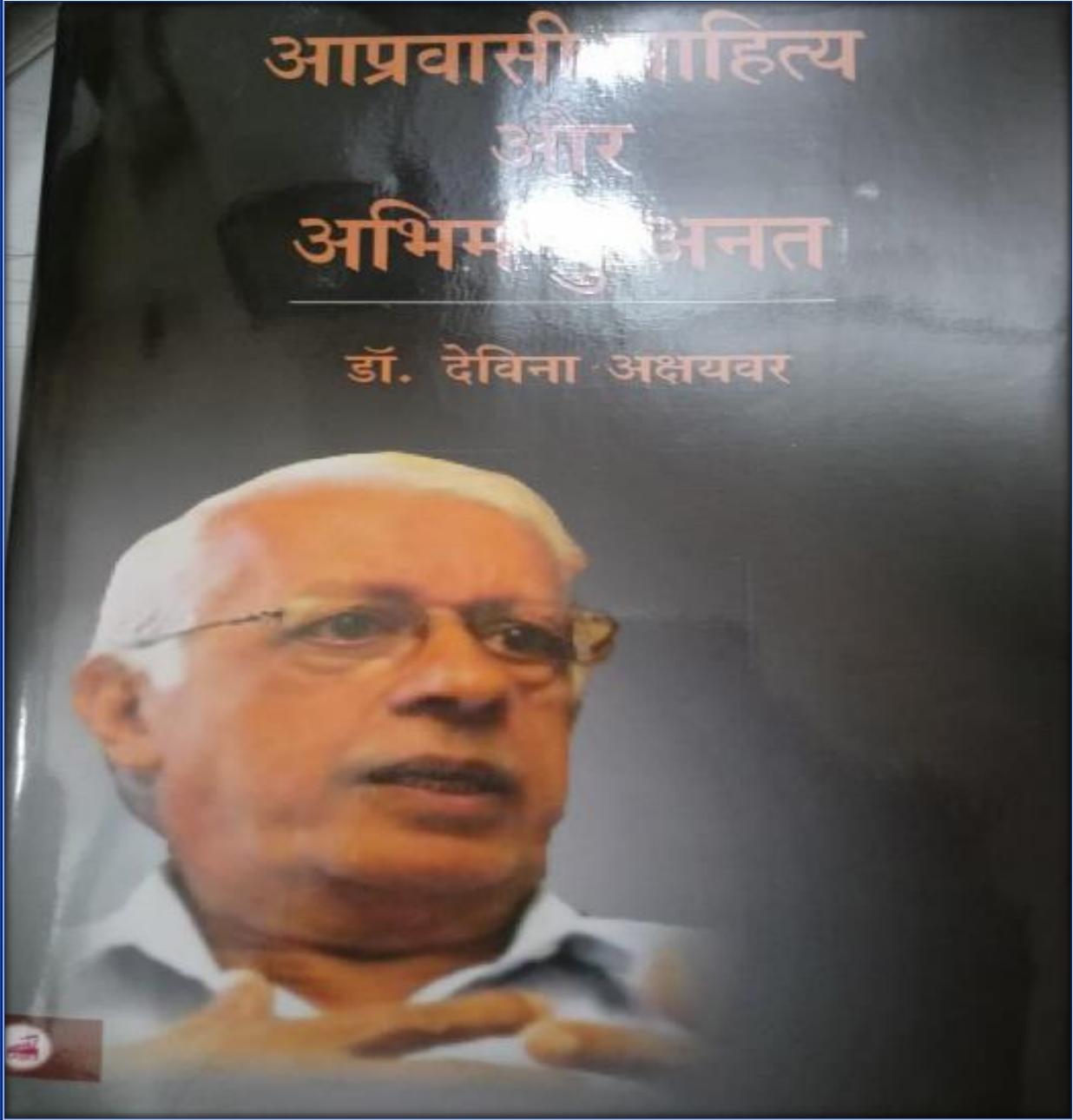
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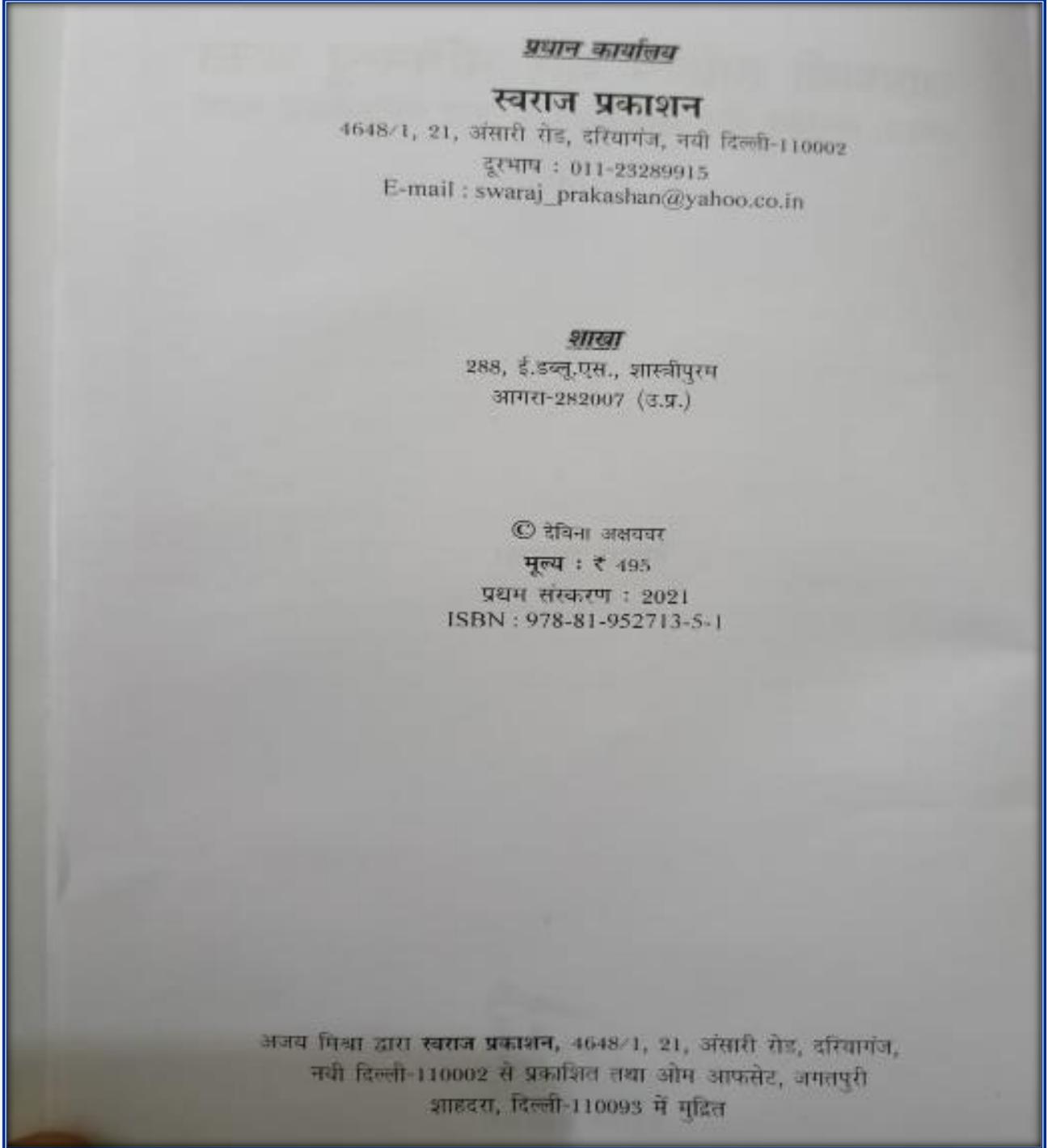
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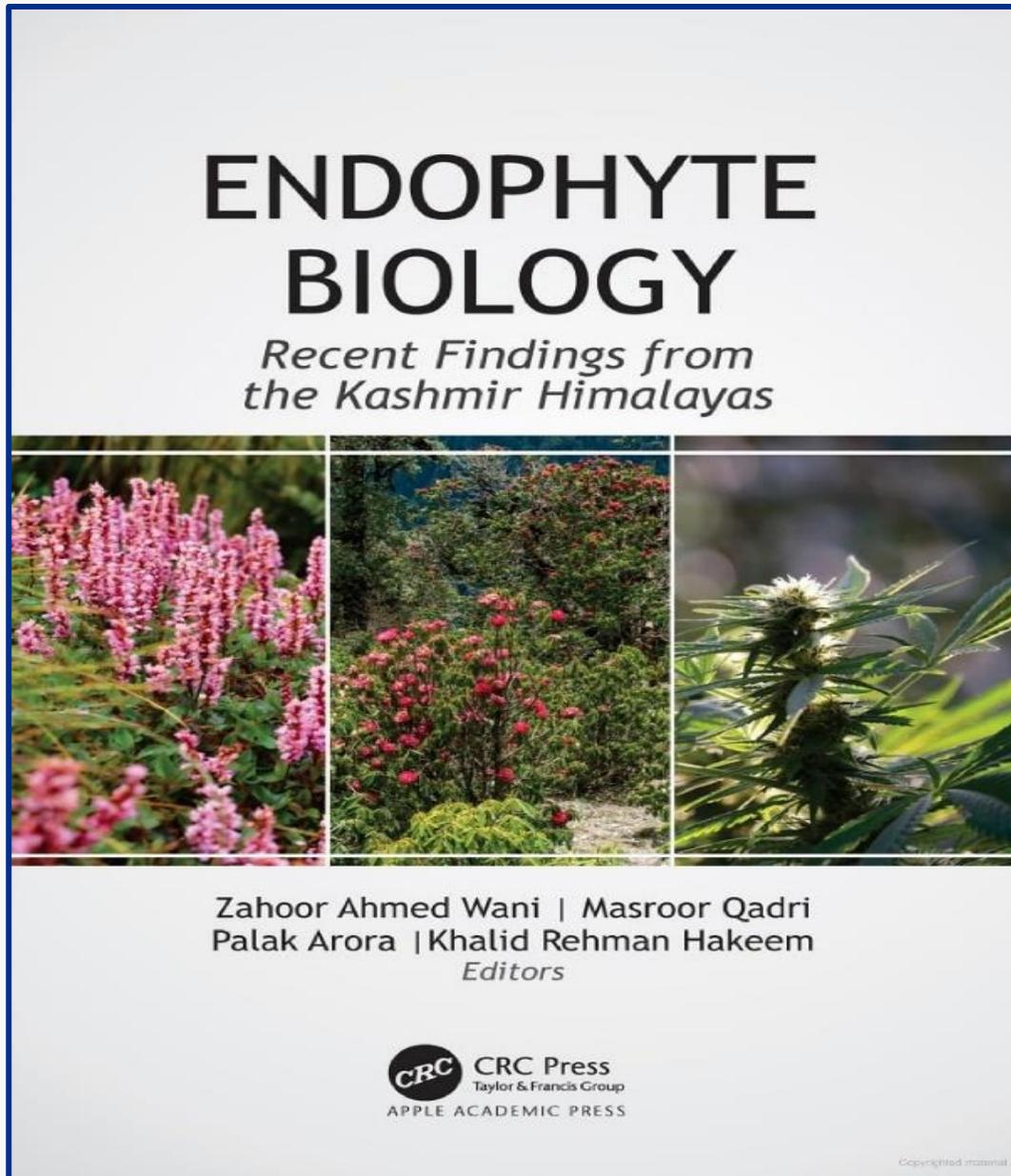
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which indicate that fungus augments orchid development through regulation of various transcription factors (DMI, NSP, WRKY, GRAS, SWEET, CCaMK, ENOD1, TPP etc.), involved in plant growth and development. In addition to this, tissue culture studies involving symbiotic seed germination and further development in the presence of the specific mycorrhizal partner, promotes seed germination and robustness of the seedlings. The studies on orchid mycorrhizal associations provide a conceptual framework to understand the mechanisms of selection of fungal partner, establishment of the symbiotic association, nutritional aspects, and ecological adaptations. The present chapter provides an outline on possible physiological, molecular and ecological approaches involved in the study of OMF interactions.

14.1 INTRODUCTION

It is believed that almost all land plants are, to some extent, engaged in symbiotic relationships with mycorrhizal fungi (Dickie et al., 2015). These mutually beneficial interactions act as important drivers of global plant biogeographical patterns (Delavaux et al., 2019). The interactions are constantly evolving where the mycorrhizal fungi have gradually widened their biotrophic capabilities to take advantage of their hosts for food and protection while the hosts have developed strategies to accommodate the fungal associates (Geure et al., 2020). Such relationship is quite crucial in Orchidaceae, where right from the germination of seed to the establishment seedlings, all the processes are positively correlated with successful mycorrhizal associations under natural conditions.

Orchids are well known worldwide for their unique and long-lasting flowers, and immense therapeutic properties. Presently, there are more than 28,000 species recorded across the globe (Govarts et al., 2020). Opting chiefly for an epiphytic life mode, and the presence of velamen tissue in roots, and labellum (lip), gynostegium (column), and compound pollens in flowers, are some of the important characteristic features, which make them different from other plants. They represent the pinnacle of plant evolution but still depend upon suitable fungi and pollinators to complete their life cycle. Orchid seeds are the smallest in plant kingdom and are produced in large numbers. These seeds lack necessary nutritional reserves to sustain its own germination, and this inability forms the basis of various orchid-mycorrhizal interactions (Rasmussen and Rasmussen, 2009). The fungus aids in germination of these microscopic, nonendospermic seeds by providing the requisite nutrients. This association is so important that the abundance

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and distribution of mycorrhizal fungi act as a key factor affecting orchid population dynamics (McCormick et al., 2019). According to McCormick and Jacquemyn (2014), orchid mycorrhizal fungi (OMF) not only drive the local abundance and dynamics of individual orchid populations but also influence the coexistence and the regional distribution of various orchid species.

Association of fungi with orchid roots was first observed by Reissek (1847), and Frank (1885) proposed the term mycorrhiza, for this association. Wöhlich (1886) and Junse (1897) later confirmed the occurrence of mycorrhizal fungi in orchids. Further research carried out by Bernard (1903, 1904) and Burgeff (1936, 1943, 1959) demonstrated that orchid seeds cannot germinate without these fungal association. Orchids remain associated with fungal mycelia at least at some stage of their life cycle, but the requirement is critical during the early stages of their development when ambient nutritional resources are scarce (Harley, 1963; Jacquemyn et al., 2012).

14.2 MYCORRHIZAL ASSOCIATION VARIES WITH ORCHID LIFE MODE

Mycorrhizal association is more prominent in terrestrial orchids (Rasmussen, 1995; Sathiyadash et al., 2020; Phillips et al., 2020) as the mycorrhizae aid in survival of ground growing taxa under comparatively harsher conditions by making them better adapted to their habitats (Burgeff, 1959; Rasmussen, 1995; Swarts and Dixon, 2009; Smith et al., 2010). The leafless mycoheterotrophs, which prefer to grow in moist and humus-rich habitats, possess comparatively stronger mycorrhizal obligation, which is usually lifelong (Vij and Sharma, 1983; McKendrick et al., 2000; Smith and Read, 2008; Matos et al., 2009; Merckx, 2013). Such orchids involve a wider variety of mycorrhizal fungi belonging to Glomeromycota, Basidiomycota, and Ascomycota, as well as some saprobic taxa of Agaricomycetes (like *Hydropus*, *Gymnopus*, *Marasmiellus*) and Sordariomycetes fungi (like *Clonostachys*, *Resinicium*), and also exhibit higher degree of specificity with respect to their association (Furman and Trappe, 1971; Richardson et al., 1993; Taylor and Bruns, 1997; McKendrick et al., 2000; Taylor et al., 2002; Tsujita et al., 2009; Deamaley et al., 2012). According to Merckx (2013), the retention of an entirely mycoheterotrophic state, where the plant remains totally dependent on the fungus even at maturity, has also evolved sporadically across Orchidaceae. Interestingly, under certain circumstances, the orchid seedlings also get carbon nutrition via ectomycorrhizal fungi which connect them with the roots of some

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neighboring autotrophic plants (Zelmer and Currah, 1995; Taylor and Bruns, 1997; McKendrick et al., 2000; Selseose and Roy, 2009; Rasmussen et al., 2015) thereby making them behave as epiparasites (exploitative association) on the later (Taylor and Bruns, 1997; Cullings et al., 1996; Bistarondo and Bruns, 2001; Ogura-Tsujita et al., 2009).

In epiphytic orchids, on the other hand, the mycorrhizal dependency is rather less as their protocorms become photosynthetic at early life stages (Hadley, 1982; Vij and Sharma, 1983; Arditi, 1992; Deamaley, 2007; Manoharachary and Tilak, 2015). These orchids can partially meet their mineral nutrition from dust, organic debris, and stemflow along the host bark (Arditi, 1992; Zettler et al., 2011; Rasmussen et al., 2015) and, therefore, generally have facultative mycorrhizal associations (Goh et al., 1992; Richardson et al., 1993; Rasmussen, 2002; Benzing, 2004; Motomura et al., 2008; Zott and Winkler, 2013). Comparatively lesser occurrence of pelotons in many adult epiphytic orchids has led some researchers to question their importance for plant nutrition, especially during their adulthood (Boyman et al., 2002). According to Rasmussen et al. (2015) and Phillips et al. (2020), our understanding about the mycorrhizal ecology of tropical epiphytic and lithophytic orchids is quite limited. Interestingly, habitat-driven mycorrhizal associations have also been indicated by Oja et al. (2015) and Rnibal et al. (2017) while investigating *Neottia ovata* and *Chiloglottis* populations growing in varied substrates and locations.

14.3 ORCHID MYCORRHIZAL FUNGI (OMF) HELP THE HOST IN MANIFOLD WAYS

Lack of chlorophyll and failure to utilize the available nutrient reserves make orchid seeds completely dependent upon their fungal associates for nutrition (Rasmussen and Rasmussen, 2009). OMF augment carbohydrate nutrition by breaking down the complex organic compounds in the soil substrate and facilitates their subsequent release in the orchid host (Rasmussen, 1995; Smith and Read, 1997; Deamaley, 2007; Mehra et al., 2016). This includes carbon (Smith, 1967; Alexander and Hadley, 1985; Trudell et al., 2003; Cameron et al., 2006, 2006; Bougoure et al., 2010; Rasmussen et al., 2015; Mehra et al., 2016), phosphorus (Alexander et al., 1984; Smith and Read, 1997; Cameron et al., 2007; Nurfadhili et al., 2013; Zhao et al., 2014), nitrogen (Burgeff, 1936; Barrosso et al., 1986; Rasmussen, 1995; Smith and Read, 1997; Trudell et al., 2003; Cameron et al., 2006; Bougoure et al., 2010; Nurfadhili et al., 2013; Diag et al., 2014; Zhao et al., 2014; Rasmussen et al., 2015), water

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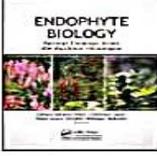
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**Endophyte Biology**  
Recent Findings from the Kashmir Himalayas

Editors: Zahoor Ahmed Wani, PhD  
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Palak Arora, PhD  
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**This volume, *Endophyte Biology: Recent Findings from the Kashmir Himalayas*, is a unique compilation of the original, latest, and updated information on endophyte biology of the Kashmir Himalayas. The book presents an introduction to and definition of endophytes, the endophytic diversity of some important plants of the Kashmir Himalayas, bioprospection of endophytes for various drug metabolites, sustainable agriculture, and more. This book discusses the applications of endophytes in the agriculture, aroma, and pharmaceutical industries.**

Endophyte biology, the study of microorganisms, often fungi and bacteria, which live within living plant tissues, is an emerging discipline of science with a multitude of applications in ecology, agriculture, and industry. Despite having huge diversity of plants, the information about the endophyte biology is still in its infancy in this part of the world, and this book is an attempt to bridge the information gap on endophyte biology pertaining to the Kashmir Himalayas.

This book will serve as a manual for research scholars as it presents the methodologies and techniques involved in endophyte biology research that can be applied in other regions of the world. Supplemented with illustrations, figures, and tables, the volume is a valuable reference for teachers and students at graduate and undergraduate level in colleges and universities as well as for scientists, researchers, and others.

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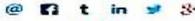
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