

Shiv Chhatrapati Shikshan Sanstha's

Rajarshi Shahu Mahavidyalaya, Latur

Empowered Autonomous Institution



Structure and Curriculum of Four Year Multidisciplinary Degree (Honors/Research) Programme with Multiple Entry and Exit option

Undergraduate Programme of Science and Technology

B.Sc. (Honors) in Biotechnology

Board of Studies

in

Biotechnology

Rajarshi Shahu Mahavidyalaya, Latur

Empowered Autonomous Institution

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[UG I Year]
Rajarshi Shahu Mahavidyalaya,
Latur (Autonomous)

w.e.f. June, 2026

(In Accordance with NEP-2020)

Review Statement

The NEP Cell reviewed the Curriculum of **B.Sc. (Honors) in Biotechnology** to be effective from the **Academic Year 2026-27**. It was found that, the structure is as per the NEP-2020 guidelines of Govt. of Maharashtra.

Date: 13/04 /2026

Place: Latur

NEP CELL

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CERTIFICATE

I hereby certify that the documents attached are the Bonafide copies of the Curriculum of **B.Sc. (Honors) in Biotechnology** to be effective from the **Academic Year 2026-27**.

Date: 06 / 04 /2026

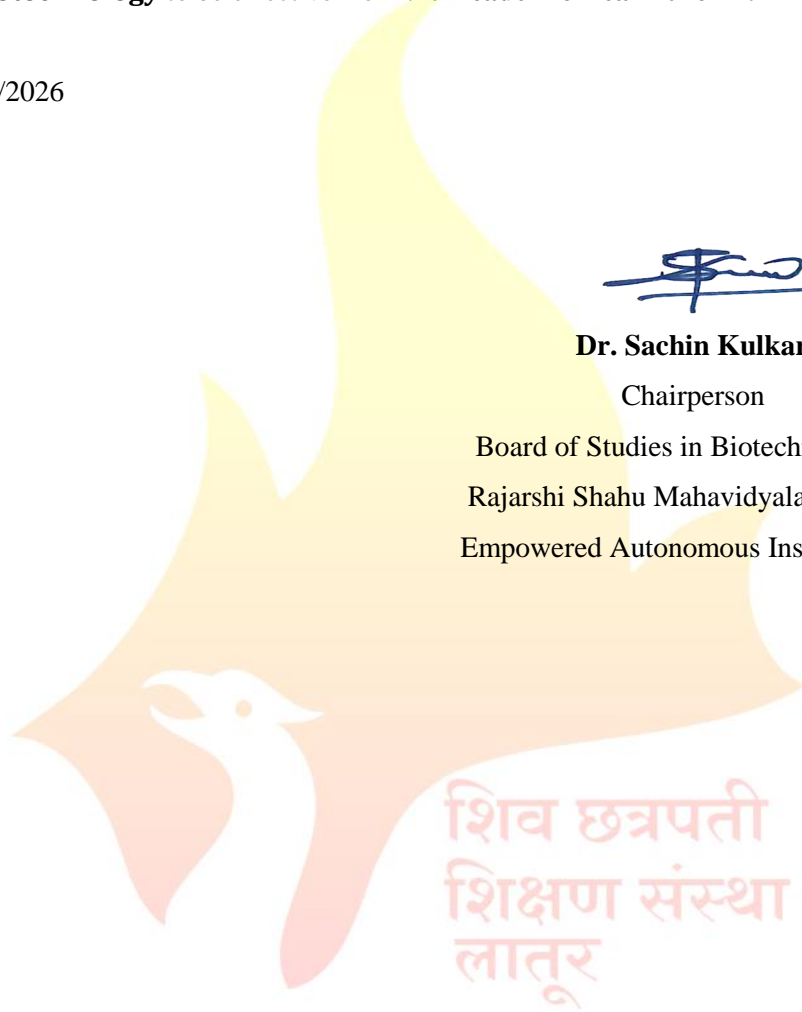
Place: Latur



Dr. Sachin Kulkarni

Chairperson

Board of Studies in Biotechnology
Rajarshi Shahu Mahavidyalaya, Latur
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Members of Board of Studies in Biotechnology

Under the Faculty of Science and Technology

Sr. No.	Name	Designation	In position
1	Dr. Sachin S. Kulkarni Head, Department of Biotechnology, Rajarshi Shahu Mahavidyalaya, Latur (Empowered Autonomous Institution)	Chairperson	HoD
2	Prof. Tukaram. A. Kadam Professor, School of Life Sciences SRTMU, Nanded.	Member	V.C. Nominee
3	Dr. Umesh Jadhav Asst. Professor, Department of Microbiology, Savitribai Phule Pune University, Pune	Member	Academic Council Nominee
4	Dr. Rajesh M. Jorgewad Asst. Professor, Department of Biotechnology and Bioengineering, KIT college of Engineering, Kolhapur (Autonomous)	Member	Academic Council Nominee
5	Dr. Ashish Gulve Asst. Professor, Department of Bioinformatics, Subcenter Campus, SRTMU, Latur	Member	Expert from outside for Special Course
6	Dr. Rahul Chavan Asst. Professor, Department of Agricultural Biotechnology, V.D. Agri Biotech College, Latur	Member	Expert from outside for Special Course
7	Mr. Abhay. M. Desai Senior Manager, Wockhardt, Chhatrapati Sambhaji Nagar	Member	Expert from Industry
8	Dr. Santosh Narwade Serum Institute Pvt.Ltd. Pune	Member	P.G. Alumni
9	Dr. Manisha. A. Dhotre	Member	Faculty Member
10	Mr. Udaybhanu. P. Sirdeshmukh	Member	Faculty Member
11	Dr. Ravindra. B. Ade	Member	Faculty Member
12	Dr. Sanghapal. S. Kshirsagar	Member	Faculty Member
13	Mr. Suraj. D. Kadam	Member	Faculty Member
14	Mr. Akash. J. Waghmare	Member	Faculty Member
15	Ms. Swati G. Swami	Member	Faculty Member
16	Ms. Karuna S. Komatwar	Member	Faculty Member
17	Ms. Rohini Shinde	Member	Faculty Member
18	Ms. Dhanashri Janakwade	Member	Faculty Member

From the Desk of the Chairperson...

Biotechnology as a subject is a highly interdisciplinary that combines biological sciences with engineering technologies to manipulate living organisms and biological systems to produce products that advances healthcare, medicine, agriculture, food, pharmaceuticals and environment. At its simplest, biotechnology is technology based on biology - which harnesses cellular and bimolecular processes to develop technologies and products that help to improve our lives and health of our planet.

Taking into consideration of the importance of Biotechnology, Rajarshi Shahu Mahavidyalaya, Latur (Autonomous), have taken an initiative to introduce a new emerging field as an undergraduate Programme in biotechnology under the faculty of science. B. Sc. Biotechnology is a Three-year graduate degree program which is started in the academic year 2004-05 followed by the postgraduate program started in academic year 2006-07.

National Education Policy (NEP) 2020 recognizes the relevance of biotechnology in the education system due to its interdisciplinary nature, potential for research and innovation, and its alignment with the development of 21st-century skills. By integrating biotechnology into the curriculum, the policy aims to prepare students for the challenges and opportunities of a rapidly advancing biotechnology driven world.

NEP-2020 has conceptualized the idea to develop well rounded competent individuals for making the nation a self-reliant and global leader. In the same spirit, we at Department of Biotechnology, have developed a curriculum framework to encompass the goals of NEP 2020. In the overall curriculum we have incorporated choice of courses of study, creating academic pathways having constructive combinations with multiple entry and exit points as well as focus on experiential learning for students by introducing multidisciplinary, skill enhancement, vocational courses along generic elective(s) and course based on Indian knowledge system and actual Hand's on training in the recent and trending areas of Biotechnology.

With reference to global changes occurring in higher education in various national and foreign universities, the newly designed syllabi of B.Sc. Biotechnology as per NEP 2020 guidelines are effectively implemented from June, 2023. The committee members of Board of Studies in Biotechnology also took the local need and employability of graduate students into consideration while framing the given curriculum, keeping in view of the guidelines given in the University Grants Commission, New Delhi.

By aligning curriculum development, pedagogy, interdisciplinary connections, research opportunities, industry collaborations, teacher training, and available infrastructure with the institute, the department of biotechnology plans to integrate students with a comprehensive understanding of biotechnology, foster critical thinking and research skills, and prepare them for future careers in the field.



Dr. Sachin Kulkarni

Chairperson

Board of Studies in Biotechnology
Rajarshi Shahu Mahavidyalaya, Latur
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Empowered Autonomous Institution

Faculty of Science and Technology

Structure for Four Year Multidisciplinary Undergraduate Degree Programme in Biotechnology

Multiple Entry and Exit (In accordance with NEP-2020)

Year & Level	Sem	Major		Minor	OE	VSC/SEC (VSEC)	AEC/VEC	OJT,FP,CEP, RP	Credit per Sem.	Cum./Cr. per exit
		DSC	DSE							
1	2	3	4	5	6	7	8	9	10	
I 4.5	I	DSC I: 04 Cr. DSC II: 04 Cr.	NA	NA	OE-I: 04 Cr.	VSC-I: 02 Cr. SEC-I: 02 Cr.	AEC-I: 02 Cr. MIL: 02 Cr. VEC-I: 02 Cr.	CC-I: 02 Cr. (NSS, NCC, Sports, Cultural)/ CEP-I: 02 Cr. (SES-I)/ OJT: 02 Cr. / Mini Project: 02 Cr.	22	44 Cr. UG Certificate
	II	DSC III: 04 Cr. DSC IV: 04 Cr.	NA	NA	OE-II: 04 Cr.	VSC-II: 02 Cr. SEC-II: 02 Cr.	AEC-II: 02 Cr. MIL: 02 Cr. VEC-II: 02 Cr.	Generic IKS: 02 Cr.	22	
	Cum. Cr.	16	-	-	08	04+04 = 08	04+02 +02=08	04	44	

Exit Option: Award of UG Certificate in Major with 44 Credits and Additional 04 Credits Core

NSQF Course / Internship or continue with Major and Minor

Abbreviations:

1. DSC : Discipline Specific Core (Major)
2. DSE : Discipline Specific Elective (Major)
3. DSM : Discipline Specific Minor
4. OE : Open Elective
5. VSEC : Vocational Skill and Skill Enhancement Course
6. VSC : Vocational Skill Course
7. SEC : Skill Enhancement Course
8. AEC : Ability Enhancement Course
9. MIL : Modern Indian Languages
10. IKS : Indian Knowledge System
11. FSRCE : Fostering Social Responsibility & Community Engagement
12. VEC : Value Education Course
13. OJT : On Job Training
14. FP : Field Project
15. CEP : Community Engagement Programme
16. CC : Co-Curricular Course
17. RP : Research Project/Dissertation
18. SES : Shahu Extension Services

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Faculty of Science and Technology

(B.Sc. Biotechnology)

Year & Level	Semester	Course Code	Course Title	Credits	No. of Hrs.	
I 4.5	I	101BIO1101 (DSC-I)	Cell Biology	03	45	
		101BIO1103	Lab Course-I	01	30	
		101BIO1102 (DSC-II)	Introductory Microbiology	03	45	
		101BIO1104	Lab Course-II	01	30	
		OE-I	From Basket	04	60	
		101BIO1501 (VSC-I)	Bioinstrumentation-I	02	45	
		(SEC-I)	From Basket	02	30	
		(AEC-I)	From Basket	02	30	
		(VEC-I)	Constitution of India	02	30	
		AIPC/OJT-I	Mini Project – I	02	60	
	Total Credits				22	
	II	101BIO2101 (DSC-III)	Biochemistry	03	45	
		101BIO2103	Lab Course-III	01	30	
		101BIO2102 (DSC-IV)	Genetics	03	45	
		101BIO2104	Lab Course-IV	01	30	
		OE-II	From Basket	04	60	
		101BIO2501 (VSC-II)	Bioinstrumentation -II	02	45	
		(SEC-II)	From Basket	02	30	
		(AEC-II)	From Basket	02	30	
		CC	CC – I	02	30	
		Generic IKS	Introduction to Indian Knowledge System	02	30	
	Total Credits				22	
Total Credits (Semester I & II)				44		



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Name of the Programme: **Biotechnology**

Programme Outcomes (POs) for Biotechnology	
PO 1	Disciplinary Knowledge Recall and apply fundamental and advanced concepts of biotechnology
PO 2	Understanding of Biological Systems Explain biological processes and mechanisms using scientific principles.
PO 3	Application of Knowledge Apply biological knowledge and laboratory skills to perform experiments and solve biotechnological problems.
PO 4	Analytical Skills Analyze biological data, experimental results, and complex biological systems using scientific reasoning and quantitative approaches.
PO 5	Evaluation of Problems Evaluate experimental outcomes, research findings, and biotechnological processes for accuracy, reliability, and limitations.
PO 6	Design & Innovation Design experiments, develop processes, and propose innovative solutions for healthcare, agriculture, environmental, and industrial biotechnology.
PO 7	Modern Tool Usage Apply and evaluate modern laboratory techniques, instrumentation, bioinformatics, and computational tools for biological analysis.
PO 8	Ethics, Biosafety & Sustainability Evaluate ethical principles, biosafety practices, sustainability, and societal impact in biotechnology.
PO 9	Communication & Teamwork Communicate scientific information effectively and collaborate in multidisciplinary teams.
PO 10	Lifelong Learning & Employability Demonstrate and pursue lifelong learning, research, and entrepreneurial skills for professional development and career advancement.



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Programme Specific Outcomes (PSOs) for Biotechnology	
PSO No.	After completion of this programme the students will be able to -
PSO 1	Conceptual Understanding & Integration Explain, classify, and integrate fundamental and advanced concepts to interpret and predict complex biological systems and processes.
PSO 2	Experimental & Analytical Competence Apply, perform, design, and validate experimental procedures, and analyze and interpret data using scientific and quantitative approaches.
PSO 3	Applied Problem Solving & Optimization Apply, analyze, design, and optimize solutions to address real-world challenges, including sustainability and resource management.
PSO 4	Computational & Technological Skills Apply, analyze, model, and interpret data using computational tools and advanced technologies for problem-solving.
PSO 5	Research, Ethics & Professional Skills Evaluate, design, implement, and communicate solutions while adhering to ethical, legal, and safety standards, and demonstrating lifelong learning skills.

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Semester - I

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Faculty of Science and Technology

Department of Biotechnology

UG I Sem I

Course Type: DSC-I

Course Title: Cell Biology

Course Code: 101BIO1101

Credits: 03

Max. Marks: 75

Lectures: 45 Hrs.

Learning Objectives:

- LO 1 Classify cell types and relate structural features with their functions and evolutionary origin.
- LO 2 Analyze organelle organization and correlate cytoskeleton and junctions with cellular functions.
- LO 3 Evaluate transport mechanisms and electrical properties of membranes in maintaining cellular homeostasis.
- LO 4 Develop conceptual models linking cell cycle, signaling, differentiation, and pathological conditions.

Course Outcomes:

After completion of the course the students will be able to-

- CO 1. Explain and apply fundamental concepts of cell biology including origin, evolution, and structural organization of prokaryotic and eukaryotic cells.
- CO 2. Analyze the structure, composition, and functional organization of cell organelles, cytoskeleton, and cell junctions.
- CO 3. Analyze and evaluate membrane transport mechanisms, bioenergetics, and electrical properties of cells.
- CO 4. Evaluate cell cycle regulation, signaling pathways, and design conceptual links between cell division, differentiation, and disease conditions.

Unit No.	Title of Unit & Contents	Hrs.
I	Introduction to Cell biology	07
	1. Cell – Shapes, morphology, 2. Cell theory. 3. Origin of life –Stanley miller Experiment. 4. Origin of Mitochondria, Chloroplast (Endosymbiotic theory).	

Unit No.	Title of Unit & Contents	Hrs.
	5. Introduction to prokaryotic and eukaryotic cells. 6. Microscopic techniques in cell biology. Unit Outcomes: UO 1. Discuss origin and evolution of cells. UO 2. Explain difference between prokaryotic and eukaryotic cell.	
II	Cell organelles and Cytoskeleton	15
	1. Cell wall and cell membrane. 2. Plasma Membrane: Components of Plasma membrane, Lipid raft, Micelles and Liposomes and Fluidity of Plasma membrane 3. Endoplasmic reticulum 4. Golgi body, Mitochondria and Chloroplast and Nucleus. 5. Microbodies: Glyoxysome, Peroxisome, Melanosome, lysosomes, vacuoles. 6. Cytoskeleton. 7. Extracellular matrix. 8. Cell junctions. Unit Outcome: UO 1. Describe physico-chemical composition of organelles and their functional organization. UO 2. Explain cytoskeleton and cell junction.	
III	Membrane Transport	13
	1. Transport across cell membrane, simple diffusion, passive transport, active transport, Na/K ion channel, Endocytosis pathways, vesicular transport, Receptor mediated endocytosis. 2. Concept of ETC Membrane. Role of high energy compound. 3. Membrane potential, Depolarization, hyperpolarization of membrane (neuronal). 4. Generation of action potential. 5. Types of biopotentials. Biopotential measurement instrument. Unit Outcomes: UO 1. Explain transport mechanism of cells UO 2 Student will be able to study action potential in cell	
IV	Vitamins and Minerals	10
	1. The mechanism of cell division 2. Cell cycle and its regulation,	

Unit No.	Title of Unit & Contents	Hrs.
	3. Cell Signaling: G-Protein coupled receptor, Nitrous oxide, Calcium as secondary messenger and its role in plant and animals. 4. Cell differentiation 5. Neoplasia & Cell death 6. Brief introduction to stem cells	
	Unit Outcomes: UO 1. Elucidate significance of cell-cell communication UO 2. Describe mechanism of cell division and cell death.	

Learning Resources:

1. A Molecular Approach the Cell, Cooper & Hausmann –4th Edition, 2004.
2. Cell and Molecular Biology, Gerald Karp - 4th Edition, 2007.
3. Cell Biology A Short Course, Stephen R. Bolsover Wiley Liss A JOHN WILEY & SONS, INC., PUBLICATION, 2004.
4. Cell biology, Veer Bala Publication Rastogi, MedTech Science Press 2021.
5. Manual of Laboratory Expts. in Cell Biol, Edward Gasque, W. C. Wilson Pub, 2005.
6. Medical Physiology, Guyton & Hall, Eleventh Edition-Elsevier, 2009.
7. Molecular Cell Biology, Lodish et al, Scientific American Book, 2004.
8. Nature cell biology, ISSN: 1465-7392, 2010.
9. The Biology of the Cell, Alberts et al 5th Edition, 2002.
10. Trends in Cell Biology (Magazine), Ilaria Carnevale, Editor-in-chief, 2020.

Internal Examination Pattern:

CAT – I: Activity Based

CAT – II: Open Book Test

Mapping of POs, PSOs and COs:

COs/P Os & PSOs	P O1	P O2	P O3	P O4	P O5	P O6	P O7	P O8	P O9	PO 10	PS O1	PS O2	PS O3	PS O4	PS O5
CO1	3	3	2	1	1	1	1	1	1	1	3	2	1	1	1
CO2	3	3	2	3	2	1	2	1	1	1	3	3	2	1	1
CO3	2	3	3	3	2	2	2	1	1	1	3	3	2	2	1
CO4	2	3	2	3	3	3	2	2	2	2	3	3	3	2	3

Scale: 3 = High, 2 = Moderate, 1 = Low, 0 = No correlation.



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Faculty of Science and Technology
Department of Biotechnology
UG I Sem I

Course Type: Lab Course

Course Title: Lab Course I (Based on DSC- I)

Course Code: 101BIO1103

Credits: 01

Max. Marks: 50

Hours: 30 Hrs.

Learning Objectives:

- LO 1 Understand and describe cell diversity and different stages of the cell cycle.
- LO 2 Design and perform experiments on karyotyping and cell lysis techniques.
- LO 3 Apply cell separation techniques for isolation of cellular components.
- LO 4 Perform and analyze staining techniques for lipids and other cellular components.

Course Outcomes:

After completion of the course the students will be able to-

- CO 1 Perform separation of subcellular components of cells.
- CO 2 Identify and describe the cellular structure of organs and tissues from prepared slides, and outline the principles of histochemical staining.
- CO 3 Interpret the chromosome structure, cell division events in cells.
- CO 4 Explain membrane transport practically.

Practical No.	Unit
1.	To Study Cell Diversity
2.	To study Permeability Change in erythrocyte using Osmosis
3.	Separation of cells using sedimentation and velocity Centrifugation
4.	Staining of mitochondria
5.	Staining of Vacuoles
6.	Staining of Glycogen bodies
7.	Staining of Lipids
8.	Study of Karyotyping
9.	Study of Mitosis using Onion Root
10.	Study of Meiosis Using Onion Flower
11.	Cell harvesting and cell lysis- methodology
12.	Study of Tissue by Microtomy
13.	Isolation of Chloroplast
14.	Estimation of Chlorophyll
15.	Isolation of Mitochondria from goat liver.

N.B.: Any Ten Practicals from above.



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Faculty of Science and Technology

Department of Biotechnology

UG I Sem I

Course Type: DSC-II

Course Title: Introductory Microbiology

Course Code: 101BIO1102

Credits: 03

Max. Marks: 75

Lectures: 45 Hrs.

Learning Objectives:

- LO 1 Classify microorganisms and relate structural components with their functions.
- LO 2 Differentiate types of media and analyze sterilization methods based on application and effectiveness.
- LO 3 Evaluate staining, biochemical, and cultivation techniques for microbial identification.
- LO 4 Design strategies to optimize and control microbial growth under different environmental conditions.

Course Outcomes:

After completion of the course the students will be able to-

- CO 1 Explain and apply concepts of microbial classification, structure, and diversity to differentiate major groups of microorganisms.
- CO 2 Apply and analyze principles of microbial media preparation, sterilization, and disinfection techniques in laboratory practices
- CO 3 Analyze and evaluate microbial isolation, cultivation, staining, and identification techniques for accurate characterization of microorganisms.
- CO 4 Evaluate bacterial growth kinetics and design approaches to control microbial growth under varying environmental conditions.

Unit No.	Title of Unit & Contents	Hrs.
I	History and Overview of Microbiology	11
	<ol style="list-style-type: none"> 1. Biogenesis and abiogenesis, Contributions of Redi, Spallanzani, Needham, Tyndall, Joseph Lister, Pasteur, Koch [Germ Theory]. 2. Scope of Microbiology. 3. Three Domain Classification 4. General classification of microorganisms as Bacteria, Fungi, Algae, Protozoa and Virus 5. Structure and organization of bacteria: Capsule, cell wall, cytoplasmic membrane, nucleoid, Ribosome, endospores, cytoplasmic inclusions, flagellum, Pili, protoplast and spheroplast. <p>Unit Outcomes:</p> <p>UO 1 Interpret the structural similarities and differences among microorganisms and the unique structure/function relationships of prokaryotic cells.</p> <p>UO 2 Understand the types of micro-organisms.</p>	
II	Microbial Media and Sterilization Techniques	11
	<ol style="list-style-type: none"> 1. Major and minor media components. 2. Types of media Viz. Basal, Selective, Differential and Enrichment media. Mode of nutrition. 3. Definition of sterilization, dry and moist heat, pasteurization, Tyndallization, radiation, ultrasonication, filtration. 4. Physical and Chemical methods of sterilization; disinfection sanitization, antiseptics, sterilant and fumigation. 5. Determination of phenol coefficient of disinfectant. <p>Unit Outcome:</p> <p>UO 1 Explain the diversity of microorganism in special reference to bacteria.</p> <p>UO 2 Explain the methods of sterilizations.</p>	
III	Isolation and Identification Techniques	12
	<ol style="list-style-type: none"> 1. Isolation, cultivation and identification techniques for microorganisms, aerobic and anaerobic cultivation. 2. Morphological and Biochemical methods for bacterial identification 3. Pure culture techniques and preservation of pure cultures. 4. Definition of auxochrome, chromophores. 5. Classification of stains, Theories of staining. 6. Mechanism of gram staining, acid fast staining, negative staining, capsule staining, flagella staining, endospore staining. <p>Unit Outcomes:</p> <p>UO 1 Demonstrate the proper use of a microscope to observe microorganisms and report observed characteristics</p> <p>UO 2 Elaborate their concepts about isolation of microbes from different forms.</p>	

Unit No.	Title of Unit & Contents	Hrs.
IV	Bacterial Growth	11
	1. Different types of bacterial culture (Batch, Synchronous, Diauxic, Axenic). 2. Definition and brief description. Growth Curve, Calculation of duration of Phases and generation time, Growth yields. 3. Methods of growth determination. 4. Environmental factors affecting growth - temperature, pH, osmotic pressure and nutrient concentration per cell.	
	Unit Outcomes: UO 1 Master aseptic technique and be able to perform routine culture handling tasks safely and effectively. UO 2 Understand the concepts of bacterial culture.	

Learning Resources:

- Advances in Omics Technologies: Exploring Genomics, Proteomics, and Metabolomics – A. K. Rout et al. – Springer – 2025
- Brock Biology of Microorganisms – Michael T. Madigan, Kelly S. Bender, Daniel H. Buckley, W. Matthew Sattley – Pearson – 2018
- Elementary Microbiology (Vol. I & II) – H. A. Modi – Akta Prakashan – 2002
- Essentials of Microbiology – Apurba S. Sastry, Sandhya Bhat – Jaypee Brothers Medical Publishers – 2018
- General Microbiology – Pelczar M. J., Chan E. C. S., Krieg N. R. – Tata McGraw Hill – 2001
- General Microbiology – Powar C. B., Dagainawala H. F. – Himalaya Publishing House – 2019
- General Microbiology – Stanier R. Y., Ingraham J. L., Wheelis M. L., Painter P. R. – Macmillan Press – 1986
- Microbiology – R. C. Dubey, D. K. Maheshwari – Rastogi Publications – 2010
- Microbiology: A Laboratory Manual – James G. Cappuccino, Natalie Sherman – Pearson Education – 2010
- Microbiology: An Introduction – Gerard J. Tortora, Berdell R. Funke, Christine L. Case – Pearson – 2024
- Microbiology Laboratory Theory and Application – Michael J. Leboffe, Burton E. Pierce – Morton Publishing – 2015
- Prescott's Microbiology – Joanne M. Willey, Linda M. Sherwood, Christopher J. Woolverton – McGraw Hill – 2017
- Textbook of Microbiology – Ananthanarayan R., Paniker C. K. J. – Universities Press – 2017
- Textbook of Microbiology – K. R. Aneja – S. Chand Publications – 2013
- Textbook of Microbiology and Immunology – Subhash Chandra Parija – Elsevier – 2012

Internal Examination Pattern:

CAT – I: Activity Based

CAT – II: Open Book Test

Mapping of POs, PSOs and COs:

COs/P Os & PSOs	P O1	P O2	P O3	P O4	P O5	P O6	P O7	P O8	P O9	PO 10	PS O1	PS O2	PS O3	PS O4	PS O5
CO1	3	3	2	2	1	1	1	0	1	0	3	2	1	1	1
CO2	2	2	3	2	2	1	3	2	1	0	2	3	2	1	2
CO3	2	2	3	3	3	2	3	2	1	1	2	3	2	2	2
CO4	1	2	3	3	3	3	2	2	1	1	2	3	3	2	2

Scale: 3 = High, 2 = Moderate, 1 = Low, 0 = No correlation.

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Faculty of Science and Technology

Department of Biotechnology

UG I Sem I

Course Type: Lab Course

Course Title: Lab Course –II (Based on DSC-II)

Course Code: 101BIO1104

Credits: 01

Max. Marks: 50

Lectures: 30 Hrs.

Learning Objectives:

- LO 1 Explain fundamental microbiology laboratory concepts, safety guidelines, and principles of aseptic techniques.
- LO 2 Demonstrate the use and handling of microbiological instruments and perform sterilization, media preparation, and inoculation techniques.
- LO 3 Perform staining methods and microscopic techniques to observe, differentiate, and characterize microorganisms.
- LO 4 Analyze microbial isolation, growth, and quantification methods from different environmental samples.

Course Outcomes:

After completion of the course the students will be able to-

- CO 1 Apply aseptic and sterilization techniques for safe handling, isolation, and cultivation of microorganisms.
- CO 2 Perform and interpret staining and microscopic techniques for identification and differentiation of microorganisms.
- CO 3 Analyze microbial growth, colony characteristics, and results obtained from culture-based methods.
- CO 4 Demonstrate proficiency in environmental sampling, microbial quantification, and selection of appropriate microbiological techniques.

Practical No.	Unit
1	Introduction to Microbiology Laboratory, Safety Rules and Aseptic Techniques
2	Study and Handling of Microscope
3	Sterilization Techniques and Operation of Autoclave
4	Preparation of Culture Media (Broth and Agar)
5	Isolation of Bacteria by Streak Plate Method
6	Isolation of Bacteria by Spread Plate and Pour Plate Methods
7	Isolation of Bacteria by Serial Dilution Method
8	Simple Staining and Observation of Cell Morphology
9	Gram Staining (Differential Staining)
10	Special Staining Techniques: Acid-fast, Capsule and Endospore Staining
11	Motility Test (Hanging Drop / Semi-solid Media)
12	Observation of Colony Morphology
13	Methods of Inoculation in Different Media (Slant, Broth, Plates)
14	Microscopic Measurement Using Ocular and Stage Micrometer
15	Sampling and Quantification of Microorganisms from Air, Soil and Water

N.B.: Any Ten Practicals from above

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॥ आरोग्यं तमसो ज्योतिः ॥

Rajarshi Shahu Mahavidyalaya,
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Shiv Chhatrapati Shikshan Sanstha's

Rajarshi Shahu Mahavidyalaya, Latur

Empowered Autonomous Institution

Faculty of Science and Technology

Department of Biotechnology

UG I Sem I

Course Type: VSC-I

Course Title: Bioinstrumentation-I

Course Code: 101BIO1501

Credits: 02 (01+01)

Max. Marks: 50

Lectures: 45 Hrs.

(15 Th +30 P)

Learning Objectives:

- LO 1 Explain and apply the principles, operation, and applications of basic bioinstrumentation used in biological research.
- LO 2 Explain and analyze the working, structural components, and applications of microscopy and centrifugation techniques.
- LO 3 Apply, analyze, and select appropriate chromatographic techniques for separation and characterization of biomolecules.
- LO 4 Demonstrate and evaluate safe handling, calibration, maintenance, and accuracy of laboratory instruments with relevant scientific calculations.

Course Outcomes:

After completion of the course the students will be able to-

- CO 1 Operate, calibrate, and analyze the performance of basic laboratory instruments for accurate measurements and solution preparation.
- CO 2 Explain, apply, and analyze microscopy and centrifugation techniques for biological structure and biomolecule separation.
- CO 3 Perform, analyze, and optimize chromatographic techniques (paper, tlc, ion exchange) for biomolecule separation and purification.
- CO 4 Demonstrate, evaluate, and design good laboratory practices, safety measures, and analytical strategies in bioinstrumentation experiments.

Unit No.	Title of Unit & Contents	Hrs.
I	Fundamental Instrumentation used in biological research	
	1. Tools and Instruments for measurements: Pipette, measuring cylinders, Micropipette, Weighing balance etc.	
	2. Principles and working of pH meter and Colorimeter	

Unit No.	Title of Unit & Contents	Hrs.
	<p>3. Other tools/instruments: Hot water bath, Hot plate, heating mantle, distillation unit, vortex mixer, homogenizer etc.</p> <p>Unit Outcomes:</p> <p>UO 1 Explain the principles and working of basic laboratory instruments such as pipettes, pH meter, and colorimeter.</p> <p>UO 2 Apply calibration, operation, and maintenance procedures for accurate measurement and experimental reliability.</p>	
II	Microscopy	
	<p>1. Light microscopy: Simple microscope, compound microscope, Dark field microscope, Inverted light microscope.</p> <p>2. Fluorescence microscope</p> <p>3. Electron microscopy: TEM, SEM</p> <p>Unit Outcome:</p> <p>UO 1 Describe the principles and structural components of different types of microscopes.</p> <p>UO 2 Analyze the applications of light, fluorescence, and electron microscopy in biological research.</p>	
III	Centrifugation	
	<p>1. Centrifuge – principle, working and applications.</p> <p>2. Care and safety aspects of centrifuges</p> <p>3. Analytical ultracentrifugation</p> <p>4. Differential and Density gradient centrifugation</p> <p>Unit Outcomes:</p> <p>UO 1 Explain the principle, types, and working of centrifugation techniques.</p> <p>UO 2 Apply centrifugation methods with proper safety and handling in biomolecule separation.</p>	
IV	Chromatography	
	<p>1. Principle of Chromatography</p> <p>2. Principle and applications of paper and TLC chromatography</p> <p>3. Ion exchange chromatography</p> <p>Unit Outcomes:</p> <p>UO 1 Explain the principles and types of chromatography used in biological studies.</p> <p>UO 2 Apply chromatographic techniques for separation and analysis of biomolecules.</p>	

Unit No.	Title of Unit & Contents	Hrs.
V	Practical's (Included in above 04 units)	
	<ol style="list-style-type: none"> 1. Calibration and handling of measurement tools and weighing balance. 2. Calibration and working applications of PH meter. 3. Calibration and practical handling and applications of colorimeter and spectrophotometer. 4. Calibration and Working of Hot water bath, Hot plate, heating mantle, vortex mixer, homogenizer etc. 5. To learn the process of distillation of water by using distillation unit. 6. A study of components and their functions of simple and compound microscope. 7. Prepare the specimen by using temporary mounting methods for compound microscope. 8. Prepare the specimen by using dehydration, staining and clearing by using permanent mounting of plant specimens. 9. Problems on Microscopy. 10. Demonstration of different types of centrifugation techniques. 11. Separation of Biomolecules by Centrifugation 12. Problems on Centrifugation. 13. To separate the plant leaf homogenate pigments by using paper chromatography technique. 14. To separate the amino acids by using thin layer chromatography technique. 15. To purify the enzyme from crude preparation by using ion exchange chromatography. 	

Learning Resources:

1. Analytical Biochemistry (3rd Edition), Holme, David J.; Peck, Hazel; Pearson Education, 1998.
2. Biochemical Techniques: Theory and Practice, Robyt, John F.; White, Bernard J.; Waveland Press, Inc., U.S.A., 1990.
3. Biophysical Chemistry, Upadhyay, A.; Upadhyay, K.; Nath, N.; Himalaya Publishing House, Delhi, 2016.
4. Biophysics, Arora, Mohan P.; Himalaya Publishing House, 2020.
5. Biophysics, Chatwal, G.R.; Himalaya Publishing House, 2011.
6. Bioinstrumentation, Veerakumari, L.; MJP Publisher, 2019.
7. Bioinstrumentation, Webster, J.G.; Wiley, 2007.

8. Essentials of Biophysics (2nd Edition), Narayanan, P.; New Age International Publications, 2007.
9. Fundamentals of Biochemistry: Life at the Molecular Level (5th Edition), Voet, Donald; Voet, Judith G.; Pratt, Charlotte W.; Wiley, 2016.
10. Instrumental Methods of Chemical Analysis, Chatwal, G.R.; Anand, S.K.; Himalaya Publishing House, 2007.
11. Introduction to Practical Biochemistry, Plummer, David T.; McGraw-Hill Education, 2001.
12. Physical Biochemistry: Applications to Biochemistry and Molecular Biology, Freifelder, D.; W.H. Freeman, San Francisco, 1976.
13. Practical Biochemistry: Principles and Techniques (5th Edition), Wilson, Keith; Walker, John; Cambridge University Press, London, UK, 2000.
14. Principles and Techniques of Biochemistry and Molecular Biology (6th Edition), Wilson, Keith; Walker, John; Cambridge University Press, London, UK, 2005.
15. Principles of Instrumental Analysis (6th Edition), Skoog, Douglas A.; Holler, F. James; Crouch, Stanley R.; Cengage Learning, 2007.

Internal Examination Pattern:

CAT – I: Activity Based

CAT – II: Open Book Test

Mapping of POs, PSOs and COs:

COs/P Os & PSOs	P O1	P O2	P O3	P O4	P O5	P O6	P O7	P O8	P O9	PO 10	PS O1	PS O2	PS O3	PS O4	PS O5
CO1	3	2	3	2	2	1	3	2	1	2	2	3	2	1	2
CO2	3	3	2	2	2	1	3	1	1	1	3	2	1	2	1
CO3	2	2	3	3	2	2	2	1	1	1	2	3	3	1	2
CO4	2	2	2	2	3	3	2	3	2	2	2	2	2	1	3

Scale: 3 = High, 2 = Moderate, 1 = Low, 0 = No correlation.



Semester - II

लातूर

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Empowered Autonomous Institution

Faculty of Science and Technology

Department of Biotechnology

UG I Sem II

Course Type: DSC-III

Course Title: Biochemistry

Course Code: 101BIO2101

Credits: 03

Max. Marks: 75

Lectures: 45 Hrs.

Learning Objectives:

- LO 1 Explain and analyze nucleic acid structure, forms, and biological functions.
- LO 2 Describe, apply, and analyze carbohydrate and lipid structure, classification, and functions.
- LO 3 Explain, analyze, and evaluate amino acid and protein structure and functions.
- LO 4 Describe, interpret, and evaluate the metabolic roles of vitamins and minerals.

Course Outcomes:

After completion of the course the students will be able to-

- CO 1 Explain and analyze the structure, properties, and stability of nucleic acids, including denaturation and renaturation processes.
- CO 2 Apply and analyze the structure, classification, and biological roles of carbohydrates and lipids in biological systems.
- CO 3 Analyze and evaluate the structure, classification, and functional significance of amino acids and proteins.
- CO 4 Explain, interpret, and evaluate the role of vitamins and minerals, including deficiency and toxicity in metabolism.

Unit No.	Title of Unit & Contents	Hrs.
I	Nucleic acids	07
	1. Introduction to biomolecules and chemical basis of life 2. Types of chemical bonds: covalent, non-covalent interactions. 3. Nucleic acids: Discovery and historical aspects 4. Nucleosides, nucleotides, Polynucleotides.	

Unit No.	Title of Unit & Contents	Hrs.
	5. DNA and its different forms [A, B, C, D, E and Z]. 6. Chargaff's rule 7. RNA and its types, mRNA, tRNA, siRNA, microRNA with function 8. Forces stabilizing nucleic acid structure, Denaturation and renaturation of DNA. Unit Outcomes: UO 1. Understand the basic concepts in formation and function of nucleic acids. UO 2. Understand the structure and stabilizing stabilization forces of nucleic acid	
II	Carbohydrates and Lipids	15
	1. Carbohydrates: Introduction, biological importance. 2. Definition, stereochemistry of carbohydrates. 3. Classification, Monosaccharides other than glucose, glycosidic bond, disaccharides, polysaccharides: homopolysaccharides and heteropolysaccharides. [starch, glycogen]. 4. Lipids: Introduction, Classes, Fatty acids. 5. Physical properties, Chemical properties, Saponification value, acid value, iodine number, rancidity. Phospholipids, Sphingolipids, Glycolipids. 6. Cholesterol Unit Outcome: UO 1. Distinguish between monosaccharides, disaccharides, and polysaccharides. UO 2. Gain the knowledge about classification, properties and role of lipids.	
III	Amino acids and Proteins	13
	1. Amino acids: structure and classification. 2. Properties and functions of amino acids, Acid base behavior, color reactions, Zwitterions. 3. Isoelectric point of amino acids. 4. Protein structure and Classification, Conformation of proteins. 5. Biological functions of protein. 6. Peptide bond. 7. Secondary structure – α -helix, β -sheet, triple helical structure.	

Unit No.	Title of Unit & Contents	Hrs.
	8. Tertiary Structure: Myoglobin. 9. Quaternary structure – Hemoglobin. 10. Ramachandran Plot Unit Outcomes: UO 1. Comprehend how amino acids are linked via peptide bonds to make polypeptides and proteins. UO 2 Explain the structure and functions of proteins.	
IV	Vitamins and Minerals	10
	1. Introduction of vitamins 2. Water soluble vitamins (Vit-B1, B2, B3, B5, B6, B7, B9, B12 & Vit C) 3. Fat soluble vitamins (Vit-A, D, E & K). 4. Minerals: Introduction of Macro (Na, K, Ca, Mg, P) minerals, micro minerals (Fe, I, F, Zn, Cu, Co, Se, Cr. Mn, Mo, Ni, Sn, Si, V), 5. Trace elements (Pb, Hg, B, Bo, Al). 6. Functions of micro, macro & trace elements. Unit Outcomes: UO 1. Develop the ability to understand both deficiency and toxicity symptoms of each micronutrient. UO 2. Understand classification of vitamins	

Learning Resources:

- Biochemistry, Donald J. Voet and Judith G. Voet 3rd Edition, John Wiley and Sons publication, 2004.
- Biochemistry, L. Stryer, WH Freeman Publication, 2015.
- Biomolecules And Cell Biology, P.K. Gupta, Rastogi Publication first edition, 2018.
- Chemistry Of Biomolecules, S.P. Bhutani, ANE Books, 2009.
- Fundamentals of Biochemistry, 5th Edition Voet et al., Wiley Publication, 2016.
- Outlines of Biochemistry Conn and Stumpf, 5th Edition, Wiley Publication, 2006.
- Principles of Biochemistry, Geoffrey Zubay, McGraw Hill Publishers, 1995.
- Principles of Biochemistry, Jeffery Zubey, WCB Publishers, 1995.
- Principles of biochemistry, Lehninger, Nelson, Cox., CBS Publishers, 7th ed. 2017.
- Textbook of Medical Biochemistry, Dr (Brig) MN Chatterjee and Rana Shinde, Eighth Edition, Jaypee Brothers Medical Publishers, 2012.

Internal Examination Pattern:

CAT – I: Activity Based

CAT – II: Open Book Test

Mapping of POs, PSOs and COs:

COs/P Os & PSOs	P O1	P O2	P O3	P O4	P O5	P O6	P O7	P O8	P O9	PO 10	PS O1	PS O2	PS O3	PS O4	PS O5
CO1	3	3	1	2	2	1	1	1	1	1	3	2	1	1	1
CO2	3	3	2	2	2	1	1	1	1	1	3	2	2	1	1
CO3	3	3	2	3	2	2	1	1	1	1	3	3	2	1	2
CO4	3	3	1	2	3	1	1	3	1	1	3	2	2	1	3

Scale: 3 = High, 2 = Moderate, 1 = Low, 0 = No correlation.

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Faculty of Science and Technology

Department of Biotechnology

UG I Sem II

Course Type: Lab Course

Course Title: Lab Course III (Based on DSC-III)

Course Code: 101BIO2103

Credits: 01

Max. Marks: 50

Hours: 30 Hrs.

Learning Objectives:

- LO 1 Develop and apply skills in the preparation of laboratory reagents, normal/molar solutions, and buffers.
- LO 2 Understand and analyze the quality and purity of biomolecules, particularly lipids.
- LO 3 Perform and interpret qualitative estimation methods for different biomolecules.
- LO 4 Apply and evaluate quantitative estimation techniques for biomolecules.

Course Outcomes:

After completion of the course the students will be able to-

- CO 1 Apply techniques to estimate the concentration of proteins, lipids, nucleic acids, and carbohydrates.
- CO 2 Analyze and identify the presence of biomolecules in known and unknown samples using qualitative tests.
- CO 3 Evaluate the quality of fats and oils by determining saponification and iodine values.
- CO 4 Prepare standard laboratory solutions and buffers for biochemical experiments.

Practical No.	Unit
1.	Preparation of solutions, buffer sensitivity, specificity accuracy, Molarities, molality, normality.
2.	Preparation of acetate buffer.
3.	Preparation of phosphate buffer.
4.	Preparation of citrate buffer.
5.	Titration of Oxalic acid and amino acid
6.	Qualitative test for carbohydrates and lipids.
7.	Determination of Acid value of fat
8.	Determination of iodine number of oil.
9.	Estimation of Amino acids by Ninhydrin method
10.	Estimation of Protein by Biuret and Lowry Method
11.	Estimation of total sugar by Anthrone method.
12.	Estimation of Total Reducing Sugar by DNSA method

13.	Estimation of DNA by DPA method
14.	Estimation of RNA by Orcinol Method
15.	Estimation of Ascorbic Acid by volumetric method.
16.	Mohr's salt Titration with Potassium Dichromate.

N.B.: Any Ten Practicals from above.



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Faculty of Science and Technology

Department of Biotechnology

UG I Sem II

Course Type: DSC-IV

Course Title: Genetics

Course Code: 101BIO2102

Credits: 03

Max. Marks: 75

Lectures: 45 Hrs.

Learning Objectives:

- LO 1 Explain, interpret, and apply the historical development of genetics and Mendelian principles to solve inheritance-based problems.
- LO 2 Analyze and interpret chromosomal organization, linkage, crossing over, gene mapping, and extra-chromosomal inheritance patterns.
- LO 3 Analyze, evaluate, and correlate gene mutations and microbial recombination mechanisms for genetic mapping and variation studies.
- LO 4 Apply, evaluate, and design population genetics models using Hardy–Weinberg equilibrium and quantitative genetics for trait improvement.

Course Outcomes:

After completion of the course the students will be able to-

- CO 1 Explain, apply, and solve genetic problems involving mendelian inheritance, gene interactions, and multiple alleles.
- CO 2 Analyze and interpret chromosomal structure, linkage, crossing over, pedigree analysis, and extra-chromosomal inheritance.
- CO 3 Evaluate and correlate mutation types and microbial genetic recombination techniques for gene mapping and genetic studies.
- CO 4 Apply, analyze, and design population genetics models and breeding strategies using hardy–weinberg equilibrium and quantitative genetics.

Unit No.	Title of Unit & Contents	Hrs.
I	Classical Genetics	11
	<ol style="list-style-type: none"> History of Genetics Heredity and Environment: Phenotype, Genotype, Heredity, variation, Pure lines and Inbred lines. Biography of Mendel and his experiments on pea plants. Principles of Mendel: Monohybrid cross, Dihybrid cross, back cross and Test cross. Multiple Alleles: ABO blood groups and Rh factor in Human, Gene Interactions. Intra-allelic interactions: Incomplete inheritance and Codominance Inter allelic interactions: Complementary gene Supplementary gene, Epistasis, Duplicate gene. Sex influenced and sex-limited inheritance. Sex determination in animals and plants. 	
	<p>Unit Outcomes:</p> <p>UO 1. Describe the fundamental principles of classical genetics and Mendelian inheritance.</p> <p>UO 2. Analyze different patterns of gene interaction and mechanisms of sex determination.</p>	
II	Cytogenetics	11
	<ol style="list-style-type: none"> Chromatin structure and Chromosome theory of inheritance. Structure of Eukaryotic Chromosome. Nucleosome model, Karyotype and Ideogram. Linkages: Types of linkages, Factors affecting linkages and Significance of linkages. Crossing over: Types and Mechanism of crossing over, interference and coincidence. Chromosomal Mapping. Sex linkages: Examples Drosophila and Man. Extra-chromosomal Inheritance: Characteristic features, Mitochondrial, Chloroplast, Kappa articles in Paramecium, Shell coiling in snail. Pedigree analysis in human. 	
	<p>Unit Outcome:</p> <p>UO 1. Explain the chromosomal basis of inheritance and the structural organization of chromosomes.</p> <p>UO 2. Interpret patterns of linkage, crossing over, and extra-chromosomal inheritance.</p>	
III	Mutation and Microbial Genetics	12
	<ol style="list-style-type: none"> Fine structure of the Gene- Cistron, muton and recon. Mutation: Physical and chemical mutagen, Types of Mutation. 	

Unit No.	Title of Unit & Contents	Hrs.
	3. Chromosomal Mutation: Structural and Numerical. 4. Microbial genetics: Conjugation and conjugation mapping, Transformation and Transformation mapping, Transduction and Transduction mapping.	
	Unit Outcomes: UO 1. Explain the types and molecular mechanisms of mutations. UO 2. Evaluate microbial recombination processes used in genetic mapping.	
IV	Population genetics and quantitative genetics	11
	1. Gene and genotype frequency, Hardy-Weinberg law and equation and its application in the study of population genetics. 2. Quantitative genetics, application of quantitative genetics in agriculture.	
	Unit Outcomes: UO 1. Apply Hardy–Weinberg equilibrium to analyze allele frequency in populations. UO 2. Apply quantitative genetics principles to develop strategies for crop or animal improvement.	

Learning Resources:

1. An introduction to genetic analysis, Griffiths AJF, Wessler SR, Carroll SB, Doebley J. 12th ed. New York: W. H. Freeman and Company; 2020.
2. Concepts of genetics, Klug WS, Cummings MR, Spencer CA, Palladino MA. 12th ed. Boston: Pearson Education; 2018.
3. Genetics, Gupta PK. 6th ed. Meerut (India): Rastogi Publications; 2020.
4. Genetics, Rastogi VB. 5th ed. New Delhi: Medtech Publications; 2021.
5. Genetics: A conceptual approach, Pierce BA. 7th ed. New York: W. H. Freeman and Company; 2026.
6. Genetics: Analysis of genes and genomes, Hartl DL, Ruvolo M. 8th ed. Burlington (MA): Jones & Bartlett Learning; 2012.
7. Genetics: From genes to genomes, Hartwell LH, Goldberg ML, Fischer JA, Hood L. 6th ed. New York: McGraw-Hill Education; 2020.
8. Genetics and analysis of quantitative traits, Lynch M, Walsh B. Sunderland (MA): Sinauer Associates; 2018.
9. Human molecular genetics, Strachan T, Read A. 5th ed. New York: Garland Science; 2018.
10. I Genetics: A molecular approach, Russell PJ. 3rd ed. Boston: Pearson Education; 2016.

11. Lewin's genes XII, Krebs JE, Goldstein ES, Kilpatrick ST. 12th ed. Burlington (MA): Jones & Bartlett Learning; 2017.
12. Molecular biology of the gene, Watson JD, Baker TA, Bell SP, Gann A, Levine M, Losick R. 7th ed. Boston: Pearson Education; 2014.
13. Principles of genetics, Snustad DP, Simmons MJ. 7th ed. Hoboken (NJ): John Wiley & Sons; 2016.
14. Principles of population genetics, Hartl DL, Clark AG. 4th ed. Sunderland (MA): Sinauer Associates; 2007.
15. The science of genetics, Atherly AG, Girton JR, McDonald JF. Revised ed. Philadelphia: Saunders College Publishing; 1999.

Internal Examination Pattern:

CAT – I: Activity Based

CAT – II: Open Book Test

Mapping of POs, PSOs and COs:

COs/P Os & PSOs	P O1	P O2	P O3	P O4	P O5	P O6	P O7	P O8	P O9	PO 10	PS O1	PS O2	PS O3	PS O4	PS O5
CO1	3	2	3	2	1	1	1	0	0	1	3	2	2	1	1
CO2	3	3	2	3	2	1	1	0	1	1	3	2	1	1	1
CO3	2	2	3	3	3	2	2	1	1	1	2	3	2	2	2
CO4	2	2	3	3	2	3	2	1	1	2	2	3	3	2	2

Scale: 3 = High, 2 = Moderate, 1 = Low, 0 = No correlation.



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Department of Biotechnology

UG I Sem II

Course Type: Lab Course

Course Title: Lab Course –IV (Based on DSC-IV)

Course Code: 101BIO2104

Credits: 1

Max. Marks: 50

Lectures: 30 Hrs.

Learning Objectives:

- LO 1 Explain the principles of Mendelian inheritance by interpreting genetic problems and predicting phenotypic and genotypic ratios.
- LO 2 Apply probability principles and statistical tests such as Student's t-test and Chi-square test to analyze genetic data and test inheritance hypotheses.
- LO 3 Analyze genetic patterns including gene interactions, pedigree inheritance, chromosome mapping, and Hardy–Weinberg equilibrium to interpret inheritance in populations.
- LO 4 Evaluate genetic traits, blood group inheritance, karyotype structures, and the effects of physical and chemical mutagens to understand genetic variation and mutation.

Course Outcomes:

After completion of the course the students will be able to-

- CO 1 Solve genetic problems involving monohybrid, dihybrid, trihybrid crosses, and gene interactions using Mendelian principles.
- CO 2 Interpret pedigree charts, chromosome mapping data, and Hardy–Weinberg calculations to analyze inheritance patterns and allele frequencies in populations.
- CO 3 Use statistical tools such as probability, Student's t-test, and Chi-square test to evaluate experimental genetic data.
- CO 4 Analyze human blood group inheritance, karyotype diagrams, trait variations, and the effects of mutagens to understand genetic diversity and mutation mechanisms.

Practical No.	Unit
1	Problems based on monohybrid cross.
2	Problems based on dihybrid cross.

3	Problems based on trihybrid cross
4	Problems based on interaction of genes
5	Problems based on application of probability, Student's T test and Chi square test in genetics.
6	Problems based on pedigree analysis.
7	Problems based on Chromosome mapping.
8	Problems based on Hardy-Weinberg equilibrium.
9	To study the human blood group by using a given blood sample.
10	Analysis and interpretation karyotype and ideogram by using charts / diagrams.
11	Study of Human traits, Animal traits and plant traits for its diversity in phenotype.
12	Study of effect of physical mutagens
13	Study of effect of chemical mutagens

N.B.: Any Ten Practicals from above.



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Faculty of Science and Technology

Department of Biotechnology

UG I Sem II

Course Type: VSC-II

Course Title: Bioinstrumentation-II

Course Code: 101BIO2501

Credits: 02 (01+01)

Max. Marks: 50

Lectures: 45 Hrs.

(15 Th +30 P)

Learning Objectives:

- LO 1 Understand & explain the principles, instrumentation, and applications of electrophoresis and spectroscopy techniques.
- LO 2 Apply chromatographic and electrophoretic techniques for separation and analysis of biomolecules.
- LO 3 Analyze spectroscopic data, chromatograms, and electrophoretic patterns for biomolecular characterization.
- LO 4 Evaluate radioisotope techniques with respect to safety, data interpretation, and biological applications.

Course Outcomes:

After completion of the course the students will be able to-

- CO 1 Prepare and perform electrophoretic techniques (agarose gel, page) for separation of nucleic acids and proteins using appropriate buffers and media.
- CO 2 Explain and apply spectroscopic techniques (uv-vis, ir, raman, fluorescence) for qualitative and quantitative biomolecular analysis.
- CO 3 Demonstrate and analyze advanced chromatographic techniques (affinity, gel filtration, gas chromatography) for purification and characterization of biomolecules.
- CO 4 analyze, evaluate and integrate radioisotope techniques with safety practices and interpret experimental data to solve biological problems.

Unit No.	Title of Unit & Contents	Hrs.
I	Electrophoresis	
	<ol style="list-style-type: none">1. General Principles2. Support media and Buffers3. Electrophoresis of Nucleic acid – Agarose gel electrophoresis of nucleic acid4. Electrophoresis of Proteins- PAGE5. Capillary electrophoresis.	

Unit No.	Title of Unit & Contents	Hrs.
	<p>Unit Outcomes:</p> <p>UO 1. Explain the principles, types, and working mechanisms of electrophoresis techniques (agarose gel, PAGE, capillary).</p> <p>UO 2. Apply buffer preparation, supporting media selection, and electrophoretic methods for separation of nucleic acids and proteins.</p>	
II	Spectroscopy	
	<ol style="list-style-type: none"> 1. Introduction: Basic principles and applications 2. Ultraviolet and Visible light spectroscopy 3. Infrared and Raman Spectroscopy 4. Fluorescence spectroscopy 	
	<p>Unit Outcome:</p> <p>UO 1. Explain the principles and instrumentation of UV-Visible, IR, Raman, and fluorescence spectroscopy.</p> <p>UO 2. Analyze spectroscopic data for identification and quantification of biomolecules.</p>	
III	Advanced Chromatography Techniques	
	<ol style="list-style-type: none"> 1. Affinity chromatography 2. Gel filtration chromatography 3. Gas chromatography 	
	<p>Unit Outcomes:</p> <p>UO 1. Explain the principles and working of affinity, gel filtration, and gas chromatography techniques.</p> <p>UO 2. Analyze chromatographic profiles for biomolecule purification and separation efficiency.</p>	
IV	Radioisotope Techniques	
	<ol style="list-style-type: none"> 4. Detection and measurement of radioactivity 5. Other practical aspects of counting radioactivity and Analysis of Data 6. Safety aspects. 	
	<p>Unit Outcomes:</p> <p>UO 1. Explain the principles, detection, and measurement of radioactivity in biological systems.</p> <p>UO 2. Apply safety practices and analyze radioactivity data in biological experiments.</p>	
V	Practicals (Included in above 04 units)	
	<ol style="list-style-type: none"> 1. A study of Good laboratory practices in Biochemistry and molecular biology laboratories. 	

Unit No.	Title of Unit & Contents	Hrs.
	2. To resolve the given DNA sample by using agarose gel electrophoresis. 3. To resolve the given mixture of proteins by means of SDS PAGE. 4. To Study Lamberts Beers Law 5. Demonstration of IR spectroscopy for the study of plant secondary metabolites. 6. Problems on Spectroscopy 7. To carry out desalting of the given protein by using column chromatography technique. 8. A virtual study of affinity and Gel Permeation chromatography by using animations and other study materials. 9. A virtual study of Gas chromatography by using animations and other study materials. 10. To solve the problems based on Radioactivity techniques 11. Demonstration of Geiger Muller Counter	

Learning Resources:

- Biochemical Techniques: Theory and Practice, Robyt, John F.; White, Bernard J.; Waveland Press, Inc., U.S.A., 1990.
- Biophysical Chemistry, Upadhyay, A.; Upadhyay, K.; Nath, N.; Himalaya Publishing House, Delhi, 2016.
- Biophysics, Arora, Mohan P.; Himalaya Publishing House, 2020.
- Biophysics, Chatwal, G.R.; Himalaya Publishing House, 2011.
- Bioinstrumentation, Veerakumari, L.; MJP Publisher, 2019.
- Bioinstrumentation, Webster, J.G.; Wiley, 2007.
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Internal Examination Pattern:

CAT – I: Activity Based

CAT – II: Open Book Test

Mapping of POs, PSOs and COs:

COs/P Os & PSOs	P O1	P O2	P O3	P O4	P O5	P O6	P O7	P O8	P O9	PO 10	PS O1	PS O2	PS O3	PS O4	PS O5
CO1	2	2	3	2	1	1	3	2	1	1	2	3	1	1	2
CO2	3	3	2	3	2	1	2	1	1	1	3	2	1	2	2
CO3	2	2	3	3	2	2	3	1	1	1	2	3	2	2	2
CO4	2	2	2	3	3	2	2	3	2	1	2	3	2	1	3

Scale: 3 = High, 2 = Moderate, 1 = Low, 0 = No correlation.

॥ आरोह तमसो ज्योतिः ॥

Rajarshi Shahu Mahavidyalaya,
Latur (Autonomous)



Shiv Chhatrapati Shikshan Sanstha's

Rajarshi Shahu Mahavidyalaya, Latur

Empowered Autonomous Institution

Extra Credit Activities

Sr. No.	Course Title	Credits	Hours T/P
1	MOOCs	Min. of 02 credits	Min. of 30 Hrs.
2	Certificate Courses	Min. of 02 credits	Min. of 30 Hrs.
3	IIT Spoken English Courses	Min. of 02 credits	Min. of 30 Hrs.

Guidelines:

Extra -academic activities

1. All extra credits claimed under this heading will require sufficient academic input/ contribution from the students concerned.
2. Maximum 04 extra credits in each academic year will be allotted.
3. These extra academic activity credits will not be considered for calculation of SGPA/CGPA but will be indicated on the grade card.

Additional Credits for Online Courses:

1. Courses only from SWAYAM and NPTEL platform are eligible for claiming credits.
2. Students should get the consent from the concerned subject Teacher/Mentor/Vice Principal and Principal prior to starting of the course.
3. Students who complete such online courses for additional credits will be examined/verified by the concerned mentor/internal faculty member before awarding credits.
4. Credit allotted to the course by SWAYAM and NPTEL platform will be considered as it is.

Additional Credits for Other Academic Activities:

1. One credit for presentation and publication of paper in International/National/State level seminars/workshops.
2. One credit for measurable research work undertaken and field trips amounting to 30 hours of recorded work.
3. One credit for creating models in sponsored exhibitions/other exhibits, which are approved by the concerned department.
4. One credit for any voluntary social service/Nation building exercise which is in collaboration with the outreach center, equivalent to 30 hours
5. All these credits must be approved by the College Committee.

Additional Credits for Certificate Courses:

1. Students can get additional credits (number of credits will depend on the course duration) from certificate courses offered by the college.
2. The student must successfully complete the course. These credits must be approved by the Course Coordinators.
3. Students who undertake summer projects/ internships/ training in institutions of repute through a national selection process, will get 2 credits for each such activity. This must be done under the supervision of the concerned faculty/mentor.

Note:

1. The respective documents should be submitted within 10 days after completion of Semester End Examination.
2. No credits can be granted for organizing or for serving as office bearers/ volunteers for Inter-Class / Associations / Sports / Social Service activities.
3. The office bearers and volunteers may be given a letter of appreciation by the respective staff coordinators. Besides, no credits can be claimed for any services/ activities conducted or attended within the college.
4. All claims for the credits by the students should be made and approved by the mentor in the same academic year of completing the activity.
5. Any grievances of denial/rejection of credits should be addressed to Additional Credits Coordinator in the same academic year.
6. Students having a shortage of additional credits at the end of the third year can meet the Additional Credits Coordinator, who will provide the right advice on the activities that can help them earn credits required for graduation.

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Examination Framework

Theory:

40% Continuous Assessment Tests (CATs) and 60% Semester End Examination (SEE)

Practical:

50% Continuous Assessment Tests (CATs) and 50% Semester End Examination (SEE)

Course	Marks	CAT & Mid Term Theory				CAT Practical		Best Scored CAT & Mid Term	SEE	Total
		Att.	CAT I	Mid Term	CAT II	Att.	CAT			
1	2	3				4		5	6	5 + 6
DSC/DSE/ GE/OE/Minor	100	10	10	20	10	-	-	40	60	100
DSC	75	05	10	15	10	-	-	30	45	75
Lab Course/AIPC/ OJT/FP/SEC (Science & Technology)	50	-	-	-	-	05	20	-	25	50
VSC/SEC/ AEC/VEC/CC	50	05	05	10	05	-	-	20	30	50

Note:

1. All Internal Exams are compulsory
2. Out of 02 CATs best score will be considered
3. Mid Term Exam will be conducted by the Exam Section
4. Mid Term Exam is of Objective nature (MCQ)
5. Semester End Exam is of descriptive in nature (Long & Short Answer)
6. CAT Practical (20 Marks): Lab Journal (Record Book) 10 Marks, Overall Performance 10 Marks