

**Shiv Chhatrapati Shikshan Sanstha's**  
**Rajarshi Shahu Mahavidyalaya, Latur**  
**(Autonomous)**



**Structure and Curriculum of Four Year Multidisciplinary  
Degree (Honors) 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**  
**(Autonomous)**

**w.e.f. June, 2023**  
**(In Accordance with NEP-2020)**

## **CERTIFICATE**

I hereby certify that the documents attached are the Bonafide copies of the Curriculum of **B.Sc. (Honors) in Biotechnology** Programme to be effective from the **Academic Year 2023-24.**

Date: 14/07/2023

Place: Latur



**(Dr.Sachin Kulkarni)**

Chairperson

Board of Studies in Biotechnology  
Rajarshi Shahu Mahavidyalaya, Latur  
(Autonomous)



## **Rajarshi Shahu Mahavidyalaya, Latur**

**(Autonomous)**

### **Members of Board of Studies in the Subject Biotechnology Under the Faculty of Science and Technology**

<b>Sr. No.</b>	<b>Name</b>	<b>Designation</b>	<b>In position</b>
<b>1</b>	<b>Dr. Sachin S. Kulkarni</b> Head, Department of Biotechnology, Rajarshi Shahu Mahavidyalaya, Latur (Autonomous)	Chairperson	HoD
<b>2</b>	<b>Prof. Tukaram. A. Kadam</b> Professor, School of Life Sciences SRTMU, Nanded.	Member	V.C. Nominee
<b>3</b>	<b>Dr. Rahul. P. Bhagat</b> Asst. Professor, Department of Biotechnology, Govt. Institute of Science, Aurangabad (Autonomous)	Member	Academic Council Nominee
<b>4</b>	<b>Dr. Rajesh M. Jorgewad</b> Asst. Professor, Department of Biotechnology and Bioengineering, KIT college, Kolhapur (Autonomous)	Member	Academic Council Nominee
<b>5</b>	<b>Dr. Gunderao. H. Kathwate</b> Asst. Professor, Dept. of Biotech. S. P. P. U. Pune	Member	Expert from outside for Special Course
<b>6</b>	<b>Mr. Abhay. M. Desai</b> Wockhardt, Aurangabad	Member	Expert from Industry
<b>7</b>	<b>Dr. Santosh Narwade</b> Serum Institute Pvt.Ltd. Pune	Member	P.G. Alumni
<b>8</b>	<b>Dr. Manisha. A. Dhotre</b> Asst. Professor, Department of Biotechnology, Rajarshi Shahu Mahavidyalaya, Latur (Autonomous)	Member	Faculty Member
<b>9</b>	<b>Mr. Udaybhanu. P. Sirdeshmukh</b> Asst. Professor Department of Biotechnology Rajarshi Shahu Mahavidyalaya, Latur (Autonomous)	Member	Faculty Member
<b>10</b>	<b>Dr. Ravindra. B. Ade</b> Asst. Professor Department of Biotechnology Rajarshi Shahu Mahavidyalaya, Latur (Autonomous)	Member	Faculty Member
<b>11</b>	<b>Dr. Sanghapal. S. Kshirsagar</b> Asst. Professor Department of Biotechnology Rajarshi Shahu Mahavidyalaya, Latur (Autonomous)	Member	Faculty Member

<b>Sr. No.</b>	<b>Name</b>	<b>Designation</b>	<b>In position</b>
<b>12</b>	<b>Mr. Suraj. D. Kadam</b> Asst. Professor Department of Biotechnology Rajarshi Shahu Mahavidyalaya, Latur (Autonomous)	Member	Faculty Member
<b>13</b>	<b>Mr. Akash. J. Waghmare</b> Asst. Professor Department of Biotechnology Rajarshi Shahu Mahavidyalaya, Latur (Autonomous)	Member	Faculty Member
<b>14</b>	<b>Miss. Swati G. Swami</b> Asst. Professor, Department of Biotechnology, Rajarshi Shahu Mahavidyalaya, Latur (Autonomous)	Member	Faculty Member
<b>15</b>	<b>Mr. Sanket M. Bansode</b> Asst. Professor, Department of Biotechnology, Rajarshi Shahu Mahavidyalaya, Latur (Autonomous)	Member	Faculty Member
<b>16</b>	<b>Miss. Karuna S. Komatwar</b> Asst. Professor, Department of Biotechnology, Rajarshi Shahu Mahavidyalaya, Latur (Autonomous)	Member	Faculty Member
<b>17</b>	<b>Dr. Kakasaheb S. Raut</b> Asst. Professor Department of Zoology and Fishery Science, Rajarshi Shahu Mahavidyalaya Latur (Autonomous)	Member	Member from same Faculty

### 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 biomolecular 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 Hands 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

(Autonomous)

### Index

Sr. No.	Content	Page No.
1	Structure for Four Year Multidisciplinary UG Programme	1
2	Abbreviations	2
3	Courses and Credits	3
4	UG Program Outcomes	4
5	Programme Specific Outcomes	5
6	Curriculum: Semester-I	6-16
7	Basket I: Generic/Open Elective (GE/OE)	17
8	Basket II: Skill Enhancement Courses (SEC)	18
9	Basket III: Ability Enhancement Courses (AEC)	19
10	Extra Credit Activities	20-21
11	Examination Framework	22



## Rajarshi Shahu Mahavidyalaya, Latur

(Autonomous)

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	GE/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	GE-I: 04 Cr.	VSC-I: 02 Cr. SEC-I: 02 Cr.	AEC-I 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	DSCIII: 04 Cr. DSC IV: 04 Cr. (IKS)	NA	NA	GE-II: 04 Cr.	VSC-II: 02 Cr. SEC-II: 02 Cr.	AEC- II MIL: 02 Cr. VEC- II: 02 Cr.	CC-II: 02 Cr. (NSS, NCC, Sports, Cultural)/ CEP-II: 02 Cr. (SES-II)/ OJT: 02 Cr. / Mini Project: 02 Cr.	22	
	Cum. Cr.	16	-	-	08	04+04= 08	04+02 +02=0 8	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. **GE/OE : Generic/Open Elective**
5. **VSEC : Vocational Skill and Skill Enhancement Course**
6. **VSC : Vocational Skill Courses**
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 Courses**
13. **OJT : On Job Training**
14. **FP : Field Projects**
15. **CEP : Community Engagement and Service**
16. **CC : Co-Curricular Courses**
17. **RP : Research Project/Dissertation**
18. **SES : Shahu Extension Services**





## Rajarshi Shahu Mahavidyalaya, Latur

(Autonomous)

### Department of Biotechnology

### B.Sc. (Honors) in 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	
		GE-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/ Field Project	02	60		
	<b>Total Credits</b>				<b>22</b>	
	II	101BIO2105 (DSC-III)	Biochemistry	03	45	
		101BIO2107	Lab Course-III	01	30	
		101BIO2106 (DSC-IV) IKS	Indian Medicinal Plants and Traditional System of Medicines	03	45	
		101BIO2108	Lab Course-IV	01	30	
		GE-II	From Basket	04	60	
		101BIO2502 (VSC-II)	Bioinstrumentation -II	02	45	
		(SEC-II)	From Basket	02	30	
		(AEC-II)	From Basket	02	30	
		(VEC-II)	FSRCE (CBPR)	02	30	
		AIPC/OJT-II	Mini project/ Field Project	02	60	
	<b>Total Credits</b>				<b>22</b>	
<b>Total Credits (Semester I &amp; II)</b>				<b>44</b>		



## **Rajarshi Shahu Mahavidyalaya, Latur**

**(Autonomous)**

**Faculty of Science & Technology**

<b>Programme Outcomes (POs) for B.Sc. Programme</b>	
PO 1	
PO 2	
PO 3	
PO 4	
PO 5	
PO 6	
PO 7	



## Rajarshi Shahu Mahavidyalaya, Latur

(Autonomous)

<b>Programme Specific Outcomes (PSOs) for B.Sc. Biotechnology (Honors)</b>	
<b>PSO No.</b>	Upon completion of this programme the students will be able to
<b>PSO 1</b>	Prepare the students with the skills, ethics, aptitude and human values of practicing the science in day-to-day life
<b>PSO 2</b>	Promote the interdisciplinary research in biotechnology for tackling the future problems threatening the society
<b>PSO 3</b>	Equip the students with the abilities required to attain self-sufficiency and life sustainability by imparting entrepreneurial skills
<b>PSO 4</b>	Design process equipment, plants, biosensors and recombinant molecules for biotechnological and allied processes
<b>PSO 5</b>	Identify measures for energy, environment, health, safety and society following ethical principles and apply the knowledge of basic science and engineering to solve complex biotechnological problems
<b>PSO 6</b>	Isolate, purify and characterize biological samples using sophisticated analytical experimental techniques
<b>PSO 7</b>	Apply modern software tools including prediction and modeling methods on biological databases to identify issues in biomedical problems
<b>PSO 8</b>	Assess personal, product and environmental safety, intellectual property and social responsibilities related to modern biotechnological research and development



## Rajarshi Shahu Mahavidyalaya, Latur

(Autonomous)

Department of Biotechnology

Course Type: DSC-I

Course Title: Cell Biology

Course Code: 101BIO1101

Credits: 03

Max. Marks: 75

Lectures: 45 Hrs.

### Learning Objectives:

- LO 1. To understand basic of cell biology and its applications.
- LO 2. To study Cell organelles and its Function
- LO 3. To understand transport mechanism in and out of cell
- LO 4. To understand cell cycle and its regulation events
- LO 5. To understand the concept of types of cells.
- LO 6. To study the concept of cytoskeleton.
- LO 7. To acquire the knowledge about cell signaling.
- LO 8. To acquire the knowledge about active transport.

### Course Outcomes:

After completion of course the student will be able to-

- CO 1. discuss origin and evolution of cells
- CO 2. describe physico-chemical composition of organelles and their functional organization.
- CO 3. explain transport mechanism of cells
- CO 4. elucidate significance of cell-cell communication
- CO 5. explain the knowledge about origin of mitochondria.
- CO 6. elucidate the concept of extracellular matrix.
- CO 7. understand the role of high energy compounds.
- CO 8. understand the basic concept of stem cell.

Unit No.	Title of Unit & Contents	Hrs.
<b>I</b>	<b>Introduction to Cell biology</b>	<b>07</b>
	<ul style="list-style-type: none"><li>1. Cell – Shapes, morphology, Cell theory.</li><li>2. Origin of life –Stanley miller Experiment.</li><li>3. Origin of Mitochondria, Chloroplast (Endosymbiotic theory).</li><li>4. Introduction to prokaryotic and eukaryotic cells.</li><li>5. Microscopic techniques in cell biology.</li></ul>	
	<b>Unit Outcomes:</b> UO 1. Discuss origin and evolution of cells. UO 2. Explain difference between prokaryotic and eukaryotic cell.	
<b>II</b>	<b>Cell organelles and Cytoskeleton</b>	<b>15</b>
	<ul style="list-style-type: none"><li>1. Cell wall and cell membrane.</li><li>2. Endoplasmic reticulum and Golgi body.</li><li>3. Mitochondria and Chloroplast.</li><li>4. Nucleus.</li><li>5. Microbodies: Glyoxysome, Peroxisome, Melanosome, lysosomes, vacuoles.</li><li>6. Cytoskeleton.</li></ul>	

Unit No.	Title of Unit & Contents	Hrs.
	7. Extracellular matrix. 8. Cell junctions. <b>Unit Outcome:</b> UO 1. Describe physico-chemical composition of organelles and their functional organization. UO 2. Explain cytoskeleton and cell junction.	
<b>III</b>	<b>Membrane Transport</b>	<b>13</b>
	1. Transport across cell membrane, simple diffusion, passive transport, active transport, Na/K ion channel, vesicular transport. 2. concept of ETC Membrane. 3. Role of high energy compound. 4. Membrane potential, Depolarization, hyperpolarization of membrane (neuronal). 5. Generation of action potential. 6. Types of biopotentials. Biopotential measurement instrument. <b>Unit Outcomes:</b> UO 1. Explain transport mechanism of cells UO 2. Student will be able to study action potential in cell	
<b>IV</b>	<b>Cell cycle and Cell-cell communication</b>	<b>10</b>
	1. The mechanism of cell division 2. Cell cycle and its regulation, 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 <b>Unit Outcomes:</b> UO 1. Elucidate significance of cell-cell communication UO 2. Describe mechanism of cell division and cell death.	

### Learning Resources:

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



## Rajarshi Shahu Mahavidyalaya, Latur

(Autonomous)

Department of Biotechnology

**Course Type: Lab Course**

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

**Course Code: 101BIO1103**

**Credits: 01**

**Max. Marks: 50**

**Hours: 30**

### Learning Objectives

- LO 1. To study cell diversity.
- LO 2. To design experiments on karyotyping
- LO 3. To study different stages of cell cycle
- LO 4. To provide hands-on Cell Separation Techniques
- LO 5. To study the staining technique of lipids.
- LO 6. To design experiments on cell lysis- methodology.

### Course outcomes

After completion of course the student 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

N.B.: Any Ten Practicals from above.



## Rajarshi Shahu Mahavidyalaya, Latur

(Autonomous)

### Department of Biotechnology

**Course Type: DSC-II**

**Course Title: Introduction to Microbiology**

**Course Code: 101BIO1102**

**Credits: 03**

**Max. Marks: 75**

**Lectures: 45 Hrs.**

#### Learning Objectives:

- LO 1. To learn and understand the contributions of various scientists in microbiology
- LO 2. To learn structure and function of bacterial cell
- LO 3. To understand and apply pure culture technique for isolation of microorganisms
- LO 4. To understand different methods of sterilization of culture media
- LO 5. To observe, understand and measure microbial growth
- LO 6. To understand the mechanism and function of staining used in microbiology
- LO 7. To understand the different types of culture media, direct and indirect methods of quantification of microorganisms
- LO 8. To understand the mechanism of external environmental factors on growth of microorganism

#### Course Outcomes:

After completion of course the student will be able to-

- CO 1. interpret the structural similarities and differences among microorganisms and the unique structure/function relationships of prokaryotic cells
- CO 2. explain the diversity of microorganism in special reference to bacteria
- CO 3. demonstrate the proper use of a microscope to observe microorganisms and report observed characteristics
- CO 4. describe aseptic technique and be able to perform routine culture handling tasks, safely and effectively
- CO 5. perform preparation of culture media for microbial growth.
- CO 6. describe effect of different environmental factors on microbial growth.

Unit No.	Title of Unit & Contents	Hrs.
I	<b>History and Overview of Microbiology</b>	11
	<b>Unit I:</b> <ol style="list-style-type: none"><li>1. Biogenesis and abiogenesis, Contributions of Redi, Spallanzani, Needham, Tyndall, Joseph Lister, Pasteur, Koch [Germ Theory].</li><li>2. Scope of Microbiology.</li><li>3. General classification of microorganisms as Bacteria, Fungi, Algae, Protozoa.</li><li>4. Structure and organization of bacteria: Capsule, cell wall, cytoplasmic membrane, nucleoid, Ribosome, endospores, cytoplasmic inclusions, flagellum, Pilli, protoplast and spheroplast.</li></ol>	

Unit No.	Title of Unit & Contents	Hrs.
	<p><b>Unit Outcomes:</b></p> <p>UO 3. Interpret the structural similarities and differences among microorganisms and the unique structure/function relationships of prokaryotic cells.</p> <p>UO 4. Understand the types of micro-organisms.</p>	
<b>II</b>	<b>Microbial Media and Sterilization Techniques</b>	<b>12</b>
	<ol style="list-style-type: none"> <li>1. Major and minor media components.</li> <li>2. Types of media Viz. Basal, Selective, Differential and Enrichment media. Mode of nutrition.</li> <li>3. Definition of sterilization, dry and moist heat, pasteurization, Tyndallization, radiation, ultrasonication, filtration.</li> <li>4. Physical and Chemical methods of sterilization; disinfection sanitization, antiseptics sterilant and fumigation.</li> <li>5. Determination of phenol coefficient of disinfectant.</li> </ol> <p><b>Unit Outcome:</b></p> <p>UO 3. Explain the diversity of microorganism in special reference to bacteria.</p> <p>UO 4. Explain the methods of sterilizations.</p>	
<b>III</b>	<b>Isolation and Identification Techniques</b>	<b>13</b>
	<ol style="list-style-type: none"> <li>1. Isolation, cultivation and identification techniques for microorganisms, aerobic and anaerobic cultivation.</li> <li>2. Biochemical methods for identification, pure culture techniques and preservation of pure cultures.</li> <li>3. Definition of auxochrome, chromophores.</li> <li>4. Classification of stains, Theories of staining.</li> <li>5. Mechanism of gram staining, acid fast staining, negative staining, capsule staining, flagella staining, endospore staining.</li> </ol> <p><b>Unit Outcomes:</b></p> <p>UO 3. Demonstrate the proper use of a microscope to observe microorganisms and report observed characteristics.</p> <p>UO 4. Elaborate their concepts about isolation of microbes from different forms.</p>	
<b>IV</b>	<b>Bacterial Growth</b>	<b>09</b>
	<ol style="list-style-type: none"> <li>1. Different types of bacterial culture (Batch, Synchronous, Diauxic, Axenic).</li> <li>2. Definition and brief description. Growth Curve, Calculation of duration of Phases and generation time, Growth yields.</li> <li>3. Methods of growth determination.</li> <li>4. Environmental factors affecting growth - temperature, pH, osmotic pressure and nutrient concentration per cell.</li> </ol> <p><b>Unit Outcomes:</b></p> <p>UO 3. Master aseptic technique and be able to perform routine culture handling tasks safely and effectively.</p> <p>UO 4. Understand the concepts of bacterial culture.</p>	



### **Learning Resources:**

1. Elementary Microbiology, H. A. Modi, Nadiad Akta Prakashan, Volume I and II, 2002.
2. General Microbiology- Powar and Daginawala- Himalya Publication, 2019.
3. Fundamental Principles of Bacteriology- A.J.Salle- TATA-McGraw Hill publication, 1984.
4. General Microbiology-Pelczar- Tata McGraw Hill publication V<sup>th</sup> Edition, 2001.
5. Text-book of Microbiology- Anantnarayan, C.K. Jayram, Panikar, Orient Longman, Universities Press (India) Pvt. Ltd.; X<sup>th</sup> edition, 2017.
6. General Microbiology- Stanier R.-. Macmillan Press Ltd V<sup>th</sup> Edition, 1986.
7. Text Book of Microbiology- R.C. Dubey- S. Chand Publications; Fourth edition, 2013.
8. Microbiology: A Laboratory Manual, Cappucino J and Sherman N., 9th edition. Pearson Education limited 2010.
9. Microbiology Paperback, by P. D. Sharma, Rastogi Publication, 4th Edition 2010.
10. Textbooks of Microbiology and Immunology by Subhash Chandra Parija, ELSEVIER, 2nd Edition, 2012



## Rajarshi Shahu Mahavidyalaya, Latur

(Autonomous)

Department of Biotechnology

**Course Type: Lab Course**

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

**Course Code: 101BIO1104**

**Credits: 01**

**Max. Marks: 50**

**Hours: 30**

### Learning Objectives

- LO 1. To educate students in a variety of important microbiological disciplines
- LO 2. To promote and develop skills in the use of tools, technologies and methods common to microbiology.
- LO 3. To understand use of different staining methods in differentiation of Bacteria.
- LO 4. To understand pure culture techniques and media required for microbial growth.
- LO 5. To educate the student in various sterilization techniques used in laboratory and media preparation.
- LO 6. To study and understand the microbial world and its diversity.

### Course outcomes

After completion of course the student will be able to-

- CO 1. isolate and enumerate bacteria.
- CO 2. identify microbes using microscopic and biochemical tests.
- CO 3. determine, interpret and discuss the growth kinetics of microbes growing in batch culture.
- CO 4. act in accordance with safe laboratory practice in terms of conduct, attire, risk minimization and appropriate waste disposal.

Practical No.	Unit
1	Introduction of Microbiology laboratory
2	Study of Microscope
3	Sterilization techniques
4	Preparation of culture media
5	Isolation of bacteria by Streak plate method
6	Isolation of bacteria by spread plate method
7	Isolation of bacteria by pour plate method
8	Isolation of bacteria by serial dilution method
9	Identification of microorganisms from the habitats by simple staining method
10	Identification of microorganisms from the habitats by differential staining method
11	Identification of microorganisms from the habitats by acid fast staining method
12	Identification of microorganisms from the habitats by capsule staining method
13	Identification of microorganisms from the habitats by spore staining and motility
14	Observation of morphology - shape and arrangement of cells

15	Methods of inoculation of different microbes in selective media
16	Microscopic measurements, micrometer (ocular and stage), hemocytometer
17	Sampling and quantification of microorganisms from air
18	Sampling and quantification of microorganisms from soil
19	Sampling and quantification of microorganisms from water

N.B.: Any Ten Practicals from above.



## Rajarshi Shahu Mahavidyalaya, Latur

(Autonomous)

Department of Biotechnology

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. To understand the analytical techniques and equipment used in biological science.
- LO 2. To understand the basic principle and applications of microscopy and centrifugation.
- LO 3. To acquire knowledge on the Chromatographic methods for the separation of biological molecules.
- LO 4. To learn care and safety during handling of laboratory equipment's.
- LO 5. To learn scientific calculations related with measurements, microscopy, centrifugation and chromatography.
- LO 6. To understand good laboratory practices in practicals related with biological studies.
- LO 7. To learn different applications of bioinstrumentation in biological research and industries.

### Course Outcomes:

After completion of course the student will be able to-

- CO 1. Handle successfully all measurement tools in solution preparation.
- CO 2. Explain the use and applications of microscopy.
- CO 3. Explain the use and applications of centrifugation.
- CO 4. Perform paper chromatography and TLC for the separation of biomolecules.
- CO 5. Prepare Different Solutions
- CO 6. understand calibrations of tools and instruments.
- CO 7. expertise in handling above biological techniques in their research.

Unit No.	Title of Unit & Contents	Hrs.
I	<b>Fundamental Instrumentation used in Biological research</b>	<b>04</b>
	1. Tools and Instruments for measurements: Pipette, measuring cylinders, Micropipette, Weighing balance etc. 2. Principles and working of pH meter and Colorimeter 3. Other tools/instruments: Hot water bath, Hot plate, heating mantle, distillation unit, vortex mixer, homogenizer etc.	

	<p><b>Unit Outcomes:</b>          UO 1. Understand the principle of basic instrumentation          UO 2. Understand functions and working of laboratory tools and techniques          UO 3. Understand calibration and maintenance of basic instrumentation</p>	
<b>II</b>	<b>Microscopy</b>	<b>05</b>
	<ol style="list-style-type: none"> <li>1. Light microscopy: Simple microscope, compound microscope, Dark field microscope, Inverted light microscope.</li> <li>2. Fluorescence microscope</li> <li>3. Electron microscopy: TEM, SEM</li> </ol>	
	<p><b>Unit Outcomes:</b>          UO 1. Acquaint knowledge of Microscopy.          UO 2. Understand the principle and working of Microscopy.          UO 3. Understand applications of advanced microscopy in life sciences.</p>	
<b>III</b>	<b>Centrifugation</b>	<b>03</b>
	<ol style="list-style-type: none"> <li>1. Centrifuge – principle, working and applications.</li> <li>2. Care and safety aspects of centrifuges</li> <li>3. Analytical ultracentrifugation</li> <li>4. Differential and Density gradient centrifugation</li> </ol>	
	<p><b>Unit Outcome:</b>          UO 1. Augment the knowledge of different Centrifugation techniques          UO 2. Understand applications of Centrifugation.          UO 3. Aware about care and handling of different centrifuge machines.</p>	
<b>IV</b>	<b>Chromatography</b>	<b>03</b>
	<ol style="list-style-type: none"> <li>1. Principle of Chromatography</li> <li>2. Principle and applications of paper and TLC chromatography</li> <li>3. Ion exchange chromatography</li> </ol>	
	<p><b>Unit Outcomes:</b>          UO 1. Understand basic principles of chromatography.          UO 2. Acquaint significance of chromatography in biological studies.          UO 3. Understand applications of different chromatography types in their biological studies.</p>	
<b>V</b>	<b>Practicals (Included in above 04 units)</b>	<b>30</b>
	<ol style="list-style-type: none"> <li>1. Calibration and handling of measurement tools and weighing balance.</li> <li>2. Calibration and working applications of PH meter.</li> <li>3. Calibration and practical handling and applications of colorimeter and spectrophotometer.</li> <li>4. Calibration and Working of Hot water bath, Hot plate, heating mantle, vortex mixer, homogenizer etc.</li> <li>5. To learn the process of distillation of water by using distillation unit.</li> <li>6. A study of components and their functions of simple and compound microscope.</li> <li>7. Prepare the specimen by using temporary mounting methods for</li> </ol>	

	<p>compound microscope.</p> <ol style="list-style-type: none"> <li>8. Prepare the specimen by using dehydration, staining and clearing by using permanent mounting of plant specimens.</li> <li>9. Problems on Microscopy.</li> <li>10. Demonstration of different types of centrifugation techniques.</li> <li>11. Separation of Biomolecules by Centrifugation</li> <li>12. Problems on Centrifugation.</li> <li>13. To separate the plant leaf homogenate pigments by using paper chromatography technique.</li> <li>14. To separate the amino acids by using thin layer chromatography technique.</li> <li>15. To purify the enzyme from crude preparation by using ion exchange chromatography.</li> </ol>	
--	---	--

### Learning Resources:

1. Biophysical Chemistry by Upadhyay, Upadhyay and Nath, Himalaya Pub. House, Delhi, 2016.
2. Practical Biochemistry- principles and techniques; (5th edition), Keith Wilson and John Walker. Cambridge University press, London, UK, 2000.
3. Principles and Techniques of Biochemistry and Molecular Biology (6th edition), Keith Wilson and John Walker. Cambridge University press, London, UK, 2005.
4. Essentials of Biophysics (2nd edition) - P.Narayanan, New Age International Publications, 2007.
5. Biophysics by G.R.Chatwal, Himalaya Publishing House, 2011.
6. Biophysics by Mohan P Arora, Himalaya Publishing House, 2020.
7. Physical Biochemistry: Applications to Biochemistry and Molecular Biology by Freilder, D. Freeman, San. Francisco, 1976.
8. Biochemical Techniques: Theory and Practice by Robyt, John F.; White, Bernard J. Waveland Press, Inc., U.S.A. Published: 1990.
9. Bioinstrumentation by Webster, Wiley, 2007.
10. Bioinstrumentation by I. Veerakumari, MJP Publisher, 2019.



## Rajarshi Shahu Mahavidyalaya, Latur

(Autonomous)

UG First Year

### Basket I: Generic/Open Elective (GE/OE)

(GEs offered to the Science & Technology students in Sem.-I)

Sr. No.	BoS Proposing GE/OE	Code	Course Title	Credits	Hrs.
1	Physics	101PHY1401	Energy Sources	04	60
2	English	101ENG1403	Developing Interpersonal Skills	04	60
3	Chemistry	101CHE1401	Medicines for Daily Life	04	60
4	Commerce	101MAE1401	Fundamentals of Statistics	04	60
5	Commerce	101BAI1401	Personal Financial Management	04	60
6	Political Science	101POL1401	Human Rights	04	60
7	Music	101MUS1401	Indian Vocal Classical & Light Music	04	60
8	NCC Studies	101NCC1401	Introduction to NCC	04	60
9	Sports	101SPO1401	Counseling and Psychotherapy	04	60
10	Mathematics	101MAT1401	Fundamentals of Mathematics	04	60

**Note: Student can choose any one GE from the basket.**



## Rajarshi Shahu Mahavidyalaya, Latur

(Autonomous)

UG First Year

### Basket II: Skill Enhancement Courses (SEC)

(SEC offered to the Science & Technology students in Sem.-I)

Sr. No.	BoS Proposing SEC	Code	Course Title	Credits	Hrs.
1	Computer Science	101COS1602	Cyber Security	02	30-45
2	Computer Science	101COS1601	Data Analysis and Computer Application	02	30-45
3	Information Technology	101COM1601	Basics of Python Programming	02	30-45
4	Commerce	101BAI1601	Investment Management	02	30
5	Geography	101GEO1601	Tourism & Travel Management	02	30
6	NCC Studies	101NCC1601	Leadership and Personality Development	02	30-45
7	Chemistry	101CHE1601	Pesticides and Green Chemistry	02	30-45
8	Botany	101BOT1601	Mushroom Cultivation Technology	02	30-45
9	English	101ENG1601	Proof Reading and Editing	02	30

**Note: Student can choose any one SEC from the basket.**





**Rajarshi Shahu Mahavidyalaya, Latur**

**(Autonomous)**

**UG First Year**

**Basket III: Ability Enhancement Courses (AEC)**

**(AEC offered to the Science & Technology students in Sem.-I)**

<b>Sr. No.</b>	<b>BoS Proposing AEC</b>	<b>Code</b>	<b>Course Title</b>	<b>Credits</b>	<b>Hrs.</b>
1	English	101ENG7101	English for Professionals	02	30



## **Rajarshi Shahu Mahavidyalaya, Latur**

**(Autonomous)**

**UG First Year**

### **Extra Credit Activities**

<b>Sr. No.</b>	<b>Course Title</b>	<b>Course Code</b>	<b>Credits</b>	<b>Hours T/P</b>
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.



## Rajarshi Shahu Mahavidyalaya, Latur

(Autonomous)

### 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
		3				4				
1	2	Att.	CAT I	Mid Term	CAT II	Att.	CAT	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	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.