

Rayat Shikshan Sanstha's
Karmaveer Bhaurao Patil College, Vashi
(Empowered Autonomous)



Syllabus for Approval

Sr. No.	Heading	Particulars
1.	Title of the Course	S.Y.B. Sc. in Biotechnology
2.	Eligibility for Admission	F.Y.B. Sc in Biotechnology
3.	Passing Marks	40%
4.	Ordinances/ Regulation	
5.	No. of Years/ Semester	1 Year / 2 Semesters
6.	Level	Undergraduate (UG)
7.	Pattern	Semester
8.	Status	Revised (Under Autonomous Status)
9.	To be implemented from Academic Year	2024-25

Date:

Name of BOS Chairperson: _____ Signature: _____

**RAYAT SHIKSHAN SANSTHA'S
KARMAVEER BHAURAO PATIL COLLEGE, VASHI
(AUTONOMOUS)**



Proposed Syllabus
For
S.Y. B.Sc. in Biotechnology
2024-25

Preamble of the Syllabus:

Bachelor of Science (B.Sc.) in Biotechnology is a under graduation course of Department of Biotechnology, Karmaveer Bhaurao Patil College Vashi, Navi Mumbai, affiliated to University of Mumbai (MH). Biotechnology is defined as the application of technological principles for the processing or manipulating biological agents to provide goods and services. It derives its strength by harnessing biological processes that sustain life. It is a technology that is more reliable and firmer. Biotechnology has the potential to transform the lives of the people by impacting hugely on agriculture, animal husbandry, health and medicines, environment, sustainable development, etc. Biotechnology has accomplished tremendous applications in just a matter of time. People have just started to recognize the endless window of opportunities it has open. Biotechnology has revolutionized the recent advancements in research and development. CBSGS: The Choice Based Semester and Grading System to be implemented through this curriculum would allow students to develop a strong footing in the fundamentals and specialize in the disciplines of his/her liking and abilities.

Program Education Objective (PEO's):

To prepare students to prime for-

- Higher education and research in field of biotechnology and related subjects.
- Careers related broadly to biotechnology and life sciences. Students will embark upon diverse career paths medical coding/pharmaceutical/biotechnology industries, and use their education in a variety of related endeavors.

Course Objective:

- To produce students who understand fundamental principles of basic sciences and apply that understanding to analyze, solve problems and interrelate with current technological developments.
- To promote independent learning and add rationale thinking, knowledge ability by activity-based learning, innovative, teaching learning and evaluation methods.

Name of the Faculty: Science and Technology

Name of the Program: B Sc

Program Outcomes (POs):

PO-1	Disciplinary Knowledge: Understand the basic concepts, fundamental principles, theoretical formulations and experimental findings and the scientific theories related to Physics, Chemistry, Mathematics, Microbiology, Computer Science, Biotechnology, Information Technology and its other fields related to the program.
PO-2	Communication Skills: Develop various communication skills such as reading, listening and speaking skills to express ideas and views clearly and effectively.
PO-3	Critical Thinking: Propose novel ideas in explaining the scientific data, facts and figures related to science and technology.
PO-4	Analytical Reasoning and Problem Solving: Hypothesize, analyse, formulate and interpret the data systematically and solve theoretical and numerical problems in the diverse areas of science and technology.
PO-5	Sense of Inquiry: Curiously ask relevant questions for better understanding of fundamental concepts and principles, scientific theories and applications related to the study.
PO-6	Use of Modern Tools: Operate modern tools, equipment's, instruments and laboratory techniques to perform the experiments and write the programs in different languages (software).
PO-7	Research Skills: Understand to design, collect, analyze, interpret and evaluate information/data that is relevant to science and technology.
PO-8	Application of Knowledge: Develop scientific outlook and apply the knowledge with respect to subject.
PO-9	Ethical Awareness: Imbibe ethical, moral and social values and exercise it in day-to-day life.
PO-10	Teamwork: Work collectively and participate to take initiative for various field-based situations related to science, technology and society at large.
PO-11	Environment and Sustainability: Create social awareness about environment and develop sustainability for betterment of future.
PO-12	Lifelong Learning: Ability of self-driven to explore, learn and gain knowledge and new skills to improve the quality of life and sense of self-worth by paying attention to the ideas and goals throughout the life.

Name of the Faculty: Science and Technology

Name of the Program: B. Sc Biotechnology

Program Specific Outcomes (PSOs):

Students will be able to –

PSO-1	Identify, understand and analyze problems and propose valid solutions related to field of Biotechnology.
PSO-2	Critically evaluate biotechnological solutions on environment and societies keeping in mind the need for sustainable solutions.
PSO-3	Develop a research-based ideology and technical skills to build career in Biotechnology.

Scheme of examination for Each Semester:

Continuous Internal Evaluation: 40 Marks (Common Test-20 Marks & 20 Marks for Assignment, Projects, Group discussion, Open book test, online test etc.)

Semester End Examination: 60 Marks will be as follows –

I	Theory:	
	Each theory paper shall be of two- and half-hour duration.	
	All questions are compulsory and will have internal options	
	Q-1	From Unit – I (having internal options.) 12 M
	Q-2	From Unit – II (having internal options.) 12 M
	Q-3	From Unit – III (having internal options.) 12 M
	Q-4	From Unit – IV (having internal options.) 12 M
	Q-5	Questions from all the FOUR Units with equal weightage of marks allotted to each Unit. 12 M
II	Practical:	The External examination per practical course will be conducted as per the following scheme.
Sr. No.	Particulars of Semester End Practical Examination	Total Marks
I	Semester end Practical Exam	300

SEMESTER-III

S.Y. B. Sc Biotechnology (Honors)
Proposed Semester III Syllabus
2024-25

Semester III & IV Plan

Sem	Major	Minor	OE	VSC, SEC (VSEC)	AEC, VEC, IKS	OJT, FP, CEP, CC, RP	Cum Cr. / Sem
III	1. Enzymology (4 Credits) (BT201) 2. Molecular Biology (4 Credits) (BT202)	Molecular Biology (4 Credits) (BT202)	Health & Hygiene (2 Credits) (BT203)	VSC-Biogas Production (2 Credits) (BT204)	IKS-2 (2 Credits) (BT205)	FP/CEP 2 (Sci) & CC2	22
IV	1. Genetic Engineering (4 Credits) (BT251) 2. Immunology (4 Credits) (BT252)	Genetic Engineering (4 Credits) (BT251)	Nutraceuticals (2 Credits) (BT253)	SEC Biofertilizer Production (2 Credits) (BT254)	Scientific Communications & Skills (2 Credits) (BT255)	FP/CEP 2 (Arts/Com) & CC2	22
Cum Cr.	8 + 8	4+4	2 + 2	2 + 2	2 + 2	4 + 4	44

S.Y. B.Sc Biotechnology (Honours)

Proposed Semester III Syllabus

2024-25

Major-1

Paper Name: Enzymology

Paper Code: BT 201

No. of credits: 4

Course Outcome	Student will be able to – CO-1: Understand fundamental vocabulary and Concepts of Enzymes CO-2: Differentiate between various factors affecting enzyme activity CO-3: Describe the concepts of co-operative behaviour, enzyme inhibition and allosteric regulation CO-4: Illustrate the major applications of enzymes in various industries and in Biosensors	No. of lectures
Unit 1 Introduction	Definition, Classification, Nomenclature, Chemical Nature, Properties of Enzymes, Mechanism of Enzyme Action, Active Sites, Enzyme Specificity, Co-Factors, Co-enzymes, Zymogens,	15 Lectures
Unit 2 Enzymen Kinetics	Michelis-Menten Equation, Lineweaver Burk Plot, EadieHofstee Plot, Factors affecting enzyme activity, “concerted” & “sequential” models for allosteric enzymes Types of Enzyme Inhibitions-Competitive, Uncompetitive, Non-Competitive Allosteric Modulators, Enzyme regulation and its mechanism, Covalent modifications of enzyme, Feed back inhibition	15 Lectures
Unit-3 Applications	Industrial: Textile industry, Paper and pulp industry, Animal Feed Industry, Enzyme technology for detoxification of mycotoxins in animal feed, Phytases for feed application and leather industry, Enzymes for human and animal nutrition. Medical: Biosensors; introduction, instrumentation, types and examples, Enzyme based sensors as diagnostic tools- Biosensors for Blood glucose, Biosensors for urea in blood and urine, Biosensors for Uric acid, Biosensors for Arginine, Biosensors for Asparagine, Biosensors for Creatinine, Biosensors for Cholesterol, Allosteric enzyme based biosensors.	15 Lectures

Enzymology-References

1. Lehninger Principles of Biochemistry - 4th Ed (2005) - Nelson, D., and Cox, W.H. Freeman and Company, New York,
2. Biochemistry (2013) -Satyanarayan and Chakrapani, New Delhi, Elsevier Health Sciences APAC,.
3. Biochemistry, 5th Ed, (2002) - Berg JM, Tymoczko JL, Stryer L Freeman WH and Co., New York.
4. Understanding enzymes (3rd edition). Edited by Trevor Palmer, Ellis Horwood, Chichester, 1991.

Laboratory Sessions

Enzymology

1.	Effect of pH, Temp, Substrate concentration, Enzyme concentration, Inhibitor on Enzyme activity
2.	Determination of LDH activity in serum
3.	Determination of serum glucose using Glucose oxidase-peroxidase method
4.	Liver function tests: SGOT & SGPT
5.	Kidney function tests: Urea, Uric acid & Creatinine
6.	Determination of serum acid phosphatase
7.	Determination of serum alkaline phosphatase

Major-2

Paper Name: Molecular Biology

Paper Code: BT 202

No. of credits: 4

Course Outcome		No. of lectures
	Student will be able to – CO1-Learn structures of nucleic acids CO2-Find Out difference between prokaryotic & eukaryotic DNA replication CO3-Understand central dogma of life CO4-Describe translation & post translation events in organism	
Unit– 1: Nucleic Acids and DNA Replication	Structure of DNA, RNA, DNA Replication in Prokaryotes and Eukaryotes, Semi-conservative DNA replication, DNA Polymerases and its role, <i>E.coli</i> Chromosome Replication, Bidirectional Replication of Circular DNA molecules. Rolling Circle Replication, DNA Replication in Eukaryotes DNA Recombination – Holliday Model for Recombination, Types of Mutations, DNA repair	15 Lectures
Unit– 2: Transcription Gene expression	Types of RNA, Structural and functional genes, An overview of transcription process in prokaryotes, mRNA synthesis in eukaryotes - Promoters and enhancers, Initiation of transcription at promoters, Elongation and termination of RNA chain, Post transcriptional modifications	15 Lectures
Unit – 3: Translation	Deciphering genetic code, Characteristics of Genetic code, Wobble Hypothesis Translation in Prokaryotes Initiation, Elongation and Termination, Post translational modifications, Protein sorting. Post translational modifications	15 Lectures

Molecular Biology -References

1. Genetics by Peter Russell, 5th Edition
2. i Genetics A Molecular Approach by Russell, 3rd Edition
3. Genes VIII by Benjamin Lewin
4. Molecular Biology of the Gene by J.D. Watson and Baker, 5th Edition
5. Molecular Biology by Robert Weaver, 2nd Edition

Laboratory Sessions

Molecular Biology

1.	Extraction of genomic DNA from plant source
2.	Measurement of purity and quantity of DNA
3.	Agarose Gel Electrophoresis (Demonstration)
4.	Polyacrylamide gel electrophoresis (Demonstration)

Open Elective (OE)

Paper Name: Health & Hygiene

Paper Code: BT203

No. of credits: 2

Course Outcome	Student will be able to –	No. of lectures
	CO1- Understand the importance of health, hygiene and associated diseases CO2- Gain the knowledge of occupational hygiene and sanitization problems of the work place.	
Unit 1: Introduction to sanitation & hygiene for health and its practices in India	Definitions and Concepts, Global, national and regional perspective, Relation between health, hygiene & sanitation, Relevance & importance of health, hygiene in the contemporary times, Present scenario of health hygiene in India, Diseases and disorders that can be controlled and remedied through the adoption of principles of hygiene	15 lectures
Unit 2: Occupational Health and Hygiene & its promotion and education	Concept, definition and its role, Link between occupational hygiene, risk assessment & risk management, Sanitation problems of the workplace: industries, academic institutions, corporate, hospitals, Public spaces etc., Hygiene Behavior promotion & education- concept and its importance, Hygiene promotion & education in children & adolescence, Government initiatives & policies in rural & urban area	15 lectures

Health & Hygiene -References

1. A college text book of health and hygiene, Arvind Kumar Goel, 1st edition (1 Jan 2005), ABD publishers

Public health and hygiene, Dr. K.Dass, Notion press (20 May 2021)

E-RESOURCES: • Water, Sanitation and Culture, <http://www.sswm.info/content/water-sanitation-and-culture>

Vocational Skill Course (VSC)

Paper Name: Biogas Production

Paper Code: BT204

No. of credits: 2

Course Outcome	Student will be able to –	No. of lectures
	CO-1: Enlist and describe various types of biofuels CO-2: Understand the biological and chemical process of biogas production CO-3: Design a biogas plant and produce biogas	
Unit 1: Introduction	Biofuels: Biomass characteristics and their availability, Biofuel production processes: Biomethane, Biohydrogen, Alcoholic fermentation, Biodiesel, Microbial Fuel Cell, Biomass based steam power plant, combined cycle powerplant, cogeneration plant	15 lectures
Unit 2 Biogas Production Process	Ecology of Biogas, Chemical composition, Types and applications, Production rates, Types, working and design calculations of biogas plant, case study	15 lectures

Biogas Production -References

1. Biogas Energy, P.N.Singh
2. Anaerobic Biotechnology for Bioenergy Production: Principles & Applications, Edited by Samir Khanal
3. Biogas Handbook, Arthr Wellinger, Jerry Murphy & David Baxter

Indian Knowledge System-2 (IKS-2)

Paper Name: Indian Knowledge System

Paper Code: BT205

No. of credits: 2

Course Outcome	Student will be able to –	No. of lectures
	CO-1 Major sequential development in Science & Technology CO-2 Trace, identify and develop the ancient knowledge system to make meaningful contributions in the development of science CO-3 Understand the universal solution from Ancient Indian Knowledge system for the scientific, technological and holistic development	
Unit 1:	Indian Traditional Knowledge; Science & Practices	15 Lectures
Unit 2:	Ancient Indian Science; Textile, Agriculture, Transport, Ayurveda etc.	15 Lectures

References:

1. Biotechnology & Traditional Knowledge; Dr. S. K. Jadhav
2. Science & Technology in Ancient Indian Texts; Bal Ram Singh, Nath Girish, Umesh Kumar Singh
3. Methodology of Ancient Indian Science; Prof. W. K. Lele
4. Ancient Indian Science & Technology; Dr. Shiv Swaroop Sahai
5. Ancient Indian Sciences; Subodh Kapoor
6. Ancient Indian Sciences; Swami Chidatman Jee Maharaj

SEMESTER-IV

S.Y. B.Sc Biotechnology (Honours)
Proposed Semester IV Syllabus
2024-25
Major-1

Paper Name: Genetic Engineering

Paper Code: BT 251

No. of credits: 4

Course Outcome	Student will be able to – CO1-Learn enzymes used in genetic engineering CO2-Understand properties of vector CO3-Learn various concepts of recombinant DNA technology CO4-Describe techniques in transgenic animal and plants	No. of lectures
Unit 1: Enzymes & vectors in Gene Cloning	Sources, Mode of Action, Applications of Nucleases – Endo, exo, DNase –I, RNase, S1 Nuclease, Mung bean nuclease Restriction endonucleases - types, nomenclature, target sites, nature of cut ends, host control restriction and modification, star activity, isoschizomeres, neoschizomeres, examples with restriction sites. Ligases, DNA polymerase, Reverse transcriptase, Alkaline phosphatases, Polynucleotide kinase, Terminal transferase Properties of ideal vector, copy number Plasmid cloning vector – pBR322, pUC19 Phage vectors – Lambda phage vectors, M13 Cosmids, Shuttle vectors, Expression vectors pET vectors YAC, BAC Plant vectors – Ti Plasmid derived vector, Plant viruses derived vectors	15 Lectures
Unit 2: Techniques in Genetic Engineering	Recombinant DNA technology, Detection of clones, Electrophoresis, Construction and screening of gDNA and cDNA libraries, Restriction digestion, Southern Blot analysis, Northern Blot analysis, Western blot analysis, DNA sequencing, Polymerase chain reaction and variations, Chromosome walking, jumping	15 Lectures
Unit 3: Genetic	Transgenic plants: Physical methods of transferring	

Engineering in Plants and Animals	genes to plants: electroporation, microprojectile bombardment, liposome mediated, protoplast fusion; Chemical Methods for transferring genes to plants :Calcium phosphate, DEAE dextran Transgenic Animals: Transgenic mice- methodology- retroviral method, DNA microinjection, ES method; genetic manipulation with cre-loxP; Vectors for animal cells; Transgenic animals recombination system; Cloning live stock by nuclear transfer; Transgenic Livestock, Synthetic biology- improvement of seed quality proteins and transgenic fish	15 Lectures
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Genetic Engineering-References

Biotechnology, S.S. Purohit

2. Principles of Gene Manipulations, Primrose

3. Gene Cloning, T.A.Brown

4. The Dictionary of Cell and Molecular Biology, 4th ed., J.M. Lackie

Laboratory Sessions

Genetic Engineering

1.	Isolation of genomic DNA from E.coli
2.	Isolation of plasmid DNA
3.	Separation of DNA by AGE
4.	Study of restriction digestion
5.	To amplify the gene using PCR
6.	To separate protein samples using SDS PAGE
7.	Detection of specific protein by western blotting technique.

Major-2

Paper Name: Immunology

Paper Code: BT 252

No. of credits: 4

Course Outcome		No. of lectures
	Student will be able to – CO1-Describe the interaction between antigens and antibodies CO2-Understand significances of various methods of antigen/antibody detection and quantification CO3-Understand the receptors involved in signal transduction to elicit an immune response CO4-Understand the negative effects of overexpression of immune response	
Unit 1: Introduction to Immunology and Effectors of Immune Response	Overview of Immune system. Innate and Adaptive Immunity. Hematopoiesis Cells of the Immune System: Lymphoid Cells [B Lymphocytes (B Cells), T Lymphocytes (T Cells)], Natural Killer Cells, Mononuclear Phagocytes, Granulolytic Cells, Mast Cells, Dendritic Cells, Follicular Dendritic Cells. Organs of the Immune System: Primary Lymphoid Organs, Secondary Lymphoid Organs	15 Lectures
Unit 2: Antigens and Antibodies	Antigens: Immunogenicity Versus Antigenicity, Epitopes, Types of Antigens, Haptens, Adjuvants Antibodies: Basic Structure of Antibodies, Antibody Classes and Biological Activity, Antigenic Determinants on Immunoglobulins Monoclonal Antibodies, Hybridoma Technology	15 Lectures
Unit 3: Antigen – Antibody Interaction	Precipitation reaction, Precipitin curve, Immunodiffusion reactions – single/ double/ radial, immunoelectrophoresis Agglutination reactions, Radioimmunoassay ELISA, ELISPOT, Western blotting, CFT, Immunoprecipitations, Immunofluorescence, Chemiluminiscence, Flow cytometry	15 Lectures

Immunology -References

1. Immunology, Barbara A. Osborne and Janis Kuby

2. Textbook of Microbiology, Ananthnarayan
3. Immunology, C.V.Rao
4. New Generation Vaccines, 4 th ed., Myrone M. Levine
5. Molecular Biotechnology, Glick and Pasterneck

Laboratory Sessions

Immunology

1.	Determination of relationship between 2 given antigen by Ouchterlony's method	
2.	Determination of the concentration of antigen using Radial immunodiffusion technique	
3.	To determine the presence of antigen by sandwich ELISA method	
4.	To determine the presence of antigen by DOT ELISA method	
5.	To determine the RA antigen	
6.	Hemagglutination	

Open Elective (OE)

Paper Name: Nutraceuticals

Paper Code: BT253

No. of credits: 2

Course Outcome	Student will be able to –	No. of lectures
Unit 1: Basics of nutraceuticals	CO-1: Understand the concept of nutraceuticals and its sources with associated health benefits CO-2: Gain knowledge about prebiotics, probiotics and scope of nutraceutical industries	15 lectures
Unit 2: Prebiotics, Probiotics and Symbiotics	Concept of prebiotics, probiotics and symbiotic. Prebiotics: Non-digestible carbohydrates- Dietary fibers, functional oligosaccharides, Resistant starch and gums. Probiotic microorganisms- Features and health benefits. Probiotics in various foods: Dairy-based, fermented and non-fermented foods. Nutraceutical Industry: Scope of Industry, Indian and global scenario	15 lectures

Nutraceuticals -References

1. Nutraceuticals: Efficacy, Safety and Toxicity by Ramesh C.Gupta
2. Nutraceuticals: A complete guide by Mark Lawrence
3. Handbook of nutraceuticals, Volume I by Yashwant Pathak, CRC press (pdf available online)

Skill Enhancement Course (SEC)

Paper Name: Biofertilizer Production

Paper Code: BT254

No. of credits: 2

Course Outcome	Student will be able to –	No. of lectures
Unit-1: Introduction & Types of Biofertilizers	<p>CO1-Learn importance of biofertilizer CO2-Understand classification of biofertilizer CO3-Properties of biofertilizers CO4-Discuss applications of biofertilizers</p> <p>Introduction, History and concept of Bio fertilizers, status scope and importance of Bio fertilizers, Classification of Bio fertilizers, Nitrogen fixation.</p> <p>Structure and characteristic features of bacterial Bio fertilizers- Azospirillum, Azotobacter, Bacillus, Pseudomonas, Rhizobium and Frankia; Cynobacterial biofertilizers- Anabaena, Nostoc, Hapalosiphon and fungal biofertilizers- AM mycorrhiza and ectomycorrhiza</p>	15 lectures
Unit-2: Production technology & Applications	<p>Strain selection, sterilization, growth and fermentation, equipment, mass production of carrier based and liquid bio fertiizers. FCO specifications and quality control of bio fertilizers.</p> <p>Application technology for seeds, seedlings, tubers, sets etc. Biofertilizers -Storage, shelf life, quality control and marketing. Factors influencing the efficacy of bio fertilizers.</p>	15 lectures

Biofertilizer Production -References

1. Textbook of Biotechnology, R C Dubey
2. Biofertilizers in agriculture and Forestry, N. S. Subbarao

Laboratory Sessions

Biofertilizer Production

1	Isolation of Rhizobium from leguminous plants
2	Isolation of Azatobacter
3	Isolation of phosphate solubilizing bacteria
4	Immobilization Technique – Preparation of Agrobeads
5	Consortium Preparation and checking its efficiency
6	Isolation of auxin producers from soil
7	Laboratory scale preparation of Biofertilizers
8	Isolation of Gibberllin producers from soil
9	Carrier sterilization in Biofertilizer production
10	Study of different factors influencing the efficacy of Biofertilizer

Ability Enhancement Course (AEC)

Paper Name: Scientific Communication Skills

Paper Code: BT255

No. of credits: 2

Course Outcome	Student will be able to –	No. of lectures
	CO-1 : Learn the importance of scientific communication and characteristics of effective scientific writing. CO-2 : Gain Knowledge about structure and organization of scientific paper.	
Unit 1: Introduction to scientific writing Oral and writing techniques	Understanding the purpose and importance of scientific communication Characteristics of effective scientific writing Overview of different types of scientific documents (research articles, reviews, reports etc.) Planning and structuring an oral presentation Techniques for engaging the audience and maintaining interest Effective use of visual aids (slides, posters etc.) Strategies for effective data presentation (tables, figures, graphs) Proper use of scientific terminology and jargon	15 lectures
Unit 2: Structure and organization	Components of scientific paper (abstract, introduction, methods, results, discussion, references) Crafting clear and concise paragraphs Importance of logical flow and coherence in scientific writing	15 lectures

References:

1. “Scientific writing and communication: Papers, proposals and presentations” by Angelika H. Hofmann
2. Successful Scientific Writing : A Step-By-Step Guide For The Biological And Medical Sciences by Janice R. Matthews, Robert W. Matthews, CAMBRIDGE UNIVERSITY PRESS

