

Shri Shivaji Education Society Amravati's

# SCIENCE COLLEGE

## Congress Nagar, Nagpur

Accredited with CGPA of 3.51 at 'A+' Grade by NAAC Bangalore  
college with Potential for Excellence

An Institutional Member of APQN Recognized  
Centre for Higher Learning & Research

A Mentor College under "Paramarsh Scheme" of UGC, New Delhi

A Mentor College under Paris Sparsh Scheme of Maharashtra State

An ISO 21001:2018 Certified Institution

National Institute Ranking Framework (NIRF) Rank-band: 201-300



PO, CO, PSO

The picture can't be displayed.

BIOTECHNOLOGY  
DEPARTMENT

## Learning Outcome-based Curriculum Framework in BSc (Hons/ Res) Biotechnology

The Learning Outcomes-based Curriculum Framework (LOCF) for the B.Sc. (Hons/ Res) degree in Biotechnology provides a broad structural framework that can accommodate the current curricular needs as well as gives sufficient flexibility to include changes in content that assume importance as the frontiers of science grow. The inherent flexibility in framework allows design of course basket in tune with individual preferences. The basic uniformity in core course design ensures smooth movement across universities in the country.

PO1: To provide basic knowledge of the subject as well as allied fields

PO2: To develop new methods for effective learning of the applied aspects of the subject

PO3: To inculcate the budding biotechnologists with in depth subject knowledge and effective skills needed to be a successful professional in their fields.

PO4: Special emphasis on experimentation would be given

PO5: To help student to build-up a progressive and successful career in academics and industry

PO6: To motivate the students to contribute in the development of Nation

## Programme Specific Outcomes (PSOs) in B.Sc. (Hons/Res) Biotechnology

The B.Sc. (Hons/Res) programme in Biotechnology is designed to develop in students in depth knowledge of the core concepts and principles that are central to the understanding of this core science discipline. Undergraduates pursuing this programme of study go through laboratory work that specifically develops their quantitative and qualitative skills, provides opportunities for critical thinking and team work, and exposes them to techniques useful for applied areas of scientific study.

1. PSO1: Students will be able to design, conduct experiments, analyze and interpret data for investigating problems in Biotechnology and allied fields.
2. PSO2: Biotechnology industry-oriented preparedness: Demonstrate an ability to identify careers in biotechnology, domain like Pharmaceutical, Food Industry etc., and skills required to work in a biotechnology laboratory or manufacturing facility.
3. PSO-3 :Have basic knowledge of cell and its components
4. PSO-4: Be introduced to microbes and its applications.
5. PSO-5: Understand how the concepts of physics and chemistry are significant to biology
6. PSO-6: Learn basic molecular biology and apply it for genetic engineering of plants animals and environment.

## Course Outcomes CORE PAPERS/ MINOR PAPERS

### B.Sc. Semester – I BBT1T01 Introductory Microbial Biotechnology Theory

At the end of the course the student should be able to:

1. Diagrammatically demonstrate structure of various categories of microorganisms routinely utilized for biotechnological purposes.
2. Conceptualize handling of microbes for biotechnology applications.
3. Establish correlation of macromolecular organization and function at cellular level.
4. Design basic strategy for associating changes in DNA with cellular functioning.
5. Establish enzymatic correlation for execution of DNA manipulations
6. Select technical methods for analysis of manipulated Biomolecules

## Course Outcomes CORE PAPERS/ MINOR PAPERS

### B.Sc. Semester– I BBT1T02 Cellular Macromolecules Theory

On completion of the course, the student will be able to:

1. Describe the structure and function of DNA and RNA in the cell
2. Understand the concept of Gene and describe the structure and function of chromatin.
3. Recognize the structure of amino acid and classifies them on the basis of physicochemical properties and comprehends the primary structure of the protein.
4. Describe the three-dimensional structure of proteins, including the significance of amino acid R-groups and their impact on the three-dimensional structure of proteins.
5. From this portion students will understand the detailed structure of DNA and its variations. They will understand the concept of chromosomes, chromatin and its internal organization.
6. From this portion students will get a detailed information about the structure and function of various biomolecules like carbohydrates, lipids and vitamins. Their physiological properties and biological functions.

## Course Outcomes

### B.Sc. Semester I –BBT1P01 Introductory Microbial Biotechnology Practical

By the end of this course, students will be able to:

1. Students will gain proficiency in fundamental laboratory techniques for culturing, handling, and identifying microorganisms.
2. Application of Sterilization and Aseptic Techniques: Students will be able to apply sterilization methods and aseptic techniques to prevent contamination and ensure reliable experimental results.
3. Microscopy Skills: Students will develop the ability to use microscopes effectively, including performing staining techniques to visualize and differentiate microbial cells.
4. Isolation and Identification of Microbes: Students will learn how to isolate pure microbial cultures and use biochemical and molecular methods to identify microorganisms.

## Course Outcomes

### B.Sc. Semester I – BBT1P02 Cellular Macromolecules Practical

At the end of the course, students shall be able to:

1. Students will acquire skills to identify and analyze cellular macromolecules using techniques such as chromatography, electrophoresis, and spectrophotometry.
2. Students will gain an understanding of the structure-function relationship of proteins, nucleic acids, carbohydrates, and lipids and how these macromolecules contribute to cellular processes.
3. Students will learn to perform and interpret biochemical assays to quantify and characterize macromolecules, such as enzyme assays, nucleic acid quantification, and carbohydrate tests.
4. Students will develop proficiency in laboratory techniques for the isolation and purification of macromolecules, including protein extraction, DNA/RNA isolation, and lipid extraction.

## Course Outcomes Open Electives (OE)

### B.Sc. Semester I – BGO1T01 Biotechnology and Human Welfare

At the end of the course, students shall be able to:

1. Understand the biotechnological applications in the industry
2. Appreciate application of biotechnology in environmental management
3. Describe application of biotechnology to forensic science
4. Comprehend contributions of biotechnology to biomedical fields, such as diagnostics, genomics and therapeutics
5. Understand the biotechnological applications in the agriculture and livestock management.

## Course Outcomes Open Electives (OE)

### B.Sc. Semester I – BGO1T02 Fermented Foods

At the end of the course, students shall be able to:

1. Understand the importance of fermented foods, probiotics, prebiotics and nutraceuticals.
2. Make the students aware of the different types of beverages.
3. Understand the importance of fermented meat and fish products.
4. Understand the importance of fermented dairy and vegetable products.

## Course Outcomes Vocational Skill Course (VSC)

### B.Sc. Semester I – BVS1P01 Basic Transformation Techniques Practical

On completion of the course, the student will be able to:

1. Get an insight about the principles of bacterial/yeast cell transformation techniques.
2. Learn handling and development of genetically engineered organisms in the laboratory.
3. Design strategies to screen genetically modified organisms.
4. Work around the working principles behind various screening strategies

## Course Outcomes Skill Enhancement Courses (SEC)

### B.Sc. Semester I – BVS1P02 DNA Manipulation Techniques Practical

By the end of the course, students will be able to:

1. Perform isolation of DNA from different sources
2. Appreciate changes in DNA migratory properties by agarose gel electrophoresis
3. Describe applications of restriction enzymes in DNA manipulation methods

4. Compare effect of changes in DNA sequence and solution conditions on spectrophotometric properties of DNA
5. Plan and analyse experiments pertaining to DNA manipulations.

#### Course Outcomes CORE PAPERS/ MINOR PAPERS

##### B.Sc. Semester II – BBT2T03 Techniques in Biotechnology Theory

By the end of this course, students will be able to:

1. Understand the properties of light and its application in developing different types of spectroscopic techniques along with their instrumentation, principle and application.
2. To understand the concept of partition principle and coefficient and its application in separating various types of mixture by different types of chromatographic techniques
3. From this portion students will get a theoretical overview on electrophoresis and its applications. They will know the mechanism behind the separation of DNA, RNA and protein molecules based on their size and electrical charge.
4. Students will understand the principle behind partition, adsorption, gel filtration and affinity chromatography. They will be able to apply their knowledge to discriminate between various proteins based on chromatographic properties.

#### Course Outcomes CORE PAPERS/ MINOR PAPERS

##### B.Sc. Semester – II B.Sc. – BBT2T04 Enzyme Technology Theory

By the end of this course, students will be able to:

5. Students will gain a deep understanding of enzyme structure, function, and mechanisms, including enzyme kinetics and regulation.
6. Students will be able to perform and interpret various enzyme assays to measure enzyme activity, specificity, and stability.
7. Enzyme Purification and Characterization: Students will learn techniques for isolating and purifying enzymes from various sources and characterizing their properties, such as optimal conditions for activity and substrate specificity.
8. Students will explore the application of enzymes in various industries, including pharmaceuticals, agriculture, food and beverage, and biofuels, and understand their role in improving processes and products.

#### Course Outcomes Open Electives Course (OE)

##### B.Sc. Semester II – BGO2T03 Applications of Biotechnology in Agriculture

By the end of this course, students will be able to:

1. Understand the biotechnological applications in agriculture
2. Comprehend the pros and cons of GM crops and their plant products
3. Appreciate the biotechnological applications for effective pest control and crop improvements
4. Understand the importance of molecular markers in agriculture

#### Course Outcomes Open Elective Course (OE)

##### B.Sc. Semester II - BGO2T04 Bioethics and Biosafety in Biotechnology

By the end of this course, students will be able to:

1. Give an insight about the morals and principles while working in the field of biology.
2. Make the students aware of the issues arising per while handling and developing genetically

engineered organisms and laboratory animals.

3. Understand the risks involved and the regulations to be followed when experimenting with biological samples.
4. Develop a perception about the practices to be followed in a biotechnology laboratory and the management of the laboratory waste.

#### Course Outcomes Skill Enhancement Courses (SEC)

##### B.Sc. Semester II – BVS2P03 Dairy Technology Practical

By the end of this course, students will be able to:

1. This course will help students learn various methods of isolation, detection and identification of spoilage microorganisms in milk.
2. Understand the application of principle of effect of temperature on spoilage of milk products.
3. Develop technician level human resource for dairy industry.
4. Develop young entrepreneurs for self-employment through dairy technology and associated activities.
5. Impart knowledge and technical proficiency in processing of milk, testing and quality control of milk and milk products.

#### Course Outcomes Skill Enhancement Courses (SEC)

##### B.Sc. Semester II – BVS2P04 Wine technology

By the end of this course, students will be able to:

1. Demonstrate an understanding of the basic concepts of wine chemistry and wine microbiology
2. Students will be able to learn wine production
3. Students will be able to check quality of grapes and wine
4. Students will be able to evaluate wine quality using chemical and sensory techniques

#### Course Outcomes CORE PAPERS

##### B.Sc. Semester III - BBT3T05 Molecular Biology - I Theory

By the end of this course, students will be able to:

1. Understand and comprehend molecular biological processes like DNA replication and summarize the experiment proving its semiconservative nature.
2. Illustrate the concept of mutation and DNA repair
3. Recall the steps and factors involved in the enzymatic synthesis of RNA
4. Describe the details of transcription termination, the concept of reverse transcription and regulation of prokaryotic transcription.

#### Course Outcomes CORE PAPERS

##### B.Sc. Semester III - BBT3T06 Molecular Biology - II Theory

By the end of this course, students will be able to:

1. Explain the concept of genetic code, decoding system, codon-anticodon interactions, and selection of initiation codons.
2. Explain the concept of Initiation, elongation, termination, and also the regulation of

translation.

3. Students can give an introduction to rDNA technology, the basics of genetic engineering, various enzymes, the concept of different vectors and their applications and can apply them further.
4. Apply the concept of PCR, its applications, general features of expression vectors advantages and problems, and various applications of r-DNA technology while performing experiments in r-DNA technology.
5. Students will understand the application of valence bond theory in explaining the bonding and structure of transition metal complexes.

#### Course Outcomes CORE PAPERS

##### B.Sc. Semester III - BGO3T05 Biotechnology in Forensic Science

By the end of this course, students will be able to:

1. The detail study will help to understand about the basics and different branches of Forensic Sciences.
2. Will help to know about the working and functioning of Forensic science laboratories.
3. Will learn the Police science its role in criminal investigation and Prevention of crime.
4. Students will able to learn how the Principles of Forensic science used to solve criminal case

#### Course Outcomes CORE PAPERS

##### B.Sc. Semester III - Polymerase Chain Reaction (PCR) in Diagnostics

By the end of this course, students will be able to:

1. Students will acquire a comprehensive understanding of the fundamental principles of PCR, including DNA amplification, enzyme function, and the role of primers and thermal cycling.
2. Students will develop hands-on skills in setting up and optimizing PCR reactions, including preparing samples, selecting appropriate primers, and troubleshooting common issues.
3. Students will learn how to apply PCR techniques to diagnose various diseases and conditions, including genetic disorders, infectious diseases, and cancer, and understand the advantages and limitations of PCR in diagnostic settings.
4. Students will gain experience with quantitative PCR techniques, including real-time PCR, to measure gene expression levels and quantify DNA or RNA in samples.

#### Course Outcomes CORE PAPERS

##### B.Sc. Semester IV – BBT4T07 Fundamentals of Genetic Engineering Theory

By the end of this course, students will be able to:

1. Students will be able to understand the importance of various enzymes and their significance in genetic manipulations.
2. Students will get to know about the gene library and its application. They will be able to understand the technique required to separate the modified organisms from the unmodified ones.
3. Students will be able to understand the types of plasmids and the characteristics required for an ideal plasmid to be a vector for genetic engineering.
4. Students will be able to understand the technique behind every genetically engineered organisms.

#### Course Outcomes CORE PAPERS

##### B.Sc. Semester IV – BBT4T08 Microbial Genetics Theory

By the end of this course, students will be able to:

1. Students will gain a solid understanding of fundamental genetic principles as they apply to microorganisms, including gene structure, function, and regulation.
2. Students will learn about the mechanisms of genetic variation and mutation in microbes, including how mutations arise, their effects, and how they contribute to microbial evolution and adaptation.
3. Students will understand different mechanisms of horizontal gene transfer in microorganisms, such as transformation, transduction, and conjugation, and their implications for genetic diversity and resistance.
4. Students will develop proficiency in techniques for analyzing microbial genomes, including sequencing, bioinformatics tools, and genome mapping.

#### Course Outcomes Open Electives (OE)

#### B.Sc. Semester IV- BGO4T06 Biotechnology & Law

By the end of this course, students will be able to:

1. Gain coherent and advanced knowledge of the principles and concepts underpinning the application of traditional legal rules, and the development of new legal rules, to socio-economic issues raised by biotechnology.
2. Have the skills and knowledge to provide basic advice to scientists and those wanting to commercially exploit biotechnology and its outcomes on their rights and responsibilities in law.
3. Demonstrate an understanding of, and the ability to critically analyse and evaluate, the interests and forces that influence and shape the development and application of the law to biotechnology.
4. Have the skills to review, analyse, consolidate and synthesis the above knowledge to identify and provide solutions to complex problems arising out of the practice or development of, or activities pertaining to, biotechnology.



## Course Outcomes CORE PAPERS

### B.Sc. Semester V - BBT5T09 Immunology Theory

By the end of this course, students will be able to:

1. Students will understand the structure and function of immune system and its role in providing protection. The role of different cells and organs involved in immune system and the process of discriminating self and non-self-cells.
2. To understand the structure and function of different class of immunoglobulins and molecular events leading to maturation, activation and differentiation of B and T cells along with the cytokinins involved and the process of ADCC
3. Students will be familiarized with different types of vaccine and the process behind engineering of vaccines involved in various diseases.
4. To understand different hypersensitivity reaction and various techniques routinely used for diagnosis of various diseases involving principles of immunology.

## Course Outcomes CORE PAPERS

### B.Sc. Semester V - BBT5T10 Medical Biotechnology Theory

By the end of this course, students will be able to:

1. Students will gain a comprehensive understanding of the core principles and technologies in medical biotechnology, including genetic engineering, molecular diagnostics, and therapeutic development.
2. Students will learn how biotechnological techniques are applied to develop and improve medical treatments, including drug discovery, gene therapy, and personalized medicine.
3. Students will explore recent advancements and innovations in medical biotechnology, such as biopharmaceuticals, regenerative medicine, and diagnostic tools, and understand their impact on modern healthcare.
4. Students will develop an awareness of the ethical, regulatory, and societal issues associated

## Course Outcomes CORE PAPERS

### B.Sc. Semester V - BBT5T11 Techniques for gene editing Theory

By the end of this course, students will be able to:

1. Students will gain a comprehensive understanding of various gene editing techniques, including CRISPR/Cas9, TALENs, and ZFNs, and their mechanisms, applications, and limitations.
2. Students will develop hands-on skills in using gene editing tools, including designing and constructing vectors, performing editing experiments, and validating modifications.
3. Students will understand the ethical, legal, and safety issues associated with gene editing, including potential impacts on human health, genetic privacy, and ecological consequences.
4. Students will learn to analyze and interpret data from gene editing experiments, including evaluating the efficiency and specificity of edits, and understanding how to address and troubleshoot common issues in gene editing processes.

## Course Outcomes CORE PAPERS

### B.Sc. Semester VI- BBT6T13 Industrial Biotechnology

By the end of this course, students will be able to:

1. Understand mass transfer, heat transfer, mixing, rheology of fermentation fluids, residence time distribution, substrate utilization and yield-coefficients, oxygen transfer and oxygen sag.
2. Understand optimization parameters, medium formulation, process optimization, Medium formulation, Concept of control, advanced control policies.
3. Understand basic principles of scale-up, bases of scale up, scale down.  
Biosensors
4. Understand Primary Metabolites organic acids; amino acids and alcohols  
Secondary Metabolites antibiotics: beta-lactams, vitamins and steroids.

## Course Outcomes CORE PAPERS

### B.Sc. Semester VI- BBT6T14 Environmental Biotechnology

By the end of this course, students will be able to:

1. Understand bio feasibility, applications of bioremediation, Bioreduction, Phytoremediation. Solid waste pollution and its management

2. Understand bioabsorption, biomethylation of elements, bioleaching and advantages and disadvantages.
3. Understand biological waste treatment, treatment methods by activated sludge, percolating filters, & biofilms.
4. Understand biodegradation, biotransformation, oxidation reactions, reduction reactions, hydrolysis reactions, regulation of biotransformation.