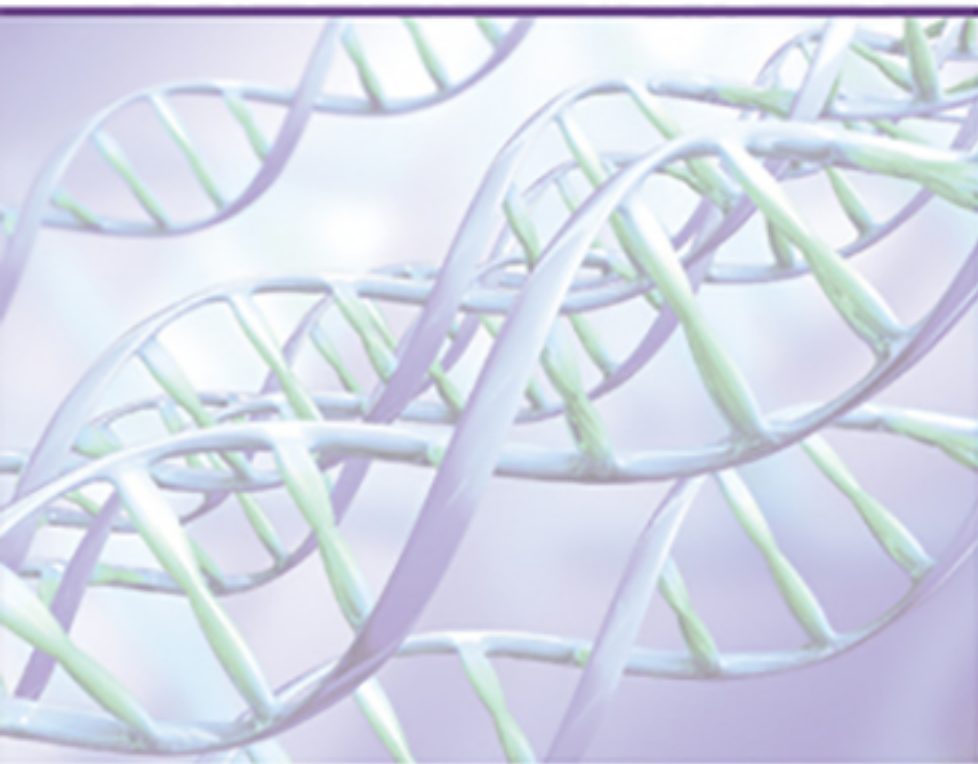


**Revised Edition** as per Latest CBSE/ISC Syllabi

# A Textbook of Biotechnology

with Biotechnology Practicals

For Class - XI



**Dr. R.C. DUBEY**



# A TEXTBOOK OF **BIOTECHNOLOGY**

*with* Biotechnology Practicals

**For CLASS – XI**

As per the CBSE Course Structure and the NCERT Guidelines  
(Also Useful for Class–XI Students of ISC and Other Indian State Boards)

**Dr. R.C. DUBEY**

M.Sc., Ph.D., F.B.S., F.P.S.I, F.N.R.S.

*Professor*

Department of Botany and Microbiology

Gurukul Kangri University

Haridwar–249 404 (Uttarakhand)



**S. CHAND & COMPANY PVT. LTD.**

(AN ISO 9001 : 2008 COMPANY)

RAM NAGAR, NEW DELHI - 110 055



# S. CHAND & COMPANY PVT. LTD.

(An ISO 9001 : 2008 Company)

Head Office: 7361, RAM NAGAR, NEW DELHI - 110 055

Phone: 23672080-81-82, 9899107446, 9911310888

Fax: 91-11-23677446

Shop at: [schandgroup.com](http://schandgroup.com); e-mail: [info@schandgroup.com](mailto:info@schandgroup.com)

*Branches :*

- AHMEDABAD** : 1st Floor, Heritage, Near Gujarat Vidhyapeeth, Ashram Road, **Ahmedabad** - 380 014, Ph: 27541965, 27542369, [ahmedabad@schandgroup.com](mailto:ahmedabad@schandgroup.com)
- BENGALURU** : No. 6, Ahuja Chambers, 1st Cross, Kumara Krupa Road, **Bengaluru** - 560 001, Ph: 22268048, 22354008, [bangalore@schandgroup.com](mailto:bangalore@schandgroup.com)
- BHOPAL** : Bajaj Tower, Plot No. 2&3, Lala Lajpat Rai Colony, Raisen Road, **Bhopal** - 462 011, Ph: 4274723, 4209587, [bhopal@schandgroup.com](mailto:bhopal@schandgroup.com)
- CHANDIGARH** : S.C.O. 2419-20, First Floor, Sector - 22-C (Near Aroma Hotel), **Chandigarh** -160 022, Ph: 2725443, 2725446, [chandigarh@schandgroup.com](mailto:chandigarh@schandgroup.com)
- CHENNAI** : No.1, Whites Road, Opposite Express Avenue, Royapettah, **Chennai** - 600014 Ph. 28410027, 28410058, [chennai@schandgroup.com](mailto:chennai@schandgroup.com)
- COIMBATORE** : 1790, Trichy Road, LGB Colony, Ramanathapuram, **Coimbatore** -6410045, Ph: 2323620, 4217136 [coimbatore@schandgroup.com](mailto:coimbatore@schandgroup.com) (**Marketing Office**)
- CUTTACK** : 1st Floor, Bhartiya Tower, Badambadi, **Cuttack** - 753 009, Ph: 2332580; 2332581, [cuttack@schandgroup.com](mailto:cuttack@schandgroup.com)
- DEHRADUN** : 1st Floor, 20, New Road, Near Dwarka Store, **Dehradun** - 248 001, Ph: 2711101, 2710861, [dehradun@schandgroup.com](mailto:dehradun@schandgroup.com)
- GUWAHATI** : Dilip Commercial (1st floor), M.N. Road, Pan Bazar, **Guwahati** - 781 001, Ph: 2738811, 2735640 [guwahati@schandgroup.com](mailto:guwahati@schandgroup.com)
- HYDERABAD** : Padma Plaza, H.No. 3-4-630, Opp. Ratna College, Narayanaguda, **Hyderabad** - 500 029, Ph: 27550194, 27550195, [hyderabad@schandgroup.com](mailto:hyderabad@schandgroup.com)
- HALDWANI** : Bhatt Colony, Callibanori, Mukhani, **Haldwani** -263139 (**Marketing Office**) Mob. 09452294584
- JAIPUR** : 1st Floor, Nand Plaza, Hawa Sadak, Ajmer Road, **Jaipur** - 302 006, Ph: 2219175, 2219176, [jaipur@schandgroup.com](mailto:jaipur@schandgroup.com)
- JALANDHAR** : Mai Hiran Gate, **Jalandhar** - 144 008, Ph: 2401630, 5000630, [jalandhar@schandgroup.com](mailto:jalandhar@schandgroup.com)
- KOCHI** : Kachappilly Square, Mullassery Canal Road, Ernakulam, **Kochi** - 682 011, Ph: 2378740, 2378207-08, [cochin@schandgroup.com](mailto:cochin@schandgroup.com)
- KOLKATA** : 285/J, Bipin Bihari Ganguli Street, **Kolkata** - 700 012, Ph: 22367459, 22373914, [kolkata@schandgroup.com](mailto:kolkata@schandgroup.com)
- LUCKNOW** : Mahabeer Market, 25 Gwynne Road, Aminabad, **Lucknow** - 226 018, Ph: 4076971, 4026791, 4065646, 4027188, [lucknow@schandgroup.com](mailto:lucknow@schandgroup.com)
- MUMBAI** : Blackie House, IInd Floor, 103/5, Walchand Hirachand Marg, Opp. G.P.O., **Mumbai** - 400 001, Ph: 22690881, 22610885, [mumbai@schandgroup.com](mailto:mumbai@schandgroup.com)
- NAGPUR** : Karnal Bagh, Near Model Mill Chowk, **Nagpur** - 440 032, Ph: 2720523, 2777666 [nagpur@schandgroup.com](mailto:nagpur@schandgroup.com)
- PATNA** : 104, Citicentre Ashok, Mahima Palace, Govind Mitra Road, **Patna** - 800 004, Ph: 2300489, 2302100, [patna@schandgroup.com](mailto:patna@schandgroup.com)
- PUNE** : Sadguru Enclave, Ground floor, Survey No. 114/3, Plot no. 8 Alandi Road, Vishrantwadi **Pune** - 411015 Ph: 64017298 [pune@schandgroup.com](mailto:pune@schandgroup.com)
- RAIPUR** : Kailash Residency, Plot No. 4B, Bottle House Road, Shankar Nagar, **Raipur** - 492 007, Ph: 2443142, Mb. : 09981200834, [raipur@schandgroup.com](mailto:raipur@schandgroup.com) (**Marketing Office**)
- RANCHI** : Shanti Deep Tower, Opp. Hotel Maharaja, Radium Road, **Ranchi**-834001 Mob. 09430246440 [ranchi@schandgroup.com](mailto:ranchi@schandgroup.com)
- SILIGURI** : 122, Raja Ram Mohan Roy Road, East Vivekanandapally, P.O., Siliguri, **Siliguri**-734001, Dist., Jalpaiguri, (W.B.) Ph. 0353-2520750 (**Marketing Office**) [siliguri@schandgroup.com](mailto:siliguri@schandgroup.com)
- VISAKHAPATNAM** : No. 49-54-15/53/8, Plot No. 7, 1st Floor, Opp. Radhakrishna Towers, Seethammadhara North Extn., **Visakhapatnam** - 530 013, Ph-2782609 (M) 09440100555, [visakhapatnam@schandgroup.com](mailto:visakhapatnam@schandgroup.com) (**Marketing Office**)

© 2004, Dr. R.C. Dubey

**All rights reserved.** No part of this publication may be reproduced or copied in any material form (including photocopying or storing it in any medium in form of graphics, electronic or mechanical means and whether or not transient or incidental to some other use of this publication) without written permission of the copyright owner. Any breach of this will entail legal action and prosecution without further notice.

**Jurisdiction :** All disputes with respect to this publication shall be subject to the jurisdiction of the Courts, Tribunals and Forums of New Delhi, India only.

First Edition 2004

Subsequent Editions and Reprints 2007, 2010

**Fourth Revised Edition 2014**

ISBN : 81-219-2417-0

Code : 03C 310

PRINTED IN INDIA

By Rajendra Ravindra Printers Pvt. Ltd., 7361, Ram Nagar, New Delhi -110 055

and published by S. Chand & Company Pvt. Ltd., 7361, Ram Nagar, New Delhi -110 055.

# PREFACE TO THE FOURTH EDITION

The scope of Biotechnology is increasing day-by-day due to its gradually increasing demand in multifarious ways. Consequently, the readers must be made available the current information on Biotechnology. This book is solely based on the syllabus of the CBSE, but it also meets the demand of the readers of the other educational boards such as CISCE, ICSE/ISC, State Education Boards like Odisha, J & K, etc. The author feels the pleasure to bring out the fourth edition of this book.

In this edition some new materials as required by the other boards have been incorporated wherever required without disturbing the shape of the CBSE syllabus.

Subject Index has been prepared and given at the end of the book to ease the students for searching out the concerned topics.

This revised and updated edition contains the latest information on different relevant areas of Biotechnology streamlining the study of this fast emerging discipline in various universities. Students will find this edition highly useful as per their requirements.

I am thankful to the management and the editorial team of S.Chand & Company Pvt. Ltd., New Delhi for help and support in publication of this edition.

I hope this edition will meet the requirements of the students via supplying new information. Any comment, from the readers for the improvement of the book will be highly appreciated.

**Dr. R.C. DUBEY**

Email:profrcdubey@gmail.com

**Disclaimer :** While the author of this book has made every effort to avoid any mistake or omission and has used his skill, expertise and knowledge to the best of their capacity to provide accurate and updated information. The author and the publisher do not give any representation or warranty with respect to the accuracy or completeness of the contents of this publication and are selling this publication on the condition and understanding that they shall not be made liable in any manner whatsoever. The publisher and the author expressly disclaim all and any liability/responsibility to any person, whether a purchaser or reader of this publication or not, in respect of anything and everything forming part of the contents of this publication. The publisher shall not be responsible for any errors, omissions or damages arising out of the use of the information contained in this publication. Further, the appearance of the personal name, location, place and incidence, if any; in the illustrations used herein is purely coincidental and work of imagination. Thus the same should in no manner be termed as defamatory to any individual.



# PREFACE TO THE FIRST EDITION

Due to gradually increasing population day-by-day, human demand is also increasing accordingly. But the natural resources are limited. Hence, there is an urgent need to make the students aware of future limitations and problems, and create interest in expansion of the subject. Today, some of the biotech products are available in the market and many more are under trials. For example, yeast is producing *insulin* which is basically produced by mammals, and DNA fingerprinting has become a basic tool in forensic science.

Biotechnology is a fascinating interdisciplinary subject which emerged in recent past and being taught at undergraduate and postgraduate levels in most of the Universities in India. The author has earlier published *S.Chand's Biotechnology* for use by the university students.

However, **S.Chand's Biotechnology for Class–XI** is written solely as per syllabus prescribed by the Central Board of Secondary Education (CBSE) for Class–XI. This book provides an understanding of up-to-date information on the concerned topics. Language of the book is simple, lucid and concise. Being interdisciplinary area, the subject is very vast. But in order to make the subject easy to understand, the text of the book has been illustrated with simplified well-labelled diagrams. The author has tried to arrange the matter in such a way that can make continuity of the subject and maintain curiosity of the students. This book has been brought out in **multicolour edition**.

The highlights of the book are: (i) important points written in Boxes, (ii) addition of six different types of questions at the end of each chapter such as very short answer type questions, short answer type questions, long answer type questions, matching type questions, fill in the blanks and multiple choice (objective type) questions with their answers (for competitive examinations).

All practicals prescribed by the CBSE on the subject are given at the end of **S. Chand's Biotechnology for Class–XII**. Students are advised to consult this book for carrying out exercises.

The author expresses his sincere thanks to Mr. R.K. Gupta, CMD, S. Chand & Company Ltd. for his interest in publication of this book in multicolour. I am told that this is the first Textbook of Biotechnology in India that has been brought out in multicolour. Thanks are also due to Shri Navin Joshi, (General Manager, Sales and Marketing) and Shri Shishir Bhatnagar (Editor) S. Chand & Co. Ltd. for their help, suggestions and in bringing out the book in a short period.

Last but not the least, I extend thanks to my wife and son for their endurance, and daughters for preparation of neat and clean diagrams of the book.

Reader's perception in the form of constructive comments and suggestions for improvement of the book will be highly appreciated.

**Dr. R.C. DUBEY**



# CBSE/ISC SYLLABUS AND COURSE STRUCTURE

Class–XI

(Theory)

One Paper

Time: Three hours

Maximum Marks: 70

Unit I	: Introduction to Biotechnology .....	10
Unit II	: Biomolecules .....	20
Unit III	: Cell and Development.....	20
Unit IV	: Genetics and Molecular Biology .....	20

## PRACTICALS

Time: Three hours

Maximum Marks: 30

Two experiments .....	20
Viva Voce .....	5
Practical record .....	5

### UNIT I. INTRODUCTION TO BIOTECHNOLOGY

#### I. Overview

Definition, historical perspectives, Scope and importance, Commercial potential, An interdisciplinary challenge, A quantitative approach, Classical vs modern concepts, Manufacturing quality control, Product safety, Good manufacturing practices, Good laboratory practices, Biotechnology in India and global trends.

#### II. Fundamentals of Biochemical Engineering

Concept of pH, Buffer, Physical variables, Dimensions and units, Measurement conversions, Physical and chemical property data, Stoichiometry, Errors in data and calculations, Absolute and relative uncertainty, Types of error, Statistical analysis, Presentation of experimental data, Data analysis, Trends, Testing of mathematical models, Goodness of fit, Use of graph paper with logarithmic coordinates, General procedure for plotting data, Process flow diagrams, Materials and energy balance, Fluid flow and mixing, Heat transfer, Mass transfer, Unit operations, Homogeneous reactions, Heterogeneous reactions, Reactor engineering.

#### III. Biotechnology and Society

Public perception, Role of science, Engineering, Arts, Commerce, Patenting- Criterion for patents, Discovery vs invention, Product and process patent, Reading a patent, National and International patent laws, Varietal protection, Patenting of biological systems, Ethical issues in agriculture and health care.

### UNIT II. BIOMOLECULES

#### I. Nature of Biomolecules

Building blocks, functional groups found in biomolecules, Optical activity/stereochemistry, Conformation and Configuration, Chirality, Properties: Physical and Chemical, biochemical transformation Oxidation, Reduction, Cleavage of C-C bonds, Group (Supramolecular assembly), Biomolecular databases.

#### II. Structure and Function

Nucleic acids- RNA and DNA and their structure, Proteins- the three dimensional structure, Function; Enzymes- Rate of enzymatic reactions, Enzymatic catalysis; Carbohydrates- structure

and function, Metabolic pathways of breakdown of carbohydrates- Glycolysis, Glycogen metabolism; Transport through membranes, Citric acid cycle, Electron transport and oxidative phosphorylation; Fermentation; Photosynthesis- chloroplasts, light and dark reactions, Photophosphorylation, Carbon dioxide fixation and synthesis of carbohydrates, Vitamins and Co-enzymes; Minerals, Lipid and Biological membranes, Nitrogen metabolism.

### **III. Biochemical Techniques**

Based on molecular weight: Vapour/osmotic pressure, Centrifugation, Gel-permeation, Electrophoresis, Mass-spectrometry, based on spectroscopy: Colorimetry, UV-VIS spectrophotometry, Fluorescence, IR, X-rays; Based on charge/polarity: Partial chromatograph, Ion exchange, Iso-electric focussing, Hydrophobic interaction; Based on solubility: salt precipitation, Organic solvent precipitation.

## **UNIT III. CELL AND DEVELOPMENT**

### **I. The Basic Units of Life**

Cell structure and components- Nucleus, Mitochondria, Chloroplasts, Ribosomes and other cell inclusions, various kinds of tissue and organs in animals and plants; Evolution of populations (speciation) and Biodiversity; Adaptation and natural selection; Organisation of life, Size and complexity- microbial, plant and animal world; Interaction with the environment.

### **II. Cell growth and Development**

Cell division and cell cycle, Cell communication and Signal transduction pathways, Movement, Nutrition, Gas exchange, Internal transport, Maintaining the internal environment, Reproduction in microbes, plants, animals and humans; Animal and plant development, Apoptosis; Immune response in animal and humans; Defence mechanisms in plants, Plant-pathogen interaction, Secondary metabolism; Defence strategies in microbes and insects.

### **III. Cellular Techniques**

Microscopy, Centrifugation technique; Cell fractionation and sorting; Cell growth determination; Mitotic index.

## **UNIT IV. GENETICS AND MOLECULAR BIOLOGY**

### **I. Principles of Genetics**

Historical perspectives, Mendelian genetics; The role of chromosomes in inheritance, Multiple alleles, Linkage and crossing over, Genetic recombination; Genetic mapping, Gene interaction, Sex-linked inheritance, Extranuclear inheritance, Quantitative inheritance, Genes at the population level, Discovery of genetic material; Mutagenesis- genome, Chromosomal and gene mutations, Molecular mechanisms of mutation; Transposons; DNA repair, Genetic disorder, Plant and animal breeding.

### **II. Genome Function**

Genome organisation, DNA replication, Fine structure of gene, From gene to protein- Transcription, Genetic code and Translation; Regulation of Gene expression in prokaryotes and eukaryotes; Genetic basis for development; Genetics of cancer; Immunogenetics, Evolutionary genetics.

### **III. Genetical Techniques**

Chromosome techniques, Chromosome stains, Chromosome banding techniques, Karyotyping, Chromosome painting, Mutagenic techniques, Physical (UV, X rays/gamma rays) and chemical (NTG/EMS) mutagenesis; Recombination in bacteria; Breeding methods in plants; Pedigree analysis in humans; DNA isolations.

# C O N T E N T S

## UNIT – I

### INTRODUCTION TO BIOTECHNOLOGY

#### **1. Introduction 3-35**

*History of biotechnology*; Definitions; Traditional biotechnology- the kitchen technology; Modern biotechnology; Classical versus modern concept; Emergence of modern biotechnology; Scope and importance; current excitement about biotechnology; Human Genome Project; Role of Celera Genomics; Objectives of HGP; Benefits from HGP; Whose genome was sequenced; genomics and proteomics; bioinformatics; bioremediation; *Biotechnology as an inter-disciplinary area*; *Potential of modern biotechnology*; *Fermentation technology*; Fermentor; Principles of microbial growth; Optimization of fermentor; Aseptic operation; Scale up; *Manufacturing quality control*; *Good manufacturing practices*; *Good laboratory practices (GLP)*; Application of GLP; Functioning of GLP; *Product safety and Biosafety*; Clinical trials of biotech pharmaceutical products; Biosafety; *Marketing - national and international*, biotechnology market in India, international biotechnology marketing; *Biotechnology in India and Global trends*; *Global scenario*; Test questions.

#### **2. Biotechnology and Society 36-55**

*Public perception of biotechnology*; (Biosafety; Societal participation; *Intellectual Property Rights (IPR) and Intellectual Property Rights Protection (IPP)*); Intellectual property; Discovery versus invention, IPR, IPP- varietal protection; *Forms of IPR*; Benefits of patents; *Biological inventions to be patented*; Product patent; Process invention; Product invention; Reading a patent, Patent status; International scenario; Paris convention, UPOV, Strasbeg I Convention; PCT; European Patent Convention, Budapest Treaty, OECD; WTO; National Scenario Ethical, legal and social issues, Ethical issues in agriculture and healthcare, growing genetically engineered crops, ethical debate on patenting life, organ transplantation and embryological tissue, xenotransplantation debate, Tackling ethical, legal and social issues, Human embryo cloning and beyond; (in agriculture and healthcare), Test questions.

#### **3. Biochemical Engineering I: Basic Concepts 56-83**

Concept of  $pH$ ;  $pH$  scale; Bronsted-Lowry concept for acid and bases;  $pH$  and  $pOH$ ; Buffer; Determination of  $pH$  of a solution of weak acid; buffering capacity; Physical variables; substantial and natural variables; Dimensions and Units; dimensional and homogeneity, Units; Measurements and Conventions; Physical and chemical property data; Stoichiometry; Process flow diagram; Material balance; Fluid flow and mixing; Mass transfer; Heat transfer; Unit operation; Homogeneous reactions; growth media; growth kinetics and fermentation process; effect of temperature on Growth; associated and non-growth associated products; Reactor engineering; large scale production; Test questions.

## **4. Biochemical Engineering II : Statistical Data Analysis 84-96**

*Data and its measurement*; Types of statistical data; Bases of classification- quantitative; qualitative; temporal and spatial; absolute and relative uncertainty; *Errors in data calculation*; Types of errors; Accuracy and precision; *Statistical data analysis*; *Presentation of experimental data*; *Data analysis*; Reporting result; data processing; *Trends*; *Testing mathematical models*; Normal distribution; Binomial distribution; Poisson distribution; log normal; Geometric distribution; Goodness of fit; Concept of probability, Uses of graph paper with logarithmic coordinate and plotting data; plotting of data on X and Y axis; plotting data of small range; Test questions.

<p style="text-align: center;"><b>UNIT – II</b> <b>BIOMOLECULES</b></p>
---

## **5. Nature of Biomolecules :Building Block Structure and Dynamics 99-121**

*Sugars and derivatives- Building blocks of carbohydrates*; Classification of carbohydrates; monosaccharides; oligosaccharides; polysaccharides; Chemical properties of sugars; *Amino acids - Building blocks of proteins*; Chemical properties of amino acids; Vitamins and co-enzymes; *Simple fatty acids sphingosine, glycerol and cholesterol- building blocks of lipids*; Chemical properties of lipids; hydrolysis; saponification; hydrogenation dehydration; *Nucleotides- building blocks of nucleic acids*; Chemical properties of nucleotides; *Stereochemistry of biomolecules*; Optical isomerism; plane of symmetry; conditions for optical activity; polarity; Geometric isomerism; Conformation and Configuration; *Precursor-product relationship*; *Supramolecular assembly*, Applications of supramolecular assembly; *Molecular biology database*; Test questions.

## **6. Biotransformations 122-151**

Biochemical Transformation; *Carbohydrate metabolism*; Structure of ATP and bond energy; Catabolism- glycolysis; Krebs cycle; electron transport chain; Fermentation; Biotechnological significance of study of metabolic pathways; *Photosynthesis*; Photosynthetic machinery and pigments; Photosystems I and II; Interaction of PS I and PS II; Dark reaction (C<sup>3</sup> Cycle)-carboxylation; reduction; regeneration; Role of RUBISCO; C<sub>4</sub> Cycle; *N<sub>2</sub> Fixation*; Nitrification; assimilation; Biological N<sup>2</sup> fixation; *nif* genes; nitrogenase; Mechanism of action of nitrogenase; Symbiotic N<sub>2</sub> fixation in legumes; Biotechnological importance of study of N<sup>2</sup> fixation; Test questions.

## **7. Macromolecules: Structure and Functions 152-175**

*Carbohydrates*; Groups of polysaccharides; glycogen; cellulose; peptidoglycan; *Proteins*; Chemical structure of proteins; Special features of proteins; Protein sequencing; Sanger's method; Edmons method; 3-D' structure; secondary structure;  $\alpha$ -helix;  $\beta$ -pleated seats; Tertiary structure; Quaternary structure; *Enzymes*; Properties of enzymes; Classification; Achievements of rate of reaction; Active sites and Enzyme activity; Determination of enzyme activity; *Lipids and biomembrane*; *Nucleic acids*; RNA; DNA; 3-D' model; Circular and superhelical DNA; Test questions.

## 8. Biochemical Techniques

176-198

*Techniques based on molecular weight*; Centrifugation; principles of sedimentation; differential sedimentation; density gradient centrifugation; types of centrifuges; Gel permeation; Osmotic pressure; *Techniques based on polarity*; Ion-exchange chromatography; matrix quality; separation of solutes; Electrophoresis; types of electrophoresis; starch gel; PAGE; SDS-PAGE; agarose gel; immuno-electrofocusing; iso-electric focusing; Hydrophobic interactions; Partition chromatography-normal phase and reverse phase partition chromatography; *Techniques based on spectroscopy*; Colorimetry; UV-VIS spectrophotometry; Infra red spectroscopy; Fluorescence spectroscopy; Mass spectrometry; X-ray crystallography; *Techniques based on solubility*; Salt precipitation, Organic solvent precipitation; Test questions.

<b>UNIT – III</b> <b>CELL AND DEVELOPMENT</b>
--

## 9. The Basic Unit of Life

201-243

Cell types (*prokaryotes and eukaryotes*); Cell size; Different forms of prokaryotes; Structure of bacterial cells, (*capsule, flagella-structure of flagella*); pili and fimbriae; Cell wall, Plasma membrane; Cytoplasm; Inclusion bodies; Plasmids; Compartmentalization of organelles; *The eukaryotes (Cell structure and components)*; Cell wall; Structure of cell wall (primary, secondary and tertiary cell wall); Function of cell wall; Cell membrane; lipids; proteins; function of cell membrane; Protoplasm; Cell organelles; nucleus; endoplasmic reticulum; ribosomes; Golgi complex; lysosomes; peroxisomes; Mitochondria; plastids; cytoskeleton; *Multicellularity among plants and animals*; Unicellular organisms; Multicellular organisms, Advantages and disadvantages of multicellularity; *Tissues and organs*; Plant tissues; Simple tissues such as parenchyma; collenchyma; sclerenchyma; Complex tissues such as xylem and phloem; Animal tissues; Epithelial tissues and its types; connective tissues, muscle tissues; nervous tissues; Organs; Evolution of population; (gene pool, gene frequencies); Factors causing variation in population; non-random breeding; genetic drift; genetic load; gene flow; Disease resistant and susceptible genes in population, pharmacogenetics and pharmacogenomics: *Speciation*; Allopatric; Sympatric speciation- pre-mating and post-mating isolation; *Biodiversity*; Genetic and ecological diversity; Importance of Biodiversity; Conservation of Biodiversity; *Adaptation*; *Natural selection*; *Organization of life*; *Size and complexity*; *Environmental interactions*; Test questions.

## 10. Cell Growth and Development

244-282

*Cell division and cell growth*; Amitosis; Mitosis; prophase; metaphase; anaphase; telophase and cytokinesis; regulation of mitosis; Meiosis; prophase I; metaphase I; anaphase I; telophase I; Meiosis II; Significance of cell division Cell cycle; regulation of cell cycle; *Cell communication and signal transduction*; Recognition of extracellular signal molecules; Forms of signalling; paracrine; synaptical signalling; endocrinal signalling; Signal transduction pathway; *Movement*; Non-muscular movement; amoeboidal; ciliary or flagellar movement; Muscular movement; *Nutrition*; Nutrition in microorganisms; Plant nutrition; symbiosis; Animal nutrition; role of enzymes in nutrition; *Gaseous exchange*; Gaseous exchange in plants and protists; Surface for gas exchange; cell surface; skin; trachea; gills; alveoli; *Internal transport*; Internal transport in plants; mass flow hypothesis; cohesive theory; Internal transport in animals; open circulatory system; closed

circulatory system; double circulation system; *Maintaining the internal environment*; Regulation of water; in plants and animals; Regulation of temperature in plants and animals; *Reproduction*; Reproduction in prokaryotes; transformation; conjugation; transduction; Reproduction in plants; asexual reproduction; Sexual reproduction in flowering plants; Reproduction in animals; binary fission; multiple fission and regeneration; sexual reproduction; Reproduction in humans; male reproductive systems; Female reproductive system; Fertilization; *Animal and plant development*; Test questions.

## **11. Defense Mechanism in Organism (Microbes, Plants, Insects and Humans) 283-306**

*Defense strategies in microbes*; Defense strategies in bacteria- presence of capsule; R plasmid; Production of endospores, exospores and cysts; competitiveness; Defense strategies in fungi; presence of biochemical characteristics; Defense through structural modifications; *Immune response in animals and humans*; Types of immunity; Cell mediated immune response; Humoral immunity; antigens; antibodies-structure and function; Antigen-antibody reactions; *Apoptosis*; Morphological changes in cells; Mechanism of apoptosis; *Defense strategies in insects*; Protective colouration; Mimicry; *Defense mechanism in plants*; Morphological and structural defense mechanism; Biochemical Defense mechanism; presence of inhibitory compounds; effect of osmotic pressure and permeability; phytoalexins; Defense through altered respiration and hypersensitive reactions; Abiotic stress-associated metabolites and proteins; *Plant-pathogen interaction*; Dispersal of pathogen; Interaction at plant surface; susceptibility and resistance; gene-for-gene relationship; pathogenesis; Role of enzymes and toxins in pathogenesis; Effect of infection on host's physiology; changes in permeability; reduction in photosynthesis; effect on respiration; Role of growth regulators in plant diseases; *Secondary metabolism*, Secondary microbial metabolites; Secondary plant metabolites; Test questions.

## **12. Cellular Techniques 307-321**

*Microscopy*; Light microscopy; bright-field microscope; dark-field microscope; phase contrast microscope; fluorescent microscope; Electron microscopy; transmission electron microscope; scanning electron microscope; *Cell sorting*; Fluorescent activated cell sorter; *Cell fractionation*; Homogenisation; Centrifugation; buoyant density-gradient centrifugation; Velocity sedimentation; *Cell growth determination*; Direct microscopic counting; Electronic particle counter; Pure culture-based counting such as pour plate method; spread plate method; serial dilution plate method; membrane filtration; most probable number; dry weight determination and biomass determination; turbidity measurement; absorbance measurement and cellular component estimation; Mitotic index, Test questions.

<b>UNIT – IV</b> <b>GENETICS AND MOLECULAR BIOLOGY</b>
---

## **13. Principles of Genetics 325-358**

Historical perspectives; Mendel's laws of inheritance; law of dominance; law of segregation; law of independent assortment; Incomplete dominance; Chromosomal theory of inheritance; Multiple alleles; Linkage and crossing over; genetic recombination; Genetic mapping; Gene interaction; Additive Gene interaction; non-additive gene interaction such as gene inhibition; complementary genes; supplementary genes; dominant epistasis; Sex-linked inheritance; Extranuclear inheritance;

maternal effect; plastid inheritance; mitochondrial inheritance; Quantitative inheritance; combined effect of genetic and environmental factors; kernel colour in wheat; skin colour in man; stature in man; Genes at population level; Hardy-Weinberg law; Discovery of DNA as genetic material; identification of transforming principle; Hershey and Chase experiment; Test questions.

## **14. Mutation, DNA Repair, Transposition, Plant and Animal Breeding** **359-385**

*Mutation*; Types of mutation; spontaneous and induced mutation; somatic and germ line mutation; mutation based on changes in amino acid sequences and functions; Mutation based on chromosome number; autopolyploidy; allopolyploids; aneuploids; Polyploidy in plants, chromosomal aberration Gene mutation; Molecular mechanism of mutation; tautomeric shift; depurination; deamination; alkylation; intercalation; photodimerization; Detection of mutagens; *Genetic disorders*; Disorders due to numerical abnormality in autosomes; Down's syndrome; Klinefelter's syndrome; Turner's syndrome; Uniparental Disomy, Disorders due to gene mutation in autosomes; alcaptonuria; phenylketonuria; albinism; sickle cell anaemia; Disorders due to Gene mutation in sex Chromosomes; Haemophilia; red-green colour blindness; Night blindness; Disorders due to gene incompatibility; Rh factor; melanomas; *DNA repair systems*; Mechanism of DNA repair; photoreactivation; excision repair; Nucleotide excision repair; SOS repair; *Transposons*; Structure of transposons, mechanism of transposition; *Animal breeding*; *Plant breeding*; Test questions.

## **15. Genome Function** **386-425**

*Genome organisation*; Viral genome; overlapping genes; Prokaryotic genome; Eukaryotic genome; nuclear genome; organellar genome such as mitochondrial genome and chloroplast genome; Genome sequencing project; Human Genome Project; *DNA replication*; Principle of DNA replication; semi-conservative replication; evidences for semi-conservative replication; Molecular mechanism of DNA replication; Uni-directional and bi-directional replication; Enzymes involved in DNA replication; steps of DNA replication; *Fine structure of gene*; Number of genes per organism; gene structure; split genes; *Genetic code*; Cryptogram of DNA; Codon assignment; Properties of genetic code; *Gene expression*; Central dogma; Transcription; Structure of RNA polymerase; mechanism of transcription; chain initiation; elongation and termination; RNA processing; Translation; tRNA; clover leaf model; wobble hypothesis; ribosomes; mechanism of translation; Regulation of gene expression; Regulation in prokaryotes; Regulation in eukaryotes; regulation through transcriptional control such as by hormones; *Immunogenetics*; The MHC molecules; Genetics of MHC molecules; Application of immunogenetics; *Genetic basis of development*; Cell determination and differentiation; binary switch genes; maternal effect genes; segmentation genes; *Genetic basis of cancer*; Causes of cancer; Role of mutation in cancer; tumour suppressor gene; proto-oncogene and oncogene; Translocation of chromosomes resulting in cancer; Environmental causes of cancer; *Evolutionary genetics*; Test questions.

## **16. Genetical Techniques** **426-457**

*Chromosomal techniques*; Chromosomal stains; Chromosome banding; Importance of banding; Karyotyping; sources of cells for karyotyping; significance of karyotyping; Fluorescence *in situ* hybridization (FISH); Chromosome painting; application of chromosome painting; *Mutagenic techniques*; (Somatic mutagenesis; Seed mutagenesis; Bacterial mutagenesis; *Recombination in bacteria*; Transformation; Conjugation; significance of conjugation; Transduction; *Breeding methods in plants*; Objectives of plant breeding; Steps in plant breeding; Hybridization; types of

hybridization; steps of hybridization; Heterosis or hybrid vigour; *Pedigree analysis*; Inheritance of autosomal recessive alleles; Inheritance of autosomal dominant alleles; X-Transmission of sex-linked genes; linked dominant and recessive inheritance; Y-linked inheritance; *DNA isolation*; Isolation of plasmid from bacteria by alkaline lysis method; Isolation of DNA from plant leaves; Isolation of DNA from blood cells; *Genetic engineering (or recombinant DNA technology)*; Strategies of genetic engineering; Basic tools of genetic engineering; Isolation and purification of foreign DNA; restriction enzymes; other enzymes; cloning vectors; Construction of recombinant DNA molecules; Transfer of DNA into host cells; Electroporation; Microinjection; Particle bombardment gun; *Agrobacterium*-mediated gene transfer; Test questions.

## **UNIT – V**

### **BIOTECHNOLOGY PRACTICAL**

#### **17. Practical for Class XI**

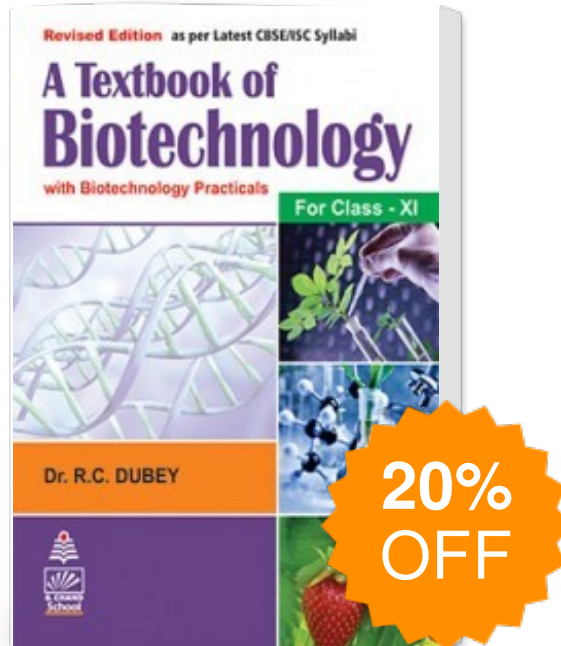
**461-500**

Introduction; Tools in Biotechnology laboratory; Experiments; Preparation of buffers and pH determination; Sterilization techniques; Media preparation; Isolation and staining of bacteria; Bacterial growth kinetics; Mitosis and mitotic index; Karyotype preparation; Cell viability assay; Cell counting; Blood group determination; Isolation of genomic DNA; DNA detection by GEL electrophoresis; DNA estimation; Isolation of milk protein; Protein estimation; Assay of acid phosphatase.

**INDEX**

**501-512**

# A Textbook Of Biotechnology For Class XI



Publisher : SChand Publications ISBN : 9788121924177

Author : Dr R C Dubey

Type the URL : <http://www.kopykitab.com/product/12011>



Get this eBook