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/Research) in Microbiology

Board of Studies

in

Microbiology

Rajarshi Shahu Mahavidyalaya, Latur

Empowered Autonomous Institution

[UG I Year]

w.e.f. June, 2026

(In Accordance with NEP-2020)

Review Statement

The NEP Cell reviewed the Curriculum of **B.Sc. (Honors/Research) in Microbiology** Programme 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

Rajarshi Shahu Mahavidyalaya, Latur

Empowered Autonomous Institution

CERTIFICATE

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

Date: 13 / 04 / 2026

Place: Latur

(Asso. Prof S. N. Shinde)
Chairperson
Board of Studies in Microbiology
Rajarshi Shahu Mahavidyalaya, Latur
Empowered Autonomous Institution

Shiv Chhatrapati Shikshan Sanstha's

Rajarshi Shahu Mahavidyalaya, Latur

Empowered Autonomous Institution

Members of Board of Studies in the Subject Microbiology

Under the Faculty of Science and Technology

Sr. No.	Name	Designation	In position
1	**Asso. Prof S. N. Shinde** Head, Department of Microbiology, Rajarshi Shahu Mahavidyalaya, Latur	Chairperson	HoD
2	**Dr. Ravindra Rakh,** Guru Buddhiswami Mahavidyalya Purna Dist. Parbhani	Member	V.C. Nominee
3	**Dr. Jeetendra Kulkarni,** Dept. of Biotechnology, Dr. BAM University Sub Centre, Dharashiv.	Member	Academic Council Nominee
4	**Dr. Shrikumar Mahamuni** Dept. of Microbiology, Shardabai Pawar Mahila ACS college Baramati Dist. Pune	Member	Academic Council Nominee
5	**Dr. Mahesh S. Dharane**, Hon. Member Sr. Scientist, Division of Biochemical Sciences, Dr. Homi Babha Road, Pashan, NCL, Pune.	Member	Expert from outside for Special Course
6	**Dr. M. K. Ranjekar,** Green Vitals Biotech Ranje, Post-Arvi, Tal. Bhor, Dist. Pune.	Member	Expert from Industry
7	**Dr. Manmohan Bajaj** Product Manager BIOGENE, INDIA, New Delhi.	Member	P.G. Alumni
8	**Ms. Sonali S. Patil**	Member	Faculty Member
9	**Ms. Rani S. Gudda**	Member	Faculty Member
10	**Ms. Rakhi S. Shinde**	Member	Faculty Member
11	**Ms. Priyanka V. Kandepatil**	Member	Faculty Member
12	**Mr. Aditya A. Kadam**	Member	Faculty Member

From the Desk of the Chairperson…

The Department of Microbiology is established in 1986. It is one of the leading departments in the field of teaching and student centric activities. After Autonomy, in keeping pace with the advances in various aspects of Microbiology, the department has introduced the courses Fundamentals of Microbiology, Methods in microbiology, Microbial Diversity, immunology, medical microbiology, industrial microbiology, Molecular microbiology, Genetics, Biostatistics, Bioinformatics, Bioinstrumentation etc. The Department has academic autonomy and has been revising its curriculum regularly. The department has successfully implemented the Choice Based Credit System (CBCS) for grading the students. The Curriculum of the B.Sc. and M.Sc. has been designed by considering NET, SET, GATE and others competitive examinations.

Institution's Motto, Aroha Tamaso Jyoti (The Journey from Dark to Light), the Mission, Pursuit of Excellence, the Vision, to evolve as a World Class Dynamic Center of Higher Education, and the Core Values have been frequently reflected in the present curriculum.

The Higher Education System in India and all over the world has undergone paradigm shift in both qualitative and quantitative aspects. Its best example is National Education Policy (NEP-2020). The National Education Policy 2020 emphasizes on developing overall personality of students by incorporating Humanitarian and Constitutional values, creativity and critical thinking, harnessing innovation, use of modern technology and interaction with various stakeholders. It recognizes that the pedagogy should evolve to make education more experiential, holistic, integrated, learner-centric, flexible and developing skill, etc. to shape the student that can face the challenges of the future, the new policy also envisages the refinement and improvement in the Learning Outcome based Curriculum Framework.

Microbiology is one of the most applied branche of Life Sciences. It is the broad subject encompassing classical and modern systemic aspects of Microbial diversity as well as contemporary subjects like Molecular Biology, Bioinformatics, Biotechnology, etc. The present learning outcome based curriculum framework for B. Sc. (Honors/Research) in Microbiology is designed to provide a focused learing outcome based syllabus at the Honors level providing structured teaching-learning experiences catering to needs of the students. The honors course in Microbiology will prepare the students both academically and in terms of employability. This program also inculcates various attributes like Problem solving, Research skills, Critical thinking etc. These attributes encompass values related to emotional stability, social justice, creative and critical thinking, well-being and

various skills required for employability, thus preparing students for continuous learning and sustainability.

As per the Institutional policy it is decided to upgrade the curriculum and syllabi of UG after every three year and PG after two years progressively. Accordingly, the curriculum and syllabi UG-I & PG-I upgraded and UG-IV newly designed keeping in mind the aspirations of the students, changing nature of the subject as well as the learning environment. Minor changes have been introduced in the syllabus of UG-II, UG-III and PG-II as per the need and the suggestions of the stakeholders. Courses of Microbiology have been designed to incorporate recent advancements, techniques to upgrade the skills of students. The new structure is expected to enhance the level of understanding among students and maintain the standard of Honors Degree in Microbiology across the country. The efforts have been made to integrate use of recent technology and use of MOOCs to assist teaching-learning process. This framework offers flexibility and innovation in syllabi designing and in methods adopted for teaching-learning process and learning assessment.

The present structure comprises Discipline specific courses (DSC), Discipline Specific Electives (DSE), Discipline Specific Minor Course (DSM), Generic/Open Electives (GE/OE), Vocational Specific Course (VSC), Skill Enhancement Course (SEC), Major Mandatory Course (MMC). Major Elective Course (MEC) Research Methodology Course (RMC) etc. The discipline specific courses (DSC) and Major Mandatory Course (MMC) are compulsory and the elective courses can be chosen from the given Basket. Most of the courses comprise theory and practicals.

The project work is specially emphasized in this structure. The project will mainly involve experimental work. The students will be asked their choice for project. The Generic Electives will be offered to the students of other departments of the college. The students will have the option to choose one generic elective from the given Basket. The generic elective comprises theory as well as practical. The students will also undertake one Vocational Specific Course (VSC) and one Skill Enhancement Course (SEC) of two credits each. The VSC and SEC also comprise theory and practicals. These courses will be chosen by the students from the concerned basket.

One DSC-Agricultural Microbiology is specified for Indian Knowledge Systems (IKS) which is a strong foundation of agricultural practices in Vedic period emphasizing the value of traditional practices that are still needed in the modern era. These knowledge systems are applicable in the modern world in several ways.

These courses offer skills to pursue research and teaching in the field of Microbiology and thus would produce best minds to meet the demands of society. This curriculum framework for B.Sc. (Honors) in Microbiology is developed keeping in view of the students centric learning Pedagogy, which is entirely outcome oriented. The curriculum framework focuses on the pragmatist approach whereby practical application of theoretical concepts is covered through Laboratory and Field works.

The new curriculum offers knowledge of wide areas in Microbiology including, Biochemistry, cell biology, Virology, Microbial physiology, Dairy microbiology, rDNA technology, Diagnostic

Microbiology, Applied Mycology and Phycology & Entrepreneurial Microbiology etc. This new syllabus has been prepared keeping in view the unique requirement of B.Sc. (Honors) Microbiology students. The contents of the syllabi have been drawn to accommodate the widening horizons of the Microbiology. The semester wise course distribution and detailed syllabus for each course is appended with a list of suggested references

The major objective of this curriculum is to elevate the subject knowledge of the students, making them critical thinkers and able to solve problems and issues related to Microbiology logically and efficiently

(Asso. Prof S. N. Shinde)
Chairperson
Board of Studies in Microbiology
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 Microbiology 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 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 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

Shiv Chhatrapati Shikshan Sanstha's

Rajarshi Shahu Mahavidyalaya, Latur

Empowered Autonomous Institution

Department of Microbiology

B.Sc. (Honors/Research) Microbiology

Year & Level	Semester	Course Code	Course Title	Credits	No. of Hrs.
I 4.5	I	101MIB1101 (DSC-I)	Fundamentals of Microbiology	03	45
		101MIB1103	Lab course I	01	30
		101MIB1102 (DSC-II)	Methods in Microbiology	03	45
		101MIB1104	Lab course II	01	30
		OE-I	From Basket	04	60
		101MIB1501 (VSC-I)	Fundamentals of Biochemistry	1+1	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	101MIB2101 (DSC-III)	Microbial Diversity	03	45
		101MIB2103	Lab course III	01	30
		101MIB2102 (DSC-IV)	Microbial Growth and Nutrition	03	45
		101MIB2104	Lab course IV	01	30
		OE-II	From Basket	04	60
		101MIB2501 (VSC-II)	Food Fermentation Technology	1+1	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: B.Sc. (Honors/Research) Microbiology

Programme Outcomes (POs) for B.Sc. Microbiology	
After completion of this programme the students will be able to -	
PO 1	**Scientific Knowledge** Acquire and apply in-depth knowledge of core scientific principles and recent advancements in the field.
PO 2	**Critical Thinking and Problem Solving** Apply logical reasoning and scientific approaches to solve microbiological and interdisciplinary problems through observation, precision and analytical mind.
PO 3	**Self-directed Lifelong Learning** Engage in self-directed learning to adapt to emerging scientific developments, evolving global challenges and develop problem-solving skills necessary to excel in competitive exams for higher education and career advancement.
PO 4	**Laboratory Competence** Demonstrate proficiency in laboratory practices, including aseptic techniques, instrument handling, and adherence to safety protocols.
PO 5	**Research Design and Execution** Design and execute research experiments using appropriate microbiological, molecular, and analytical techniques.
PO 6	**Innovation & Entrepreneurship** Apply microbiological knowledge to develop innovative solutions and entrepreneurial ventures in relevant sectors.
PO7	**Application in Society and Biosafety** Apply microbiological principles to address challenges in health, agriculture, environment, biotechnology and biosafety regulations
PO 8	**Ethics and Environmental Responsibility** It encourages students to apply emotional intelligence to recognize the socio-economic and environmental impacts of their work, ensuring that scientific innovation is balanced with empathy for human health and a deep respect for biodiversity and resonate with human moral values

Programme Specific Outcomes (PSOs) for B.Sc. (Honors/Research) Microbiology	
PSO No.	After completion of this programme the students will be able to -
PSO 1	**Fundamental Knowledge & Understanding** Understand comprehensive knowledge of core microbiological concepts, including fundamentals, methods in microbiology, microbial diversity and nutrition, core concept in immunology, virology and medical microbiology, environmental, agricultural and molecular microbiology, biochemistry, metabolism and physiology, industrial microbiology and bioanalytical tools.
PSO 2	**Scientific outlook and Innovation Skills** Apply creative and critical approaches to experimental design, problem-solving, and the development of improved microbiological methods and applications with the aid of and experiments in microbiology. Effectively communicate microbiological concepts, experimental findings, and research outcomes through structured scientific writing, data visualization, and oral presentations.
PSO 3	**Research and Inquiry Skills** Design and conduct microbiological investigations by integrating experimental planning, systematic observation, and quantitative data analysis, to interpret results, validate findings, and derive evidence-based conclusions.
PSO 4	**Industrial Competence and Venture Development** Apply microbiological principles and techniques in recent advancements of industries like clinical, environmental, agricultural and product development for real-world applications and able to aid the startup in biofertilizer, pathology lab, probiotic production and mushroom production.
PSO 5	**Personal and Professional Competence** Capability to empower himself/herself with laboratory training to prepare for careers in broad range of Microbial science fields. Ability to analyse samples and data obtained from experiments, field visits, projects, survey and will make scientific report for solving problems.

Semester - I

Shiv Chhatrapati Shikshan Sanstha's

Rajarshi Shahu Mahavidyalaya, Latur

Empowered Autonomous Institution

Faculty of Science and Technology

Department of Microbiology

UG I Sem I

Course Type : DSC-I
Course Title : Fundamentals of Microbiology
Course Code : 101MIB1101
Credits : 03 **Max. Marks: 75** **Lectures: 45 Hrs.**

Learning Objectives:

LO1. To explain the scope, interdisciplinary applications, and societal relevance of microbiology across environmental, industrial, medical, and advanced scientific domains.

LO2. To apply staining techniques through understanding of staining principles, mechanisms, and procedures for accurate visualization and differentiation of microorganisms.

LO3. To analyze the structural organization and functional differences of microbial cells by comparing prokaryotic and eukaryotic systems in terms of complexity, components, and biological roles.

LO4. To evaluate various systems of microbial classification, including classical and molecular approaches, in understanding taxonomy, evolution, and nomenclature of microorganisms.

Course Outcomes:

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

CO1. Describe scope and significance of microbiology.

CO2. Apply staining methods to identify microorganisms.

CO3. Analyze differences between prokaryotic and eukaryotic cells.

CO4. Evaluate microbial classification systems.

Unit No.	Title of Unit & Contents	Hrs.
I	**Scope of Microbiology**	**12**
	1. Introduction to microbiology 2. Definition and concept. 3. Ubiquitous nature of microorganisms. 4. Scope in applied fields of Microbiology: Air Microbiology, Water Microbiology, Sewage Microbiology, Agricultural Microbiology, Food & dairy Microbiology, Industrial Microbiology, Medical Microbiology Environmental microbiology & extremophiles 5. Scope in advanced fields of microbiology: Advanced branches in Microbiology: Pharmaceutical microbiology, Geomicrobiology, Nano-biotechnology and Space Microbiology, Bioinformatics. **6.** Role of Micro-organisms in human welfare-Agriculture, Human health and Industries	
	Unit Outcomes: UO 1. Communicate importance of microorganisms in society UO 2. Execute Ecofriendly applications of microbial activities for better human life.	

Unit No.	Title of Unit & Contents	Hrs.
II	**Microbial Staining Techniques**	**13**
	1. Definitions: Stain, Dye, Mordent, Chromogen, Leucocompound, Flurochrome, Decolorizing agent and Counter stain. 2. Types of stains: Auxochrome, chromophore, Acidic stain, Basic stain, Neutral stain, Chromogen. 3. Theories of Staining: Physical and chemical. 4. Simple staining of bacteria: Monochrome & Negative staining (Principles, Mechanism, Procedure and Observation). 5. Differential staining of bacteria: Gram's and Acid Fast staining (Principles, Mechanism, Procedure and Observation). 6. Structural staining: Cell wall, Capsule, Endospore, Flagella. PHB 7. Metachromatic granule Staining 8. Fungal Staining.	
	Unit Outcomes: UO 1. Identify various morphological forms of bacteria using simple and differential staining techniques. UO 2. Apply staining methods for observation of different structures of bacteria	
III	**Cell Structure**	**11**
	1.Overview of prokaryotic and eukaryotic cell 2. comparative accounts on prokarytoic and eukaryotis cell with respect to a. Size and Complexity b. Genetic Material (Nucleoid and Nucleus) c. Cell membrane and wall d. External motility apparatus e. Cytoplasmic matrix & Organelles f. ER & Ribosome. 3.Comparison of Prokaryotic and Eukaryotic Cells	
	Unit Outcomes: UO 1. Describe Eukaryotic and Prokaryotic cell UO 2 Compare Eukaryotic and Prokaryotic cell	
IV	**Taxonomy of Microbes**	**9**
	1. Systems of classification: Three domain classification and Whittaker's Five kingdom 2. Taxonomic Groups 3. Goals of classification 4. Nomenclature. 5. Molecular systematics – Classical, numerical, polyphasic and molecular taxonomy 6. Evolutionary trends in Microorganisms	
	Unit Outcomes: UO1. Describe classification of Microorganisms UO2. Describe nomenclature of microorganisms	

Learning Resources:

1. A Textbook of Fungi, Bacteria and Viruses, Dubey H. C. (2004), Vikas Publishing House Private Limited. New Delhi, India
2. A textbook of Microbiology, Dubey R. C. and D. K. Maheshwary. (2012), S Chand and Company. New Delhi, India
3. A Textbook of Microbiology, Ananthanarayan and Paniker (Orient Black Swan, 7th edition) 2016
4. Brock Biology of Microorganisms, Bender K. S., Buckley D. H., Stahl D. A., Sattley W. M. And Madigan M. T. (2017). E-Book, Global Edition. United Kingdom: Pearson Education.
5. Elementary Microbiology, Vol. I and II. Dr. A. H Modi, Akta Prakashan. Nadiad
6. Essentials of Microbiology, Jain A. and Jain P. (2019). Elsevier- India.
7. Fundamental Principles of Bacteriology, Salle A. J. (McGraw-Hill Book Co. New York and London 1973) 7th Edition
8. Fundamentals of Microbiology, Frobisher M., (W. B. Saunders, Philadelphia, 1962) 7th edition.
9. General Microbiology . Stanier R. Y., Ingraham J. L., Wheelis M. L. and Painter P. R., (Macmillan Education Ltd., London, 2001) 5th edition.
10. General microbiology ,Volume I. Powar C. B. and Daginawala H. I. (2005).. Himalaya Publishing House Private Limited, Pune, India.
11. General microbiology, Volume II. Powar C. B. and Daginawala H. I. (2005). Himalaya Publishing House, Private Limited, Pune, India
12. Microbiology: An Application based Approach, Pelczar M. J. Jr., Chan E.C.S. and Krieg N. R. (2010). McGraw-Hill Education (India) Private Limited, New Delhi, India.
13. Microbiology: Principles and Explorations, 7th edition. Black JG. (2008).. Prentice Hall
14. Principles of Microbiology, Atlas RM. (1997). 2nd edition. WM.T.Brown Publishers.
15. Microbial Genetics, David Freifelder (often with S. Maloy and J. Cronan) Jones and Bartlett (1987).

Internal Examination Pattern :

CAT – I: Book Reading/ Seminar
CAT – II: Descriptive Test/ Quiz/ Assignment.

Mapping of POs, PSOs and COs:

COs/POs & PSOs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5
CO1	3	1	2	1	1	2	3	2	3	1	1	1	1
CO2	2	2	2	3	3	1	2	1	3	3	2	2	3
CO3	3	3	2	2	2	1	1	0	3	2	2	1	2
CO4	3	3	2	1	2	1	1	1	3	2	3	1	2

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

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Faculty of Science and Technology

Department of Microbiology

UG-I Sem-I

Course Type : Lab Course
Course Title : Lab Course-I (Based on DSC-I)
Course Code : 101MIB1103
Credits : 01 **Max. Marks: 50** **Lectures: 30 Hrs.**

Learning Objectives:

LO1. To apply biosafety guidelines and standard laboratory practices to ensure safe handling, processing, and disposal of microbial samples during microbiological experiments.

LO2. To perform staining techniques using appropriate reagents and protocols for effective visualization and differentiation of microbial cells and structures.

LO3. To operate and maintain basic microbiological instruments such as microscopes and staining setups for accurate observation and experimental consistency.

LO4. To demonstrate proper handling, observation, recording, and disposal of microbial specimens while maintaining experimental accuracy and laboratory hygiene.

.Course Outcomes:

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

CO1. Apply biosafety and aseptic techniques during laboratory work.

CO2. Perform and standardize staining techniques for microbial identification.

CO3. Analyze microscopic observations to differentiate microbial structures.

CO4. Evaluate experimental procedures and ensure accuracy in observations and reporting.

Sr. No.	Name of Experiment
1	Biosafety in microbiology laboratory
2	Biosafety measures-Laboratory sanitation
3	Good laboratory practices.
4	Visualization of Microbial activity in Food (spoilage)
5	Visualization of Microbial activity in swage water
6	Simple staining: Monochrome and Negative staining.
7	Differential: Gram's staining, acid fast staining.
8	Staining and observation of Cell wall.
9	Staining and observation Capsule
10	Staining of Endospores by Dorner's method
11	Staining of Flagella by PKG method
12	Staining and observation of PHB granules.
13	Lactophenol Cotton blue staining of Fungi.

Note: Any Ten Practicals from above.

Learning Resources:

1) Handbook of media, stains and reagents in microbiology, A. M. Deshmukh, PAMA publication, Karad, 1997
2) Laboratory manual of Microbiology, Vivek Kumar, Scientific Publication (India),2011
3) Microbiology, Singh R.P., Kalyani Publication.
4) Practical Microbiology, Dubey, Maheshwari, S. Chand, 2022
5) Microbiology, Yadav Manju, Discovery Publishing House, New Delhi
6) Biochemical Methods, s. Sadasivam and A. Manickam, New age international publishers, 2008
7) Handbook of Microbiology, P. S. Bisen and Kavita Verma, CBS publishers and distributors, new Delhi,2007
8) Modern Tools and Techniques to Understand Microbes, Ajit Varma, Arun Kumar Sharma, Springer International Publishing, 2017.
9) Handbook of media, stains and reagents in microbiology, A. M. Deshmukh, PAMA publication, Karad, 1997
10) Microbiology, Singh R.P., Kalyani Publication.
11) Practical Microbiology, Dubey, Maheshwari, S. Chand, 2022
12) Microbiology, Yadav Manju, Discovery Publishing House, New Delhi
13) Biochemical Methods, s. Sadasivam and A. Manickam, New age international publishers, 2008
14) Handbook of Microbiology, P. S. Bisen and Kavita Verma, CBS publishers and distributors, new Delhi,2007
15) Modern Tools and Techniques to Understand Microbes, Ajit Varma, Arun Kumar Sharma, Springer International Publishing, 2017

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Faculty of Science and Technology

Department of Microbiology

UG-I Sem-I

Course Type : DSC-II
Course Title : Methods in microbiology
Course Code : 101MIB1102
Credits : 03 **Max. Marks: 75** **Lectures: 45 Hrs.**

Learning Objectives:

LO1. To explain fundamental principles underlying microbiological techniques including historical developments, microscopy, sterilization, and cultivation methods.

LO2. To apply microscopy and staining techniques for accurate visualization and analysis of microorganisms using different optical systems.

LO3. To analyze sterilization and disinfection processes by understanding physical and chemical methods used in microbial control.

LO4. To evaluate cultivation and isolation techniques along with media selection for effective growth and maintenance of microbial cultures.

Course Outcomes:

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

CO1. Explain microscopy and staining principles

CO2. Apply sterilization and isolation methods

CO3. Analyze effectiveness of microbial control methods

CO4. Evaluate culture media and cultivation techniques

Unit No.	Title of Unit & Contents	Hrs.
I	**Historical developments in microbiology**	**12**
	1. Discovery of microbial world: Contribution of Antony van 2. Leeuwenhoek Controversy over spontaneous generation - Contribution of Francisco Redi, John Needham, Lazzaro Spallanzani, Theodor Schwan, Franz Schulze, Friedrich Schroder, Von Dusch, Louis Pasteur, John Tyndall 3. Contribution of Robert Koch in Recognition of microbial role in diseases and pure culture concept. 4. Contribution of Louis Pasteur: Recognition of microbial role in Fermentation and Pasteurization. 5. Breakthroughs in medical field: Contribution of Joseph Lister (antiseptic surgery), Paul Ehrlich (Chemotherapy), Alexander Fleming (Penicillin), Discovery of Streptomycin by Walksman, 6. Development of Immunology: Edward Jenner Vaccination, Story of Rabies vaccine, contribution of Elie Metchnikoff (Phagocytosis). 7. Development of Soil Microbiology: Contribution of Martinus W. Beijerinck, Sergei N. Winogradsky.	

Unit No.	Title of Unit & Contents	Hrs.
	Unit Outcomes: UO 1. Perform experiments used to study role of microbes by scientists. UO2. Explain contribution of scientist's in development of different fields of microbiology	
II	**Microscopy**	**10**
	1. Terms in microscopy – Electromagnetic spectrum of light, concepts of magnification, Refractive index, Numerical aperture, Resolving power 2. Types of Microscopes : Bright field, Dark field, Phase contrast, fluorescent microscope 3. Compound Microscope: Part of microscope -condensers, eyepieces and objectives, image formation, Ray diagram and applications. 4. Concept of aberrations in lenses - spherical, chromatic. 5. Electron Microscope –Parts, principle of image formation, Ray diagram and applications. Comparative study of compound and electron microscope	
	Unit Outcomes: UO 1. Explain design and working of microscope. UO 2. Observe microorganisms using microscope	
III	**Sterilization and disinfection**	**12**
	1. Definition of Sterilization, Disinfection, Antiseptic, Germicide, Sanitizer, Fungicide, Vermicide, Bacteriostatic and Bactericidal agent. 2. Sterilization by Physical Agent Heat: Moist Heat: Steam under pressure (Autoclaving), Boiling, Pasteurization Dry heat: Incineration, Hot air Oven. Radiation: Ionizing and Non-ionizing radiations. Filtration: Types of Bacteriological filters 3. Chemical Disinfectants -Characteristics of an ideal disinfectant, Evaluation of Disinfectant by Phenol Coefficient method. 4. Chemical Agents: Phenol and Phenolic compounds, Alcohols, Halogens. Gaseous sterilizing Agents: Formaldehyde, Ethylene Oxide, β-Propiolactone.	
	Unit Outcomes: UO 1. Apply methods of sterilization and disinfection UO 2. Apply this knowledge for personal hygiene.	
IV	**Cultivation media and Pure culture methods**	**11**
	1. Definitions - pure culture, mixed culture, consortium, axenic culture, contamination. 2. Properties of a good culture medium. 3. General ingredients of culture media and their role 4. Definition, Concept, Use and Types of different culture media – Living and Nonliving media, Synthetic, Non-synthetic, Natural, Selective, Differential, Enriched, Enrichment, Assay, Minimal, Maintenance and Transport Medium.	

Unit No.	Title of Unit & Contents	Hrs.
	5. Isolation and Cultivation of bacteria: Principle and method of isolation-streak plate, pour plate, spread plate, single cell isolation, 6. Anaerobic bacteria cultivation. 7. Maintenance and preservation of Microbial Cultures	
	Unit Outcomes: UO 1. Describe the role of general ingredients of culture media & various types of culture UO 2. Describe the & techniques of isolation and cultivation of bacteria and preservation techniques	

Learning Resources:

1. A Chronology of Microbiology in Historical Context, Beck R. W. (2000). United Kingdom: ASM Press. A textbook of Microbiology, Dubey R. C. and D. K. Maheshwary. (2012), S Chand and Company. New Delhi, India
2. Microbiology. Pelczar, Chan and Krieg. McGraw-Hill Inc.US
3. General Microbiology. Powar and Daginawala. Vol-I. Himalaya Publishing House
4. Elementary Microbiology (Fundamentals of Microbiology). Modi H.A.: Vol. II. Ekta Prakashan, Nadiad, Gujrat.
5. Biochemistry, Seventh Edition. Jeremy M. Berg, John L. Tymoczko and Lubert Stryer, W.H. Freeman & Company. 2010
6. Lehninger: Principles of Biochemistry. Albert L. Lehninger, Michael Cox and DavidL. Nelson (4 May 2004), W. H. Freeman.
7. Microbiology: Fundamentals and Applications. Purohit S.S. Agro-Botanical publishers. Bikaner, India.
8. General Microbiology . Stanier R. Y., Ingraham J. L., Wheelis M. L. and Painter P. R., (Macmillan Education Ltd., London, 2001) 5th edition.
9. General microbiology ,Volume I. Powar C. B. and Daginawala H. I. (2005).. Himalaya Publishing House Private Limited, Pune, India.
10. General microbiology, Volume II. Powar C. B. and Daginawala H. I. (2005). Himalaya Publishing House, Private Limited, Pune, India

Internal Examination Pattern :

CAT – I: Poster Presentation/ PPT Presentation.

CAT – II: Surprise Test/ Quiz,

Mapping of POs, PSOs and COs:

COs/POs & PSOs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5
CO1	3	2	2	3	2	1	2	1	3	2	2	2	3
CO2	3	2	2	3	3	2	3	2	3	3	3	3	3
CO3	2	3	2	3	3	2	3	3	2	3	3	3	3
CO4	3	2	2	3	3	2	2	1	3	3	3	3	3

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

Shiv Chhatrapati Shikshan Sanstha's

Rajarshi Shahu Mahavidyalaya, Latur

Empowered Autonomous Institution

Faculty of Science and Technology

Department of Microbiology

UG-I Sem-I

Course Type : Lab Course
Course Title : Lab Course-II (Based on DSC-II)
Course Code : 101MIB1104
Credits : 01 **Max. Marks: 50** **Lectures: 30 Hrs.**

Learning Objectives:

LO1. To apply microscopy techniques and measurement methods such as micrometry for accurate observation and analysis of microorganisms.

LO2. To perform preparation and sterilization of culture media using appropriate techniques to ensure contamination-free microbial growth.

LO3. To apply microbial isolation techniques such as streaking, spreading, and pouring for obtaining pure cultures.

LO4. To demonstrate proper handling, maintenance, and preservation of microbial cultures under laboratory conditions.

Course Outcomes:

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

CO1. Operate microscope and perform micrometry

CO2. Prepare and sterilize culture media

CO3. Perform isolation techniques (streak, spread, pour)

CO4. Evaluate culture quality and contamination control

Sr. No.	Name of Experiment
1.	Microscopy- Different parts of compound microscope.
2.	Use, care & Handling of compound microscope.
3.	Measurement of bacterial cell size: Micrometry.
4.	Study of laboratory equipment's used for Sterilization: Autoclave, Hot air oven, Bacterial filters.
5.	Study of laboratory equipment's used for Cultivation-Incubator, Biosafety cabinet Anaerobic jar.
6.	Demonstration of basic techniques in Microbiology: Wrapping of glassware, cotton plugging, cleaning and washing glassware.
7.	Preparation and sterilization of Simple medium (Nutrient broth , Nutrient Agar) and Sugar fermentation media
8	Preparation and sterilization of Complex medium (MacConkey's Broth , MacConkey's Agar)
9.	To study Streak plate method methods for Isolation of bacteria
10.	To study spread plate method for Isolation of bacteria
11.	To study Pour plate method for enumeration of microorganisms from soil sample
12.	To study stock culture maintenance methods: Serial sub culturing, soil stocks and refrigeration, storage in mineral oil

13.	Handling of microbial cultures precaution and disposal
14	To Study methods for Controlling growth and spread of microbes in laboratory
15.	To understand SOP for biological waste disposal

Note: Any Ten Practicals from above.

Learning Resources:

1) Handbook of media, stains and reagents in microbiology, A. M. Deshmukh, PAMA publication, Karad, 1997
2) Microbiology, Singh R.P., Kalyani Publication.
3) Practical Microbiology, Dubey, Maheshwari, S. Chand, 2022
4) Microbiology, Yadav Manju, Discovery Publishing House, New Delhi
5) Biochemical Methods, s. Sadasivam and A. Manickam, New age international publishers, 2008
6) Handbook of Microbiology, P. S. Bisen and Kavita Verma, CBS publishers and distributors, new Delhi,2007
7) Modern Tools and Techniques to Understand Microbes, Ajit Varma, Arun Kumar Sharma, Springer International Publishing, 2017.
8) Handbook of media, stains and reagents in microbiology, A. M. Deshmukh, PAMA publication, Karad, 1997
9) Microbiology, Singh R.P., Kalyani Publication.
10) Practical Microbiology, Dubey, Maheshwari, S. Chand, 2022
11) Microbiology, Yadav Manju, Discovery Publishing House, New Delhi
12) Biochemical Methods, s. Sadasivam and A. Manickam, New age international publishers, 2008
13) Handbook of Microbiology, P. S. Bisen and Kavita Verma, CBS publishers and distributors, new Delhi,2007
14) Modern Tools and Techniques to Understand Microbes, Ajit Varma, Arun Kumar Sharma, Springer International Publishing, 2017

Shiv Chhatrapati Shikshan Sanstha's

Rajarshi Shahu Mahavidyalaya, Latur

Empowered Autonomous Institution

Faculty of Science and Technology

Department of Microbiology

UG-I Sem-I

Course Type : VSC-I
Course Title : Fundamentals of Biochemistry
Course Code : 101MIB1501
Credits : 1+1 **Max. Marks: 50** **Lectures: 45 Hrs.**

Learning Objectives:

LO1. To explain the structure, classification, and biological significance of major biomolecules including carbohydrates, lipids, proteins, and nucleic acids.

LO2. To apply biochemical tests and analytical methods for identification and qualitative analysis of biomolecules.

LO3. To analyze structure–function relationships of biomolecules in maintaining cellular organization and metabolic activities.

LO4. To evaluate the biochemical roles and interactions of biomolecules in sustaining life processes and cellular functions.

Course Outcomes:

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

CO1. Describe structure and classification of biomolecules

CO2. Apply biochemical tests for identification

CO3. Analyze functional roles of biomolecules

CO4. Evaluate biochemical processes in cells

Unit No.	Title of Unit & Contents	Hrs.
I	**Structural Biomolecules (Carbohydrates and Lipids)**	**6**
	1. Structure and Classification of Carbohydrates Monosaccharides, Disaccharides, Oligosaccharides, Polysaccharides Structural carbohydrates, Storage carbohydrates. 2. Lipids: Definition and classification, Biological significance	
	Unit Outcomes: UO 1. Describe the types of carbohydrates UO 2. Classify the lipid biomolecules	
II	**Informational Biomolecules (Nucleic acid)**	**5**
	1. Nucleic Acids: a) Nucleosides and Nucleotides. b) Structure types and functions of DNA c) Structure, types and functions of RNA	

Unit No.	Title of Unit & Contents	Hrs.
	Unit Outcome: UO 1. Explain the structure and types of DNA UO 2. Describe the structure and types of RNA	
III	**Functional Biomolecules (Proteins)**	**4**
	1. Proteins: Definition and Classification a) Peptide bond: Configurations of proteins b) Biological significance of proteins	
	Unit Outcomes: UO 1. Describe the protein structure and UO 2. Describe the protein classification	
IV	**Practical's**	**30**
	1. Demonstration of Colorimeter 2. Qualitative analysis of Carbohydrates by Sumner's method 3. Qualitative analysis of DNA by Diphenyl amine test 4. Qualitative analysis of RNA by Orcinol test 5. Qualitative analysis of Protein by Biuret test	

Learning Resources:

1. Biochemistry, Seventh Edition. Jeremy M. Berg, John L. Tymoczko and Lubert Stryer, W.H. Freeman & Company. 2010
2. Lehninger: Principles of Biochemistry. Albert L. Lehninger, Michael Cox and DavidL. Nelson (4 May 2004), W. H. Freeman.
3. Microbiology: Fundamentals and Applications. Purohit S.S. Agro-Botanical publishers. Bikaner, India.
4. Biochemistry, 4th edn. Dubuque, IO: William C Brown
5. Handbook of Biochemistry and Molecular Biology
6. Biochemistry, 3rd Edition, by Drs. John W. Pelley, and Edward F. Goljan.
7. The Cell: A Molecular Approach by Geoffrey M. Cooper, and Robert E. Hausman
8. Handbook of Microbiology, P. S. Bisen and Kavita Verma, CBS publishers and distributors, new Delhi,2007
9. Modern Tools and Techniques to Understand Microbes, Ajit Varma, Arun Kumar Sharma, Springer International Publishing, 2017
10. Laboratory manual of Microbiology, Dr. B.M. Sandikar
11. Practical Microbiology, Dubey, Maheshwari, S. Chand, 2022

Internal Examination Pattern :

CAT – I: Poster Presentation/ Seminar.
CAT – II: Descriptive Test/ Quiz
Open Book Test

Mapping of POs, PSOs and COs:

COs/POs & PSOs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5
CO1	3	2	2	1	1	1	1	0	3	1	1	1	1
CO2	2	3	2	3	3	2	2	1	3	3	3	2	3
CO3	3	3	2	1	2	2	3	2	3	2	2	2	2
CO4	3	3	3	1	3	2	2	1	3	3	3	2	3

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

Semester - II

Shiv Chhatrapati Shikshan Sanstha's

Rajarshi Shahu Mahavidyalaya, Latur

Empowered Autonomous Institution

Faculty of Science and Technology

Department of Microbiology

UG-I Sem-II

Course Type : DSC-III
Course Title : Microbial Diversity
Course Code : 101MIB2101
Credits : 03 **Max. Marks:75** **Lectures: 45 Hrs.**

Learning Objectives:

LO1. To explain the diversity of microbial groups by examining structural, physiological, and ecological variations across bacteria, archaea, fungi, algae, protozoa, and viruses.

LO2. To classify microorganisms based on morphological, physiological, and molecular characteristics using standard taxonomic frameworks and classification systems.

LO3. To analyze structural and metabolic diversity among microorganisms by comparing their cellular organization, metabolic pathways, and adaptive strategies.

LO4. To evaluate ecological roles and significance of microorganisms in natural and applied environments, including their interactions, functions, and impact on ecosystems.

Course Outcomes:

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

CO1. Describe characteristics of microbial groups

CO2. Classify microbes using taxonomic features

CO3. Analyze diversity in structure and metabolism

CO4. Evaluate ecological significance of microbes

Unit No.	Title of Unit & Contents	Hrs.
I	**Bacterial Diversity**	**13**
	1. Introduction to Archaea and Bacteria 2. Bacterial Taxonomy - Introduction to Bergey's Manual of Systematics of Archaea & Bacteria (BMSAB) and 3. Bergey's International Society for Microbial Taxonomy (BISMIS). 4. Characterization, Classification (Morphology), Habitat and importance of Bacteria 5. Comparative Study on structure, metabolism, ecological role, significance of • Eubacteria • Cyanobacteria • Actinobacteria 6. Comparative Study on structure, metabolism, ecological role, significance of • Methanogens • Halophiles • Thermoacidophiles • Thermophiles 7. Special Bacterial Groups	

Unit No.	Title of Unit & Contents	Hrs.
	• Rickettsia • Chlamydia • Mycoplasma	
	Unit Outcomes: UO 1. Describe the bacterial diversity UO 2 Explain the Archaea diversity	
II	**Fungal Diversity**	**12**
	1. General Characteristics of fungi with special emphasis on Yeast, Mold, dimorphic fungi 2. Occurrence, Morphology and nutritional requirement of Fugus 3. Asexual & Sexual Reproduction in Fungus 4. G. C. Ainsworth classification of Fungus 5. General Characteristics and Ecological role of • Phycomycetes (Rhizopus, Mucor) • Ascomycetes (Saccharomyces, Aspergillus, Penicillium) • Basidiomycetes (Agaricus, Puccinia, Ustilago) • Deuteromycetes (Trichoderma , Fusarium)	
	Unit Outcomes: UO 1. Understand Different morphologies of fungus UO 2 Explain ecological role of fungal classes	
III	**Algal & Protozoal Diversity**	**11**
	1. General Characteristics, environmental importance of • Chlamydomonas • Volvox • Diatoms • Spirulina 2. Economic Importance of algae 3. General Characteristics, ecological role of • Entamoeba histolytica • Plasmodium	
	Unit Outcomes: UO 1. Discuss characteristics habitat and distribution of algae in environment UO 2 Explain characteristics habitat and distribution of protozoa in environment	
IV	**Viral Diversity**	**9**
	1. Introduction and origin of viruses 2. Concept of virus , viroid, Prions, satellite 3. Core Principles of Virus Classification (Morphology & Genome) 4. Bacterial, plant and animal viruses 5. Viral Replication : Lytic cycle & Lysogenic cycle 6. Cultivation of Virus	

Unit No.	Title of Unit & Contents	Hrs.
	Unit Outcomes: UO 1. Describe classification of virus UO 2 Explain cultivation techniques of virus	

Learning Resources:

1. A textbook of fungi, bacteria and Viruses, Dubey H. C. (2004),Vikas Publishing House Private Limited. New Delhi, India
2. A textbook of Microbiology, Dubey R. C. and D. K. Maheshwary. (2012), S Chand and Company. New Delhi, India
3. A Textbook of Microbiology ,Ananthanarayan and Paniker (Orient Black Swan, 7th edition) 2016
4. Brock Biology of Microorganisms, Bender K. S., Buckley D. H., Stahl D. A., Sattley W. M. And Madigan M. T. (2017). E-Book, Global Edition. United Kingdom: Pearson Education.
5. Elementary Microbiology, Vol. I and II. Dr. A. H Modi, Akta Prakashan. Nadiad
6. Essentials of Microbiology, Jain A. and Jain P. (2019). Elsevier- India.
7. Fundamental Principles of Bacteriology, Salle A. J. (McGraw-Hill Book Co. New York and London 1973) 7th Edition
8. Fundamentals of Microbiology, Frobisher M., (W. B. Saunders, Philadelphia, 1962) 7th edition.
9. General Microbiology . Stanier R. Y., Ingraham J. L., Wheelis M. L. and Painter P. R., (Macmillan Education Ltd., London, 2001) 5th edition.
10. General microbiology ,Volume I. Powar C. B. and Daginawala H. I. (2005).. Himalaya Publishing House Private Limited, Pune, India.
11. General microbiology, Volume II. Powar C. B. and Daginawala H. I. (2005). Himalaya Publishing House, Private Limited, Pune, India
12. Microbiology: An Application based Approach, Pelczar M. J. Jr., Chan E.C.S. and Krieg N. R. (2010). McGraw-Hill Education (India) Private Limited, New Delhi, India.
13. Microbiology: Principles and Explorations, 7th edition. Black JG. (2008).. Prentice Hall
14. Principles of Microbiology, Atlas RM. (1997). 2nd edition. WM.T.Brown Publishers.
15. Microbial genetics by David friefelder.

Internal Examination Pattern :

CAT – I: Model Presentation/ Seminar/ Journal Reading.

CAT – II: Quiz/ Open Book Test

Mapping of POs, PSOs and COs:

COs/POs & PSOs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5
CO1	3	2	2	1	1	1	2	2	3	1	1	2	1
CO2	3	3	2	2	2	1	1	1	3	2	3	1	2
CO3	3	3	2	2	3	2	2	1	3	3	3	2	2
CO4	2	3	3	1	2	2	3	3	2	2	2	3	3

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

Shiv Chhatrapati Shikshan Sanstha's

Rajarshi Shahu Mahavidyalaya, Latur

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Faculty of Science and Technology

Department of Microbiology

UG-I Sem-II

Course Type : Lab Course
Course Title : Lab Course-III (Based on DSC-III)
Course Code : 101MIB2103
Credits : 01 **Max. Marks: 50** **Lectures: 30 Hrs.**

Learning Objectives:

LO1. To apply microbial isolation techniques for obtaining diverse microorganisms from environmental samples using standard laboratory procedures.

LO2. To perform morphological and biochemical characterization for identification and differentiation of microbial isolates.

LO3. To analyze microbial diversity experimentally by observing variations in morphology, metabolism, and ecological distribution.

LO4. To demonstrate environmental microbiology techniques for studying microbial populations and their interactions in natural habitats.

Course Outcomes:

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

CO1. Isolate microorganisms from different environments

CO2. Perform morphological and biochemical characterization

CO3. Analyze microbial diversity in samples

CO4. Evaluate ecological roles using experimental models

Sr. No.	Name of Experiment
1.	Cultural characteristics of Bacteria (colony morphology, shape and margin)
2.	Isolation of *Bacillus subtilis*
3.	Study of morphological and biochemical Characteristics of *Bacillus subtilis*
4.	Isolation of Actinomycetes
5.	Study of morphological and biochemical Characteristics of Actinomycetes
6.	Isolation of Halophiles/ Alkaliphiles
7.	Isolation and microscopic characterization of Aspergillus sp.
8.	Isolation and microscopic characterization of Trichoderma sp
9.	Isolation and microscopic characterization of Penicillium sp
10.	Isolation and microscopic characterization of Rhizopus and Fusarium sp
11.	Observation of microscopic Algae.
12.	Study of Winogradsky Column
13.	Isolation of coliphages from sewage water.

Note: Any Ten Practicals from above.

Learning Resources:

1) Handbook of media, stains and reagents in microbiology, A. M. Deshmukh, PAMA publication, Karad, 1997
2) Microbiology, Singh R.P., Kalyani Publication.
3) Practical Microbiology, Dubey, Maheshwari, S. Chand, 2022
4) Microbiology, Yadav Manju, Discovery Publishing House, New Delhi
5) Biochemical Methods, s. Sadasivam and A. Manickam, New age international publishers, 2008
6) Handbook of Microbiology, P. S. Bisen and Kavita Verma, CBS publishers and distributors, new Delhi,2007
7) Modern Tools and Techniques to Understand Microbes, Ajit Varma, Arun Kumar Sharma, Springer International Publishing, 2017.
8) Handbook of media, stains and reagents in microbiology, A. M. Deshmukh, PAMA publication, Karad, 1997
9) Microbiology, Singh R.P., Kalyani Publication.
10) Practical Microbiology, Dubey, Maheshwari, S. Chand, 2022
11) Microbiology, Yadav Manju, Discovery Publishing House, New Delhi
12) Biochemical Methods, s. Sadasivam and A. Manickam, New age international publishers, 2008
13) Handbook of Microbiology, P. S. Bisen and Kavita Verma, CBS publishers and distributors, new Delhi,2007
14) Modern Tools and Techniques to Understand Microbes, Ajit Varma, Arun Kumar Sharma, Springer International Publishing, 2017

Shiv Chhatrapati Shikshan Sanstha's

Rajarshi Shahu Mahavidyalaya, Latur

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Faculty of Science and Technology

Department of Microbiology

UG-I Sem-II

Course Type : DSC-IV
Course Title : Microbial Growth and Nutrition
Course Code : 101MIB2102
Credits : 03 **Max. Marks: 75** **Lectures: 45 Hrs.**

Learning Objectives:

LO1. To explain microbial nutritional requirements and transport mechanisms by understanding nutrient types, uptake systems, and metabolic needs.

LO2. To apply microbial growth principles in laboratory and natural systems by studying growth patterns, reproduction methods, and culture conditions.

LO3. To analyze growth kinetics and environmental influences on microbial populations through quantitative and qualitative assessment methods.

LO4. To evaluate strategies for controlling microbial growth based on environmental factors and physiological responses of microorganisms.

Course Outcomes:

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

CO1. Describe microbial nutrition and transport systems

CO2. Apply growth principles in culture systems

CO3. Analyze growth patterns and influencing factors

CO4. Evaluate methods for controlling microbial growth.

Unit No.	Title of Unit & Contents	Hrs.
I	**Microbial Nutrition**	**12**
	1. Introduction 2. Macronutrients, 3. Micronutrients, 4. Growth factors 5. Sources of energy 6. Nutritional categories of microorganisms on the basis of carbon and energy source 7. Modes of nutrition: osmotrophic, phagotrophic	
	Unit Outcomes: UO 1. Describe the nutritional essentials for microbial growth UO 2. Explain the types of energy and nutritional categories of microorganisms	
II	**Microbial Transport**	**12**
	1. Introduction 2. Nutrient transport and membrane function: primary and secondary transport, porins, OMP, carrier proteins	

Unit No.	Title of Unit & Contents	Hrs.
	3. Passive diffusion 4. Facilitated diffusion 5. Active transport mechanism 6. Group translocation 7. ABC transport system & Active efflux of drugs	
	Unit Outcomes: UO 1. Describe mode of nutrition of microorganisms UO 2. Describe different nutrient transport mechanism in microorganism	
III	**Microbial Growth**	**13**
	1. Introduction 2. Microbial Growth – Binary fission, Budding, fragmentation and formation of conidiophores 3. Mathematical expression of growth 4. Growth curve and diauxic growth 4 Measurement of growth: cell number, cell mass and cell activity 5. Different types of bacterial cultures –Batch culture, continuous culture, synchronous culture	
	Unit Outcomes: UO 1. Describe methods of microbial reproduction, their growth phases and measurement of growth UO 2. Explain the types of bacterial cultures and significance	
IV	**Effect of environmental factors on Growth**	**9**
	1. Introduction 2. Effect of Temperature 3. Effect of pH (Acidic environment). 4. Effect of Osmotic pressure (Saline environment) 5. Effect of Oxygen 6. Effect of Hydrostatic pressure 7. Effect of Heavy metals 8. Survival of bacteria under unfavorable conditions: Endospore and cyst.	
	Unit Outcomes: UO 1. Describe effect of environmental factors on microbial growth. UO 2. Apply this concept for controlling microbial growth	

Learning Resources:

1. Microbiology. Pelczar, Chan and Krieg. McGraw-Hill Inc.US
2. General Microbiology. Powar and Daginawala. Vol-I. Himalaya Publishing House
3. Elementary Microbiology (Fundamentals of Microbiology). Modi H.A.: Vol. II. Ekta Prakashan, Nadiad, Gujrat.
4. Biochemistry, Seventh Edition. Jeremy M. Berg, John L. Tymoczko and Lubert Stryer, W.H. Freeman & Company. 2010
5. Lehninger: Principles of Biochemistry. Albert L. Lehninger, Michael Cox and DavidL. Nelson (4 May 2004), W. H. Freeman.
6. Microbiology: Fundamentals and Applications. Purohit S.S. Agro-Botanical publishers. Bikaner, India.

Internal Examination Pattern :

CAT – I: Poster Presentation/ Seminar

CAT – II: Surprise Test/ Quiz

Mapping of POs, PSOs and COs:

COs/POs & PSOs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5
CO1	3	2	2	1	2	1	1	0	3	1	2	2	1
CO2	3	2	2	3	3	3	2	1	3	3	2	3	3
CO3	2	3	2	2	3	2	2	2	2	3	3	2	3
CO4	2	3	3	3	2	2	3	3	2	2	3	3	3

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

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Faculty of Science and Technology

Department of Microbiology

UG-I Sem-II

Course Type : Lab Course
Course Title : Lab Course-IV (Based on DSC-IV)
Course Code : 101MIB2104
Credits : 01 **Max. Marks: 50** **Lectures: 30 Hrs.**

Learning Objectives:

LO1. To apply methods for measuring microbial growth using quantitative and qualitative techniques such as cell counting and turbidity analysis.
LO2. To perform quantitative analysis of microbial populations using standard microbiological enumeration techniques.
LO3. To analyze the effects of environmental factors such as temperature, pH, and oxygen on microbial growth.
LO4. To demonstrate experimental techniques for studying microbial growth dynamics and interpreting growth-related data.

Course Outcomes:

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

CO1. Perform microbial growth measurement techniques
CO2. Apply counting methods (plate count, turbidity, etc.)
CO3. Analyze environmental effects on microbial growth
CO4. Evaluate growth data and experimental outcomes

Sr. No.	Name of Experiment
1.	Preparation of Simple medium for cultivation of autotrophs (Algae)
2.	Isolation & Comparison of Autotrophs and Heterotrophs from a Water/Soil Sample
3.	Study of bacterial growth curve (Demonstration)
4.	Direct microscopic count
5.	Demonstration of colony counter
6.	Standard Plate count
7.	Determination of cell count by turbidimetric method
8.	Demonstration of biological assay (Acid/CO_2)
9.	Effect of Temperature on growth of Bacteria
10.	Effect of pH on growth of Bacteria
11.	Effect of Salt on growth of Bacteria
12.	Effect of molecular oxygen on growth of Bacteria

Note: Any Ten Practicals from above.

Learning Resources:

1) Handbook of media, stains and reagents in microbiology, A. M. Deshmukh, PAMA publication, Karad, 1997
2) Microbiology, Singh R.P., Kalyani Publication.
3) Practical Microbiology, Dubey, Maheshwari, S. Chand, 2022
4) Microbiology, Yadav Manju, Discovery Publishing House, New Delhi
5) Biochemical Methods, s. Sadasivam and A. Manickam, New age international publishers, 2008
6) Handbook of Microbiology, P. S. Bisen and Kavita Verma, CBS publishers and distributors, new Delhi,2007
7) Modern Tools and Techniques to Understand Microbes, Ajit Varma, Arun Kumar Sharma, Springer International Publishing, 2017.
8) Handbook of media, stains and reagents in microbiology, A. M. Deshmukh, PAMA publication, Karad, 1997
9) Microbiology, Singh R.P., Kalyani Publication.
10) Practical Microbiology, Dubey, Maheshwari, S. Chand, 2022
11) Microbiology, Yadav Manju, Discovery Publishing House, New Delhi
12) Biochemical Methods, s. Sadasivam and A. Manickam, New age international publishers, 2008
13) Handbook of Microbiology, P. S. Bisen and Kavita Verma, CBS publishers and distributors, new Delhi,2007
14) Modern Tools and Techniques to Understand Microbes, Ajit Varma, Arun Kumar Sharma, Springer International Publishing, 2017

Shiv Chhatrapati Shikshan Sanstha's

Rajarshi Shahu Mahavidyalaya, Latur

Empowered Autonomous Institution

Faculty of Science and Technology

Department of Microbiology

UG-I Sem-II

Course Type : VSC-II
Course Title : Food Fermentation Technology
Course Code : 101MIB2501
Credits : 1+1 **Max. Marks: 50** **Lectures: 45 Hrs.**

Learning Objectives:

LO1. To explain principles of food fermentation by understanding microbial involvement, fermentation conditions, and biochemical transformations.

LO2. To apply fermentation techniques in the production of various food products using appropriate microorganisms and controlled conditions.

LO3. To analyze microbial roles and biochemical changes occurring during fermentation processes in different food systems.

LO4. To evaluate quality, safety, and nutritional aspects of fermented food products based on microbial activity and processing methods.

Course Outcomes:

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

CO1. Describe fermentation processes and microorganisms

CO2. Apply fermentation techniques for food production

CO3. Analyze biochemical changes during fermentation

CO4. Evaluate quality and safety of fermented products

Unit No.	Title of Unit & Contents	Hrs.
I	**Introduction to Fermentation Process:**	**6**
	1. Fermentation process and microorganisms involved in it 2. Fermentation media and conditions of fermentation, 3. Ideal fermenter (demonstration) 4. Overview on biomolecules used in fermentation	
	Unit Outcomes: UO 1. Explain the fermented foods and their advantages in human health UO 2. Observe and recognize different types of microorganisms involved in food fermentation process	
II	**Milk Based Fermented Foods**	**5**
	1. Probiotics - Definition, types, advantages and health benefits 2. Preparation of inoculums, types of microorganisms & Biochemical process of 1. Curd, 2. Yogurt, 3. cheese	

Unit No.	Title of Unit & Contents	Hrs.
	Unit Outcomes: UO1. Explain different types of fermented milk products and the biochemical reactions involved in its production UO2. Able to prepare inoculum and produce yogurt	
III	**Vegetable and Fruit based Fermented Foods**	**4**
	Microorganisms involved Biochemical activity and Production process 1. Pickles, 2. Sauerkraut, 2. wine	
	Unit Outcomes: UO1. **E**xplain different types of fermented Vegetable and fruit products and the biochemical acitivities involved in its production UO2. Able to prepare pickle and fruit wine.	
IV	**Practicals (Based on above 03 units)**	**30**
	1. Demonstration of different types of microorganisms involved in fermentation process 2. Preparation of inoculum for milk based fermented foods 3. Production of Yogurt 4. Production of pickle 5. Production of fruit Wine 6. Production of Idli	

Learning Resources:

1. An Introduction to Industrial Microbiology. K. Sukesh. S. Chand Limited · 2010
2. Handbook of food and fermentation technology. Hui YH, Meunier-Goddik L, Josephsen J, Nip WK, Stanfield PS. CRC Press. 2004.
3. Advances in Fermented Foods and Beverages. Holzapfel W. Woodhead Publishing. 2014.
4. A comprehensive dairy microbiology. Yadav JS, Grover, S and Batish VK. Metropolitan. 1993.
5. Industrial Microbiology. David B. Wilson, Hermann Sahm, Klaus-Peter Stahmann, Mattheos Koffas. Wiley. 2019
6. Ethnic Fermented Foods and Beverages of India: Science History and Culture. Jyoti Prakash Tamang. Springer Nature Singapore. 2020
7. Microbial Production of Fermented Foods. Nandkishor Jha. Link: https://www.biologydiscussion.com/foods/microbial-production-of-fermented-foods/10402
8. Model Project Report on Fruit & Vegetable Processing Unit. National Bank for Agriculture and Rural Development. July, 2024

Internal Examination Pattern :

CAT – I: PPT Presentation/ Seminar,

CAT – II: Quiz/ Open Book Test

Mapping of POs, PSOs and COs:

COs/POs & PSOs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5
CO1	3	2	2	1	2	2	2	1	3	1	1	3	1
CO2	2	2	2	3	3	3	3	2	2	3	2	3	3
CO3	3	3	2	2	3	2	1	1	3	3	3	2	3
CO4	2	3	3	3	2	2	3	3	2	2	3	3	3

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

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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
1	2	3				4		5	6	5 + 6
		Att.	CAT I	Mid Term	CAT II	Att.	CAT			
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

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Examination Question Paper Pattern (Theory)

Max. Marks: 45 **Time: 2 Hrs**

Q.1 Answer the following questions (3 Marks each) 12 Marks

a) Based on Unit - I

b) Based on Unit - II

c) Based on Unit - III

d) Based on Unit - IV

Q.2 Answer any THREE of the following (5 Marks each) 15 Marks

a) Based on Unit - I

b) Based on Unit - II

c) Based on Unit - III

d) Based on Unit - IV

Q.3 Answer any ONE of the following 08 Marks

a) Based on Unit – I

b) Based on Unit – II

Q.4 Answer any ONE of the following 10 Marks

a) Based on Unit - III

b) Based on Unit – IV