

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

**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 (IInd Year)

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

॥ आनन्दोऽमृतोऽस्मिन्नेति ॥
w.e.f. June, 2024

(In Accordance with NEP-2020)
**Rajarshi Shahu Mahavidyalaya,
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Review Statement

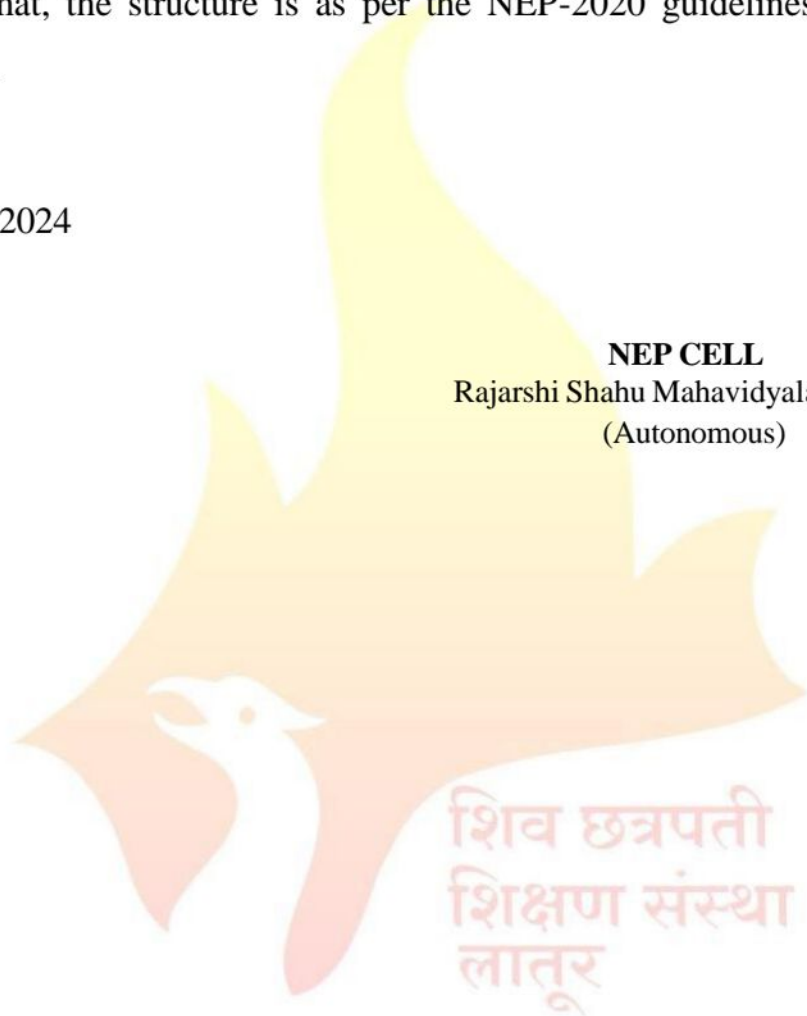
The NEP Cell reviewed the Curriculum of **B.Sc. (Honors/Research) in Microbiology** Programme to be effective from the **Academic Year 2023-24**. It was found that, the structure is as per the NEP-2020 guidelines of Govt. of Maharashtra.

Date: 20/03/2024

Place: Latur

NEP CELL

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CERTIFICATE

I hereby certify that the documents attached are the Bonafide copies of the Curriculum of **B.Sc. (Honors/Research) in Microbiology** Programme to be effective from the **Academic Year 2024-25**.

Date: 20-03-2024

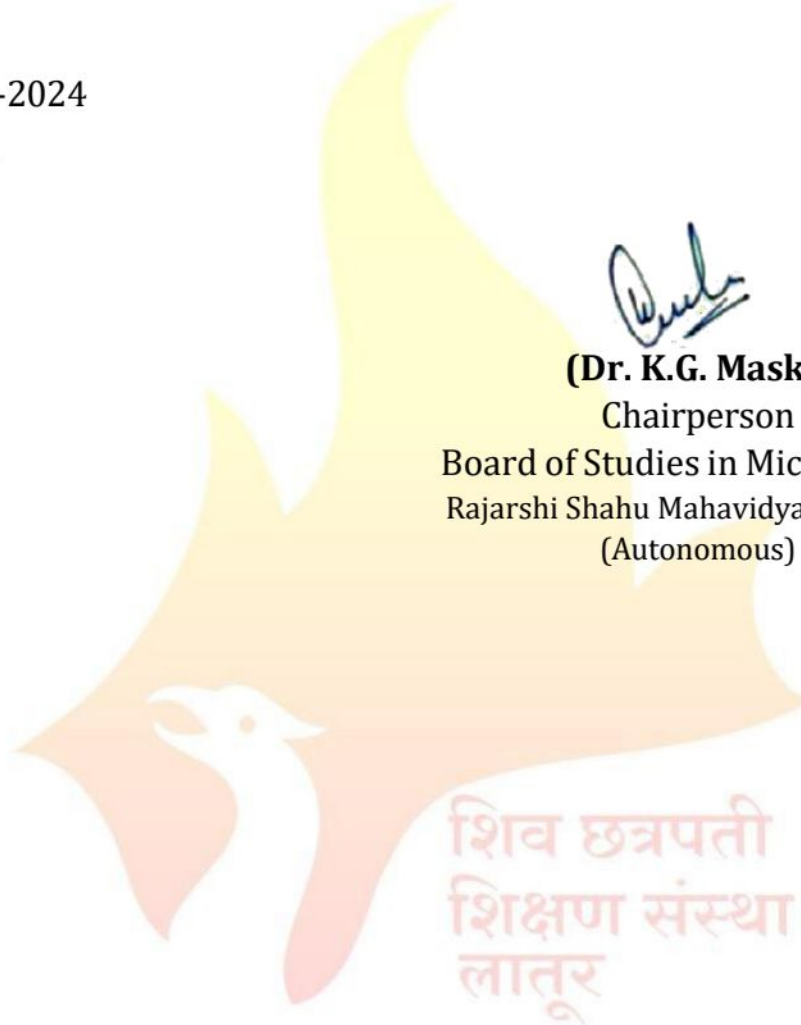
Place: Latur



(Dr. K.G. Maske)

Chairperson

Board of Studies in Microbiology
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From the Desk of the Chairperson...

The National Education Policy lays particular emphasis on the development of the creative potential of each individual. NEP-2020 has conceptualized the idea to develop well rounded competent individuals for making the nation a self-reliant and global leader.

Department of Microbiology has developed a curriculum framework to encompass the goals of NEP 2020. Microbiology is study of microorganisms such as bacteria, protozoa, algae, fungi, viruses, etc. These studies integrate cytology, physiology, ecology, genetics and molecular biology, evolution, taxonomy and systematics with a focus on microorganisms. It is one of the significant branches of sciences to understand the principles of life which has roots in the study of various microbial systems. Microbiology has been at the forefront of research in industry, environment, agriculture, food, dairy, medicine and biology. It is one of the rapidly growing and applied areas of the science. Many job opportunities available for student in this stream. Trained manpower is required in industrial production of microbial products. Considering rural and agro based life background and awareness about the general health and hygiene , our curriculum is designed to educate our students in various important microbiological domains, as well as to promote and develop skills and competencies that have great value.

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Faculty of Science & Technology After the completion of the B.Sc. programme, a student will have obtained:

Programme Outcomes (POs) for B.Sc. Programme	
After the completion of the B.Sc. programme, a student will have obtained:	
PO 1	Disciplinary Knowledge Comprehensive knowledge of science subjects which constitute the graduate programme and execution of scientific knowledge in the specific area.
PO 2	Scientific Outlook The qualities of a science graduate such as observation, precision, analytical mind, logical thinking, clarity of thought and expression and systematic approach.
PO 3	Self-Directed Life-long Learning Ability to appear for various competitive examinations or choose the post graduate programme or other related programme of their choice.
PO 4	Research Skills Functional knowledge and applications of instrumentation and laboratory techniques to do independent experiments, interpret the results and develop research ethos.
PO 5	Problem Solving Skills Analytical and logical skills and critical thinking to extract information from qualitative and quantitative data, formulate and solve problems in a systematic and rational manner.
PO 6	Professional Competence and Ethics Aptitude and skills to perform the jobs in diverse fields such as science, engineering, industries, survey, education, banking, development and planning, business, public service, self-business etc. with human rationale and moral values.



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Programme Specific Outcomes (PSOs) for B.Sc. Microbiology (Honors/Research)	
PSO No.	Upon completion of this programme the students will be able to
PSO 1	Academic Competence Comprehensive knowledge in the underlying principles of Microbiology, basics in Microbiology and Biomolecules, Methods, Microbial nutrition and growth, fundamentals of immunology, Environmental Microbiology, Production of Biofertilizer, Agricultural Microbiology.
PSO 2	Scientific Outlook Scientific temperament with the help of experiments and practicals in Microbiology such as observation of microorganism through microscope, use of microbial techniques, experiments to test physiochemical factors, perform hematological procedures
PSO 3	Personal and Professional Competence Competence to do awareness about hematological, microorganisms and causation of diseases, environmental, agricultural issues and can work to solve the environmental issues with the help of knowledge in Microbiology.
PSO 4	Entrepreneurial Competence Capacity to move in the start-up of bio fertilizer, pathology lab, Food Fermentation, Production of Probiotics for good health, medical services or work for the conservation of environment or can work in such organizations.
PSO 5	Research Competence An ability to work over minor and preliminary research in human health, environmental issues, production of various secondary metabolites of human benefit by fermentation processes and other related issues.

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Members of Board of Studies in the Subject Microbiology Under the Faculty of Science and Technology

Sr. No.	Name	Designation	In position
1	Dr.K.G.Maske Head, Department of Microbiology, Rajarshi Shahu Mahavidyalaya, Latur (Autonomous)	Chairperson	HoD
2	Dr. B. S.Nagoba Assistant Dean (R D), Professor of Microbiology, MIMSR Medical College, Latur- 413 512 (MS), India	Member	V.C. Nominee
3	Dr. Ulhas K. Patil Government Institute of Science Aurangabad	Member	Academic Council Nominee
4	Dr A. M. Deshmukh Former Professor and President, Microbiologist Society of India	Member	Academic Council Nominee
5	Dr. Manmohan Bajaj Product Manager, BIOGENE INDIA, New Delhi	Member	Expert from outside for Special Course
6	Dr.Vinodkumar Patil Director, Dyna Biotech 98/A5,Hadapsar Industrial Estate Bhd. Kirloskar Pneumatic Co., Hadapsar, Pune	Member	Expert from Industry
7	Dr Mahesh S. Dharane Sr.Scientist, Division of Biochemical Sciences,Dr. Homi Babha Road,Pashan, NCL, Pune	Member	P.G. Alumni
8	Dr.D.V.Vedpathak	Member	Faculty Member
9	Dr.K.I.Momin	Member	Member from same Faculty

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Faculty of Science and Technology

Structure for Four Year Multidisciplinary Undergraduate Degree Programme(B.Sc. II) in Microbiology 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
II 5.0	III	DSC V: 04 Cr. DSC VI: 04 Cr.	NA	Minor I: 04 Cr.	GE-III: 02 Cr.	SEC-III: 02 Cr.	AEC-III Eng. : 02 Cr.	CC-I: 02 Cr. (SSC) Field Project: 02 Cr.	22	88 Cr. UG Diploma
	IV	DSC VII: 04 Cr. DSC VIII: 04 Cr.	NA	Minor II: 04 Cr.	GE-IV: 02 Cr.	SEC-IV: 02 Cr.	AEC-IV Eng. : 02 Cr.	CC-II: 02 Cr. (SSC) Field Project: 02 Cr.	22	
	Cum. Cr.	16	-	08	04	04	04	08	44	

Exit Option: Award of UG Diploma in Major with 88 Credits and Additional 04 Credits Core NSQF Course/Internship or continue with Major and Minor

Note :

A) Co-Curricular Courses (CC) includes –

1. Health and Wellness
2. Yoga education
3. Sports and fitness
4. Cultural activities
5. NSS
6. NCC
7. Fine Applied Visual Performing Arts
8. Study Tour
9. Publication of articles in newspaper / magazine.

B) Field Project concerned with Major

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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. SSC (CC) : Students Services Centre (Co-Curricular Courses)
17. RP : Research Project/Dissertation
18. SES : Shahu Extension Services

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Department of Microbiology
B.Sc. (Honors/Research) Microbiology

Year & Level	Semester	Course Code	Course Title	Credits	No. of Hrs.
II 5.0	III	201MIB3101 (DSC-V)	Applied Microbiology	03	45
		201MIB3103	Lab Course-V	01	30
		201MIB 3102 (DSC-VI)	Fundamentals of Immunology	03	45
		201MIB3104	Lab Course-VI	01	30
		DSM - I	Elementary microbiology	03	45
			DSM-I-Lab Course	01	30
		GE-III	From Basket	04	60
		101MIB1501 (SEC-III)	Production of Biofertilizer	02	30
		(AEC-III)	English	02	30
		AIPC/OJT-I	Field Project	02	60
	Total Credits			22	
	IV	101MIB2101 (DSC-VII)	Environmental Microbiology	03	45
		101MIB2103	Lab Course-VII	01	30
		101MIB2102 (DSC-VIII)	Medical Microbiology	03	45
		101MIB2104	Lab Course-VIII	01	30
		DSM II	Basic Techniques in microbiology	03	45
			DSM-II-Lab Course	1	30
		GE-IV	From Basket	04	60
		(SEC-IV)	Single cell protein production technology	02	30
		(AEC-IV)	From Basket	02	30
		(FP/RP)	Field project	02	30
	Total Credits			22	60
Total Credits (Semester I & II)				44	



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Department of Microbiology

Course Type: DSC-V

Course Title: Applied Microbiology

Course Code: 201MIB 3101

Credits: 03

Max. Marks: 75

Lectures: 45 Hrs.

Learning Objectives:

- LO 1. To study presence of microorganisms in air and Microbiological Analysis of Air.
- LO 2. To learn the subject in perspective of public health and hygiene.
- LO 3. To know techniques to control microbial contamination in air, water and food.
- LO 4. To study different types of treatment for domestic, municipal and industrial waste.

Course Outcomes:

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

- CO 1. Describe the importance of existence of microorganisms in air and method of analysis.
- CO 2. Explain bacteriological evidence of fecal pollution of water.
- CO 3. Apply sewage treatment in domestic, municipal and industrial waste.
- CO 4. To explain microbial spoilage food and milk and food Preservation techniques

Unit No.	Title of Unit & Contents	Hrs.
I	Air Microbiology	10
	<ul style="list-style-type: none">1. Definition, composition and quality of air.2. Sources of microorganisms in air: Indoor and outdoor microflora.3. Importance of state of suspension- Bioaerosols: droplet, droplet nuclei and droplet infection.4. Significance of microorganisms present in air: With respect to human health (list of air borne diseases).5. Microbiological Analysis of Air: Solid and liquid impingement, Anderson air sampler.6. Control of microorganisms in air: Dust control, UV radiation, laminar airflow system, masks, Bactericidal vapours.	
	Unit Outcomes: UO 1. Student will be able describe water borne diseases and	

Unit No.	Title of Unit & Contents	Hrs.
	safety of drinking water. UO 2. Student will explain spread of microorganisms in air and air borne diseases .	
II	UNIT II: Water Microbiology	12
	<ol style="list-style-type: none"> 1. Natural waters: Atmospheric, surface, stored and ground water. Definitions: Fresh water (ponds, lakes, streams) and Marine water (estuaries, the sea). 2. Aquatic environment: Temperature, hydrostatic pressure, light, salinity, turbidity, Planktons and other microorganisms. 3. Domestic water: water borne diseases, nuisance microorganisms. 4. Bacteriological evidence of pollution: Fecal pollution, significance of indicator microorganisms. 5. Microbiological examination of water: Membrane filter technique, Tests for presence of coliforms (quantitative and qualitative), IMVC test, Elevated temperature test. 6. Safety of drinking water: Boiling, chlorination, radiation and ozonization 	
	Unit Outcome: UO 1. Student will be able to explain water borne diseases and safety of drinking water.	
III	Waste water microbiology	13
	<ol style="list-style-type: none"> 1. Sewage: Definition, composition and strength: BOD, COD. 2. Sewage treatment: (physical, biological and chemical Oxidation ponds, solids processing, Composting.) 3. Domestic sewage treatment 4. Municipal sewage treatment 5. Industrial waste treatment 	
	Unit Outcomes: UO 1. Student will be able to describe sewage treatment methods.	
IV	Food and milk microbiology	10
	<ol style="list-style-type: none"> 1. Sources of microorganisms in foods and milk. 2. Milk as a nutrient medium for microbial growth. 3. Common food borne bacteria-Starter culture-Lactic acid bacteria. 4. Microbiological examination of food: DMC, SPC, Differential enumeration, MBRT, Resazurin test. 5. Food Spoilage: Classification of foods depending upon ease of spoilage, Different types of spoilages with suitable examples, biochemical types of microorganisms in milk. 6. Principles and applications of food Preservation techniques: 	

Unit No.	Title of Unit & Contents	Hrs.
	<p>Asepsis, use of high temperatures (milk pasteurization and phosphatase test, canning), freezing, dehydration, radiation (UV and Gamma rays), osmotic pressure; use of chemicals- Vinegar, Benzoic acid.</p> <p>7. Food borne diseases: Staphylococcal poisoning and Salmonellosis.</p>	
	<p>Unit Outcomes:</p> <p>UO 1. Student will apply this To explain microbial spoilage food and milk and food Preservation techniques .</p>	

Learning Resources:

1. A textbook of Microbiology, Dubey R. C. and D. K. Maheshwary. (2012), S Chand and Company. New Delhi, India.
2. 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.
3. Elementary Microbiology, Vol. I and II. Dr. A. H Modi, Akta Prakashan. Nadiad
4. Essentials of Microbiology, Jain A. and Jain P. (2019). Elsevier- India.
5. Fundamental Principles of Bacteriology, Salle A. J. (McGraw-Hill Book Co. New York and London 1973) 7th Edition
6. Fundamentals of Microbiology, Frobisher M., (W. B. Saunders, Philadelphia, 1962) 7th edition.
7. General Microbiology . Stanier R. Y., Ingraham J. L., Wheelis M. L. and Painter P. R., (Macmillan Education Ltd., London, 2001) 5th edition.
8. General microbiology ,Volume I. Powar C. B. and Daginawala H. I. (2005).. Himalaya Publishing House Private Limited, Pune, India.
9. General microbiology, Volume II. Powar C. B. and Daginawala H. I. (2005). Himalaya Publishing House, Private Limited, Pune, India
10. 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.
11. Food Microbiology. 2nd Edition By Adams Basic Food Microbiology by Banwart George J. Food Microbiology: Fundamentals and Frontiers by Dolle
12. Biotechnology: Food Fermentation Microbiology, Biochemistry and Technology. Volume 2 by Joshi.
13. Fundamentals of Dairy Microbiology by Prajapati.
14. Microbiology of Fermented Foods. Volume II and I. Brian J.Wood. Elsevier Applied Science Publication.



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Department of Microbiology

Course Type: Lab Course

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

Course Code: 201MIB3103

Credits: 01

Max. Marks: 50

Hours: 30

Learning Objectives

L O 1. To study methods used for bacteriological analysis of water.

L O 2. To study methods used for bacteriological analysis of air.

L O 3. To study methods used for bacteriological analysis of soil, food and milk.

Course outcomes

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

CO 1. Perform microbiological analysis Air

CO 2. Perform microbiological analysis of Water.

CO 3. Perform microbiological analysis of Milk

CO 4. Perform quantitative microbiological analysis of food.

Practical No.	Unit
1	Microbial analysis of air from –hospital environment .
2	Microbial sampling of air for fungi by solid impingement techniques
3	Bacteriological examination of water for potability - Quantitative analysis: MPN
4	Bacteriological examination of water for potability –Qualitative: Presumptive, confirmed, completed test
5	Test for fecal coliforms: IMViC tests
6	Test for fecal coliforms: Elevated temperature tests
7	Bacteriological analysis of milk: Reductase test
8	Microbial analysis of air from – public places
9	Microbial sampling of air from industrial Area.
10	Microbial analysis of fermented food.
11	Microbial analysis of spoiled food.
12	Visit to municipal sewage treatment plant and prepare report.

N.B.: Any Ten Practical 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

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Department of Microbiology

Course Type: DSC-VI

Course Title: Fundamentals of Immunology

Course Code: 201 MIB3102

Credits: 03

Max. Marks: 75

Lectures: 45 Hrs.

Learning Objectives

- LO 1. To understand basic principles of immunology and microbial interactions with relationship.
- LO 2. To understand antigen, antibody and complement system.
- LO 3. To learn overview of Immunity and immune responses.
- LO 4. To understand antigen antibody reaction and their applications.

Course outcomes

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

- CO 1. Explain the host microbe interactions.
- CO 2. Describe the antigen and antibodies.
- CO 3. Describe the immunological concepts with reference to immunity.
- CO4. Apply serological reactions for diagnosis of the diseases.

Unit No.	Title of Unit & Contents	Hrs
I	Humans Microbial interactions	10
	1. Definitions –contamination, infection and disease, pathogen, pathogenicity and virulence. 2. Overview of human microbial interactions commensalism, mutualism, parasitism with examples 3. Aggressive factors of the pathogens 4. Normal (indigenous) micro flora. 5. Role of normal microflora of the host.	
	Unit Outcome: UO 1.Student will explain role of normal flora of the host. UO 2. Student will describe aggressive factors of pathogens	
II	Antigen and Antibody	12
	1. Antigen :Definition, Immunogenicity versus antigenicity 2. General properties of antigen. 3. Antigen specificity. 4. Bacterial antigens with special reference to antigens of <i>Salmonella typhi</i> .	

	5 Antibody-Definition and basic structure of antibody. Immunoglobulin classes, properties of immunoglobulin classes	
	Unit Outcome: UO 1. Student will be able to describe antigens. UO 2. Student will be able to describe antibodies.	
III	Immunity and Immunization	13
	<ol style="list-style-type: none"> 1. Definition and classification of immunity with suitable examples. 2. Immune response: Humoral and cellular 3. Theories of antibody production 4. Hypersensitivity: types of hypersensitivity in brief 5. Immunization-Active and passive immunization. 6. Designing vaccines for active immunization <ol style="list-style-type: none"> i. Live attenuated vaccines. ii. Inactivated or killed vaccine. iii. Subunit vaccine. iv. Toxoid. v. Recombinant DNA vaccine 7. Immunesera. 	
	Unit Outcomes: UO 1. Student will be able to explain Immune responses UO 2. Student will be able to explain Immunization process.	
IV	Antigen antibody reactions	10
	<ol style="list-style-type: none"> 1. General features of antigen antibody reactions. 2. Mechanism Precipitation and agglutination. 3. Applications of precipitation reactions 4. Applications of agglutination reactions 5. Immunodiffusion 6. Immuno electrophoresis 7. Complement fixation test. 8. Neutralization: toxin and virus neutralization 9. Enzyme linked immunosorbent assay. 	
	Unit Outcome: UO 1. Student will be able to describe antigen antibody reactions. UO 2. Student will be able to application of antigen antibody reactions	

Learning Resources:

1. Basic Immunology by Joshi and Osarano. Agrobotanical publishers Ltd. Bikaner.
2. Elementary Microbiology Vol. I and II Dr. A. H Modi. Akta Prakashan. Nadiad.
3. Medical Microbiology. N. C. Dey and T. K. Dey. Allied agency, Culcutta.
4. Microbiology by Davis, Dulbecco, Eisen Harper and Row Maryland.
5. Text book of Microbiology by R. Anantharayanan, C.K. Jayaram Panikar, Orient Longman, Mumbai.
6. Kuby's Immunology by Goldsby RA, Kindt TJ, Osborne BAW.H Freeman and Company, New York.
7. A handbook of practical immunology by G. P. Talwar, Vikas Publishing House, New Delhi.
8. Genes VII by Benjamin Lewin, Oxford University Press.
9. Immunology (2nd edition) by C. Vaman Rao, Narosa publication.
10. Immunology (2nd edition) by Janis Kuby, W. H. Freeman and company.
11. Immunology (8th Edition) by D. M. Weir, Churchill Livingstone.
12. Roitt's Essential Immunology (9th edition) by Ivan Roitt, Blackwell



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Department of Microbiology

Course Type: Lab Course

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

Course Code: 201MIB2104

Credits: 01

Max. Marks: 50

Hours: 30

Learning Objectives

LO 1. To study host microbe interaction and virulence factors of pathogens.

LO 2. To study isolation and identification of pathogens

LO 3. To study serological test used for diagnosis of diseases

LO 3. To study staining for WBC and total count.

Course outcomes

After completion of course the student will be able to-

CO 1. Perform haematological procedures for detection of blood groups.

CO 2. Perform diagnosis of diseases.

CO 3. Perform differentiate blood staining

CO 4. Perform experiment to determine presence of virulence factors of pathogens

Practical No.	Unit
1	Isolation of normal bacterial flora of human body.
2	Study of virulence factors of –Coagulase , capsule staining,
3	Study of haemolysins.
4	Determination of iso antigens on human RBC: Blood grouping
5	Serodiagnosis of Typhoid fever : Widal test.
6	RPR test.
7	Immuno diffusion test.
8	Differential blood staining for WBC
9	Differential count of leucocytes.
10	Western blot test (Demonstration)

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



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Department of Microbiology

Course Type: DSC-VII

Course Title: Environmental microbiology

Course Code: 201MIB4101

Credits: 03

Max. Marks: 75

Lectures: 45 Hrs.

Learning Objectives:

- LO 1. To study interrelationship and influence of microorganisms on each other and on environment.
- LO 2. To learn eco-friendly and sustainable microbial techniques to solve agro-environmental problems.
- LO 3. To study role of microorganisms in turnover of elements in the environment.
- LO 4. To study role of microorganisms in plant growth promotion and plant disease management.

Course Outcomes:

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

- 1. Explain microbial interactions and their role in environment.
- 2. Describe the influence of microbial interactions on environment and development of an ecosystem.
- 3. Demonstrate that microorganisms have an indispensable role in turnover of elements in the environment.
- 4. Advocate the role of microorganisms in plant growth promotion and plant disease management

Unit No.	Title of Unit & Contents	Hrs.
I	Microbial Ecology and interactions	12
	<ul style="list-style-type: none">1. Microbial ecology: Ecosystem, Synecology, Autecology, population, community (Autochthonous, Allochthonous),2. Dispersal :(Center, Active, Passive)3. Community succession (Pioneer, Successive, Climax), Adaptation(Phenotypic, Genotypic)4. Symbiosis: Definition and functions <p>Types of associations: neutralism, Commensalism, Mutualism (Lichens, Mycorrhiza) Competition, Antibiosis, Synergism, and Parasitism. (Definition and example of each).</p>	

Unit No.	Title of Unit & Contents	Hrs.
	<p>Unit Outcomes: Students will be able to</p> <p>UO 1. Types of microbial interactions and Community succession.</p>	
II	Plant growth promoting rhizobacteria	12
	<ol style="list-style-type: none"> 1. Rhizosphere. 2. Direct plant growth promotion: Microbial plant growth promoting substances: Indoleacetic acid, gibberellic acid. 3. Indirect plant growth promotion –Biocontrol. 4. Competition for an ecological niche. 5. Suppression of growth of soil-born phytopathogens by producing allelochemicals 6. Induction of systemic resistance (ISR). <p>Unit Outcome: Students will be able to</p> <p>UO 1. Describe the role of microorganisms in plant growth promotion.</p>	
III	Soil microbiology : Microbial transformation of C N,S,P in soil	11
	<ol style="list-style-type: none"> 1. Soil environment : Structure and texture of soil, Organic fraction of soil (Humus), Soil as growth medium for microorganisms. 2. Carbon cycle: Cycle, Mineralization- cellulose, Starch (Microbiology and enzymology), Carbon assimilation. 3. Nitrogen cycle: Cycle, Nitrogen fixation (Symbiotic, Non symbiotic, Nitrogenase), Mineralization of proteins, Ammonification, Nitrification, Denitrification,. 4. Sulfur cycle Phosphorus cycle. <p>Unit Outcomes: Students will be able to</p> <p>UO 1. Describe Microbial transformation of C N,S,P in soil.</p>	
IV	Bioremediation	10
	<ol style="list-style-type: none"> 1. Soil contamination- Xenobiotics 2. Bioremediation: Definition and principle. 3. Microbial Populations for Bioremediation Processes. 4. Types of Bioremediation: In situ bioremediation, Ex situ bioremediation. 5. Advantages and disadvantages of Bioremediation 	

Unit No.	Title of Unit & Contents	Hrs.
	Unit Outcomes: Students will be able to UO 1. Explain methods for decontamination of soil	

Learning Resources:

1. Introduction to soil Microbiology, Alexander Martin, John Wiley and Sons.N.Y.
2. Soil Microorganisms and plant growth. Subba Rao N.S, Oxford and IBHpublishing Co. Pvt. Ltd.
3. Microbiology. Pelczar, Chan and Crieg. TATA MCGRAW- HILL
4. Text book of applied microbiology. Dr. B.M Sandikar, Himalaya PublishingHouse
5. Microbial biotechnology: fundamentals of applied microbiology. AlexanderGlazer, Hiroshi Nikaido. Cambridge university press
6. Review on Bioremediation of Polluted Environment: A Management Tool: Kumar.A, Bisht.B.S, Joshi.V.D, Dhewa.T. International journal of environmental sciences. Volume 1, No 6, 2011
7. Environmental microbiology. Ralph Mitchell, Ji-Dong Gu. Wiley-Blackwell
8. Biochemistry, 4th edn. Dubuque, IO: William C Brown
9. Handbook of Biochemistry and Molecular Biology
10. Biochemistry, 3rd Edition, by Drs. John W. Pelley, and Edward F. Goljan.
11. The Cell: A Molecular Approach by Geoffrey M. Cooper, and Robert E. Hausman



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(Autonomous)

Department of Microbiology

Course Type: Lab Course

Course Title: Lab Course VII (Based on DSC VII)

Course Code: 201MIB4103

Credits: 01

Max. Marks: 50

Hours: 30

Learning Objectives:

- LO 1. To study microbial succession.
- LO 2. To study influence of plant on soil microorganisms .
- LO 3. To study ammonification and nitrification process.
- LO 4. To study nitrogen fixing microorganisms in soil.

Course Outcomes:

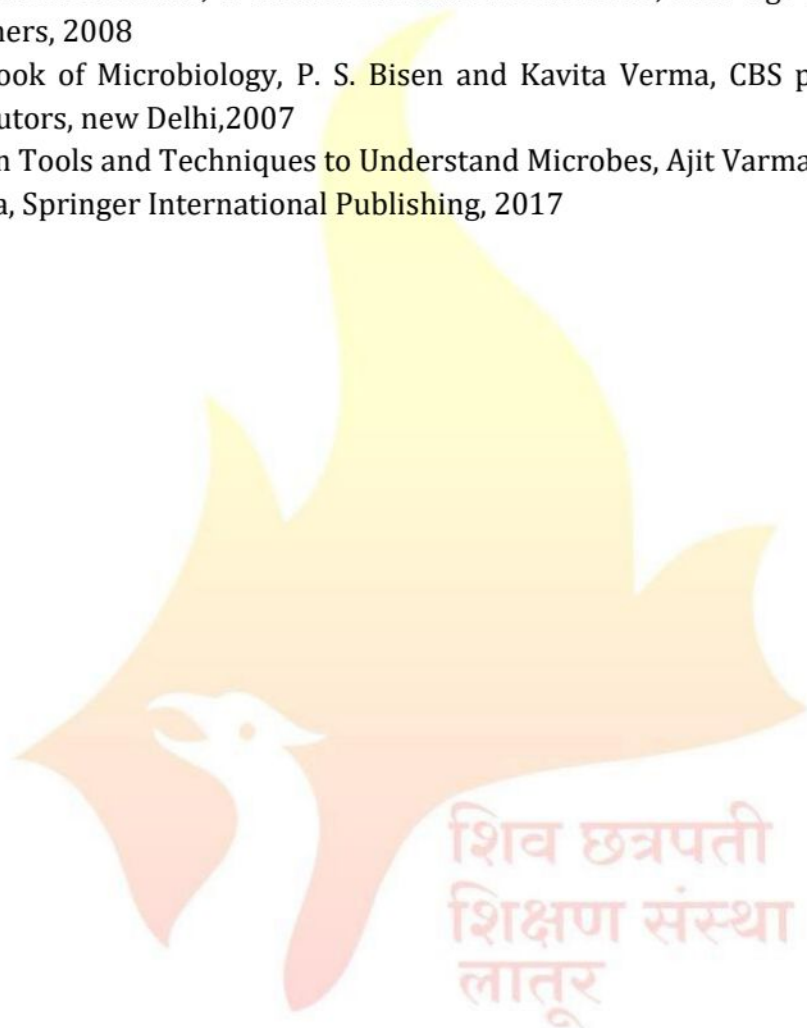
After completion of the course, students will be able to -

- CO 1 Demonstrate microbial succession with reference to raw milk.
- CO 2 Demonstrate production and analysis of plant growth promoting substances.
- CO 3 Obtain nitrogen fixing microorganisms in pure culture.
- Co 4. Obtain starch degrading bacteria from soil.

Practical No.	Unit
1	Study of microbial succession in raw milk.
2	Study of rhizosphere effect- R: S ratio.
3	Isolation of rhizospheric bacteria showing biocontrol potential.
4	Isolation of starch degrading bacteria.
5	Demonstration of Ammonification ,Nitrification and Denitrification .
6	Demonstration of i) Nitrate reduction and ii) Sulfate reduction .
7	Isolation and study of <i>Rhizobium</i> species from root nodules of leguminous plants.
8	Isolation and study of <i>Azotobacter</i> sp. from soil .
9	Chemical analysis of soil.(Demonstration)
10	Determination of BOD and COD of sewage water. (Demonstration).

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



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Department of Microbiology

Course Type: DSC-VIII

Course Title: Medical Microbiology

Course Code: 201MIB 4102

Credits: 03

Max. Marks: 75

Lectures: 45 Hrs.

Learning Objectives:

- LO1 To gain knowledge about disease process and kinds of diseases
- LO 2 To study reservoirs of infection and modes of transmission of infections.
- LO 3 To study diseases caused by bacterial pathogens.
- LO 4 To study diseases caused by viral pathogens and parasites.

Course Outcomes:

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

- CO 1 Describe an integral role of microorganisms in causation of diseases.
- CO 2 Explain sources of infection and modes of transmission of infections
- CO 3 Execute precautions to avoid the spread of viral diseases
- CO 4 Describe antimicrobial, immunological and diagnostic methodologies used in disease treatment and prevention.

Unit No.	Title of Unit & Contents	Hrs.
I	Disease process and kinds of diseases	12
	<ul style="list-style-type: none">1. Kinds of diseases .2. Infections : terms used to describe different types of infections.3. Disease process, signs, symptoms and syndrome.4. Epidemiology-epidemic, endemic, pandemic, sporadic5. Sources of infection.6. Modes of disease transmission, carriers and their types.	
	Unit Outcomes: Students will be able to UO 1. Describe the different kinds of diseases and infections.	
II	Study of following diseases	12
	<ul style="list-style-type: none">1. Introduction and definitions: Etiology, pathogenesis, Symptomatology, laboratory diagnosis, epidemiology, prophylaxis2. Typhoid3. Cholera4. Tuberculosis	
	Unit Outcome:	

Unit No.	Title of Unit & Contents	Hrs.
	UO 1. Explain about preventive measures of diseases.	
III	Study of the Fungal and mosquito borne diseases	11
	Etiology, pathogenesis, Clinical features, laboratory diagnosis, epidemiology, treatment and prophylaxis of the following 1.Candidiasis 2.Malaria 3.Dengue	
	Unit Outcomes: Students will be able to UO 1. Describe about preventive measures of diseases.	
IV	Study of following viral diseases	10
	1.Hepatitis 2.AIDS 3.COVID 19	
	UO 1. Explain about causative agent, epidemiology and preventive measures.	

Learning Resources:

1. Medical Microbiology. N.C.Dey and T.K. Dey. Allied agency, Culcutta.
2. Microbiology by Davis, Dulbecco, Eisen Harper and Row Maryland.
3. Text book of Microbiology by R. Anantharayanan, C.K. Jayaram Panikar, OrientLongman, Mumbai.
4. Medical microbiology by Chakraborty.
5. Medical Microbiology: Prep Manual for Under Graduates by Nagoba, Elsevier
6. Manual of Clinical Microbiology, Karen C. Carroll (Editor), Michael A. Pfaller ASM publications.
7. Essentials of Medical Microbiology by Apurba Sankar Sastry and Sandhya Bhat K, Jaypee Brothers Medical Publishers
8. Basic Medical Microbiology E-Book, Patrick R. Murray ·2017 Elsevier Health Sciences

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Department of Microbiology

Course Type: Lab Course

Course Title: Lab Course VIII (Based on DSC VIII)

Course Code: 201MIB4104

Credits: 01

Max. Marks: 50

Hours: 30

Learning Objectives:

LO 1 To study microscopic diagnosis of tuberculosis and malaria.

LO 2. To study causative agent of typhoid fever.

LO 3. To study causative agent of cholera.

Course Outcomes:

After completion of course the student will be able to-

CO 1 Perform diagnosis of tuberculosis and malaria.

CO 2 Perform laboratory diagnosis of typhoid.

CO3. Perform laboratory diagnosis of cholera .

CO 4. Determine antibiotic resistance of pathogens

Practical No.	Unit
1	Microscopic diagnosis of tuberculosis by acid fast staining.
2	Microscopic diagnosis of malaria by blood smear method.
3	Study of biochemical reactions for identification of pathogen.
4	Study of morphological and cultural characteristics of <i>Salmonella typhi</i> species.
5	Study of biochemical characteristics of <i>Salmonella</i> species
6	Study of morphological and cultural characteristics of <i>Vibrio cholera</i> .
7	Isolation of <i>Candida albicans</i> from lesions.
8	Antibiotic sensitivity tests for pathogens by disc diffusion method

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



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Department of Microbiology

Course Type: SEC-III

Course Title: Production of Bio fertilizers

Course Code: 201MIB3601

Credits: 02

Max. Marks: 50

Lectures: 30 Hrs.

Learning Objectives:

- LO 1. To create awareness about organic farming.
- LO 2. To inculcate skills for mass production of bio fertilizers
- LO 3. To promote self-employment.
- LO 4. To promote ecofriendly and sustainable agro practices

Course Outcomes:

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

- CO 1. Types of Bio-fertilizers and their importance
- CO 2. Explain Rhizosphere & plant growth promoting substances
- CO 3. Explain role of Nitrogen Fixing Bacteria
- CO 4. Describe Bio-fertilizer production

Unit No.	Title of Unit & Contents	Hrs.
I	Organic farming and importance of bio fertilizers	4
	<ul style="list-style-type: none">1. Organic Farming for sustainable development2. Importance of Bio-fertilizer3. Types of Bio-fertilizers <p>Unit Outcomes: Student will be able to</p> <p>UO.1 Explain importance of organic farming</p> <p>UO.2 Explain importance of bio fertilizers</p>	
II	Plant Growth Promoting Rhizobacteria	5
	<ul style="list-style-type: none">1. Rhizosphere.2. Direct plant growth promotion3. Microbial plant growth promoting substances: Indole-acetic acid, gibberellic acid. <p>Unit Outcome: Students will be able to</p> <p>UO 2. Describe the role of microorganisms in plant growth promotion.</p>	
III	Study of Nitrogen Fixing Bacteria: Rhizobium and Azotobacter	6

	<ol style="list-style-type: none"> 1. Free living nitrogen fixing bacteria 2. Study of <i>Azotobacter</i> species 3. Study of <i>Rhizobium</i> species 	
	Unit Outcome: Students will be able to UO.1 Describe the importance of <i>Azotobacter</i> and <i>Rhizobium</i> species for improving soil fertility	
IV	Laboratory Production of the Biofertilizer	30
	<ol style="list-style-type: none"> 1. Isolation and characterization of <i>Rhizobium</i> 2. Isolation and characterization of <i>Azotobacter</i> 3. Isolation and characterization of Indole-acetic acid producing Bacteria 4. Isolation of PSB and characterization 5. Mass production of bio-fertilizers 	
	Unit Outcome: Students will be able to UO.1 Design experiment for the production of Bio-fertilizer	

Learning Resources:

15. A textbook of Microbiology, Dubey R. C. and D. K. Maheshwary. (2012), S Chand and Company. New Delhi, India.
 16. Introduction to soil Microbiology, Alexander Martin, John Wiley and Sons.N.Y.
 17. Microbial biotechnology: fundamentals of applied microbiology. Alexander Glazer, Hiroshi Nikaido. Cambridge university press
 18. Kannaiyan, S. (2003). Biotechnology of Bio fertilizers, CHIPS, Texas.
 19. Mahendra K. Rai (2005). Hand book of Microbial bio fertilizers, The Haworth Press, Inc.New York.
- Reddy, S.M. (2002). Bio inoculants for sustainable agriculture and forestry, Scientific Publishers.

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(Autonomous) Department of Microbiology

Course Type: SEC-IV

Course Title: Single cell protein production technology

Course Code:201MIB4601

Credits: 02

Max. Marks: 50

Lectures: 30 Hrs.

Learning Objectives:

- LO 1. To study importance of Single cell protein for Human health.
- LO 2. To study application Yeast as protein source
- LO 3. Understand technology of SCP production
- LO 4. To study other metabolites produced by yeast.

Course Outcomes:

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

- CO 1. Describe importance SCP
- CO 2. Demonstrate SCP production method
- CO 3. Demonstrate analysis of SCP product
- CO4 . Gain practical insights for entrepreneurship

Unit No.	Title of Unit & Contents	Hrs.
I	Introduction : Single cell protein	5
	<ul style="list-style-type: none">1. Single cell protein : Introduction2. Source of SCP3. <i>Saccharomyces cerevisiae</i>: importance , cell morphology and chemical composition.4. Spirullina: importance , cell morphology and chemical composition.	
	Unit Outcomes: UO 1. Students able to explain importance of SCP	
II	Technology for production of SCP	2
	<ul style="list-style-type: none">1. Primary screening of Yeast2. Secondary screening of yeast and cultivation	
	Unit Outcomes: UO 1. Students able to explain role of <i>Saccharomyces cerevisiae</i> as SCP	
III	Production of SCP	4
	<ul style="list-style-type: none">1. Search for raw material for production of SCP	

	2. Fermentative production 3. Formulation and testing	
	Unit Outcome: UO 1. Students able to demonstrate production of SCP	
IV	Spirulina as a source of SCP	4
	1. Spirulina: occurrence and study of morphological characteristics 2. Laboratory Cultivation	
	Unit Outcomes: UO 1. Students able to explain Spirulina as a source of SCP.	
V	Practicals (Included in above 04 units)	30
	1. Primary screening of <i>Saccharomyces cerevisiae</i> strains from food 2. Secondary screening of <i>Saccharomyces cerevisiae</i> 3. Primary screening of Spirulina strains. 4. Cultivation of <i>Saccharomyces cerevisiae</i> 5. Cultivation of Spirulina strains. 6. Chemical analysis of SCP- Protein, Nucleic acid and carbohydrate.	

Learning Resources:

1. Industrial Microbiology. Patel, A.H. (2008). MaCmillan Publication, New Dehli.
2. Principal of Fermentation Technology. Stanbuzy, Peter & Whitaker, A. (2008). ButterworthHeinemann.
3. Industrial Microbiology. Casida L.E. (2005). New age International Publishers
4. Fermentation Technology. Srivastava, M.L.
5. Singh, B.D. (2008). Biotechnology. New age International.

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Department of Microbiology

Course Type: DSM-I

Course Title: Elementary Microbiology

Course Code: --

Credits: 03

Max. Marks: 75

Lectures: 45 Hrs.

Learning Objectives:

- LO 1. To understand the basics of microbiology.
- LO 2. Microbiology is the study of the biology of organisms that cannot be seen with naked eyes e.g. viruses, bacteria.
- LO 3. The methods used to study and manipulate these minute and mostly unicellular organisms differ from those used in most other biological investigations.
- LO 4. As the foundation of the biosphere and major determinants of human health, microbes claim a primary, fundamental role in life on earth.
- LO 5. Hence, the study of microbes is pivotal to the study of all living things, and microbiology is essential for the study and understanding of all life.

Course Outcomes:

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

- CO 1. To understand the microbial physiology and to identify the microorganisms.
- CO 2. Understand the regulation of biochemical pathway and possible process modifications for improved control over microorganisms for microbial product synthesis.
- CO 2. Students will gain and demonstrate competency in laboratory safety and routine in specialized microbiological laboratory skills applicable to microbiological research or clinical methods, including accurately reporting observations and analysis.

Unit No.	Title of Unit & Contents	Hrs.
I	Scope of Microbiology	9
	<ol style="list-style-type: none">1. Definition and concept.2. Milestone discoveries in Microbiology: Antony van Leeuwenhoek Robert Koch ,Louis Pasteur, Elie Matchnikoff, Edward Jenner, Alexander Flemming Winogradsky and Bejrinc3. Distribution of Microorganisms in nature.4. Scope in applied and advanced fields of microbiology.5. Role of Micro-organisms in-<ol style="list-style-type: none">i. Agricultureii. Human healthiii. Foodiv. Industries	

II	Types of microorganisms and their characteristics	12
	<ol style="list-style-type: none"> Types of microorganisms and their characteristics The eukaryotic cell & Prokaryotic cell structure. Ultra structure of bacterial cell: Structure, Chemical composition and function of following:- <ol style="list-style-type: none"> Capsule and slimes Cell wall and Cytoplasmic membranes Flagella and Motility, fimbriae and pili Nuclear material, Plasmids, Mesosomes, Ribosome Dormant forms of prokaryote: Endospore and cyst 	
III	Visualization of microorganisms	12
	<ol style="list-style-type: none"> Principles of Microscopy <ol style="list-style-type: none"> Absorption, reflection and refraction of light rays Definition: Magnification, Resolving power, Angular aperture, Numerical aperture Objectives (Low, High, Oil immersion) and Oculars Function Condensers: Abbes, variable focus and achromatic Principle and applications of Compound, Dark field. Defination: Stain, Dye, Mordent, Chromogen, Leuco compound Flurochrome, Decolorizing agent and Counter stain. Types of stains: Auxochrome, chromophore, Acidic stain, Basic stain, Neutral stain ,Chromogen Staining methods: <ol style="list-style-type: none"> Simple staining: Monochrome & Negative staining Differential staining: Gram's staining 	
IV	Biomolecules	12
	<ol style="list-style-type: none"> Carbohydrates: Definition, classification & properties <ol style="list-style-type: none"> Triose, Pentose, Hexose (Examples and Structure) Disaccharides:- Glycoside linkage (Lactose, Maltose and Sucrose) Oligosaccharides:- Trisaccharides (Structure of Raffinose) Polysaccharides:- Homo and Heteropolysaccharides Structure (Starch & Cellulose) Lipids: Definition , classification & properties Proteins: Definition, structure& properties <ol style="list-style-type: none"> Peptide bond: Configurations of proteins 	

	<p>b) Biological significance of proteins</p> <p>4. Nucleic Acids: Definition, structure & properties</p> <p>a) Nucleosides and Nucleotides.</p> <p>b) DNA: - Properties, structure and functions</p> <p>c) RNA: - Properties, structure and functions</p>	
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Learning Resources:

- 1) Biswas S.B Biswas ,Introduction to viruses: Vikas Publishing House Pvt. Ltd., New Delhi.
- 2) Dubey H.C.:A textbook of fungi and Viruses, Vikas Publishing House Pvt. Ltd. Delhi.
- 3) Frobisher, Hinsdill, Crabtree, Goodheart: Fundamentals of microbiology: W.B. Saunders Company,
- 4) Modi H.A.: Elementary Microbiology (Fundamentals of Microbiology) Vol. II Ekta Prakashan,Nadiad, Gujrat.
- 5) Pelczar Michael J., Jr./E.C.S Chan, Elements of Microbiology: McGraw, Hill International Book Company, New Delhi.
- 6) Pelczar Michael J., Jr. E.C.S Chan, Noel R. Krieg: Microbiology: Concepts and applications McGraw Hill Inc.
- 7) Powar C. B. and Dagainawala H.I.: General microbiology Vol I and II Himalaya publishing house,Bombay.
- 8) Prescott L.M. Harley J.P.. and Klein Donald A.: Microbiology , W.M.C.. Brown publishers
- 9) Stanier Roger Y., Adelberg Edward A.. Ingraham Johan L., General microbiology, Prentice- Hall,Englewood Cliffs, New Jersey, Publishing Co. Ltd., New Delhi..
- 10) Dubey, Maheshwari: Practical Microbiology.

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Department of Microbiology

Course Type: Lab Course

Course Title: Lab Course – _ (Based on DSM-I)

Course Code: --

Credits: 01

Max. Marks: 50

Hours: 30

Learning Objectives

L O 1. To learn good laboratory practices and bio safety measures.

L O 2. To understand principles involved in working of light microscope and laboratory instruments.

L O 3. To stain and observe structural features of bacterial cells.

L O 4. To study preparation and sterilization of simple media.

Course outcomes

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

CO 1. Appropriately prepare slides for microscopic observations.

CO 2. Handle light microscope and observe microorganisms.

CO 3. Perform staining of cell structures and record observations

CO 4. Prepare and sterilize culture media

Practical No.	Unit
1	Staining and observation of Cell wall and Capsule.
2	Staining of Endospores by Dorner's method
3	Microscopy- Different parts of compound microscope.
4	Use, care & Handling of compound microscope.
5	Simple staining: Monochrome and Negative staining.
6	Differential: Gram's staining
7	Qualitative analysis of Carbohydrates by Sumner's method
8	Qualitative analysis of Protein by Biuret test
9	Qualitative analysis of DNA by Diphenyl amine test
10	Qualitative analysis of RNA by Orcinol test

N.B.: Any Ten Practical from above.

Rajarshi Shahu Mahavidyalaya, Latur
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Department of Microbiology

Course Type: DSM-II

Course Title: Basic Techniques in microbiology

Course Code: --

Credits: 03

Max. Marks: 75

Lectures: 45 Hrs.

Learning Objectives

LO 1. Understand principle and working of light microscope. Gain knowledge about microbial staining technique

LO 2. Understand cultivation and management of bacterial growth. Learn control of microbial growth.

Course Outcomes:

Students will be able to understand

CO 1. Methods of visualizing microorganisms

CO 2. Environmental factors effect on growth of microorganisms,

CO 3. Isolation of microorganisms from different sources and their maintenance

Unit No.	Title of Unit & Contents	Hrs.
I	Microbial Nutrition and growth	12
	1.1 Major and minor bio-elements and growth factors 1.2 Nutritional categories of microorganisms on the basis of carbon and energy source 1.3 Microbial Growth – Binary fission, Budding, fragmentation and formation of conidiophores 1.4 Growth, phases of growth and diauxic growth 1.5 Measurement of growth: cell number, cell mass and cell activity 1.6 Different types of bacterial cultures –Batch culture, continuous culture, synchronous culture	
II	Effect of environmental factors on microbial growth	9
	2.1 Temperature 2.2 pH (Acidic environment) 2.3 Osmotic pressure (Saline environment) 2.4 Oxygen 2.5 Hydrostatic pressure 2.6 Heavy metals	

III	Microbial control methods	12
	<p>3.1 1 Definition of Sterilization,</p> <p>3.2 Sterilization by Physical Agent</p> <p>a) Heat: Moist Heat: Steam under pressure (Autoclaving) , Boiling, Pasteurization</p> <p>b) Dry heat: Incineration, Hot air Oven.</p> <p>c) Radiation: - Ionizing and Non-ionizing radiations.</p> <p>d) Filtration:- Types of Bacteriological filters</p> <p>3.3 Definition of Disinfection, Antiseptic, Germicide, Sanitizer, Fungicide, Vermicide, Bacteriostatic and Bactericidal agent.</p> <p>3.4 Chemical Disinfectants: Phenol and Phenolic compounds, Alcohols.</p> <p>3.5 Gaseous sterilizing Agents: Formaldehyde and Propiolactone.</p>	
IV	Pure culture methods	12
	<p>4.1. 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. Buffers in culture medium.</p> <p>4.2 General ingredients of culture media and their role</p> <p>4.3 Definitions -, pure culture, mixed culture, consortium, axenic culture, contamination.</p> <p>4.4 Isolation of microorganisms: Principle and method of isolation-streak plate, pour plate, spread plate, single cell isolation.</p>	

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Reference Books

- 1) Biswas S.B Biswas ,Introduction to viruses: Vikas Publishing House Pvt. Ltd., New Delhi.
- 2) Dubey H.C.:A textbook of fungi and Viruses, Vikas Publishing House Pvt. Ltd. Delhi.
- 3) Frobisher, Hinsdill, Crabtree, Goodheart: Fundamentals of microbiology: W.B. Saunders Company,
- 4) Modi H.A.: Elementary Microbiology (Fundamentals of Microbiology) Vol. II Ekta Prakashan,Nadiad, Gujrat.
- 5) Pelczar Michael J., Jr./E.C.S Chan, Elements of Microbiology: McGraw, Hill International Book Company, New Delhi.
- 6) Pelczar Michael J., Jr. E.C.S Chan, Noel R. Krieg: Microbiology: Concepts and applicationsMcGraw Hill Inc.
- 7) Powar C. B. and Dagainawala H.I.: General microbiology Vol I and II Himalaya publishing house,Bombay.
- 8) Prescott L.M. Harley J.P.. and Klein Donald A.: Microbiology , W.M.C.. Brown publishers
- 9) Stanier Roger Y., Adelberg Edward A.. Ingraham Johan L., General microbiology, Prentice- Hall,Englewood Cliffs, New Jersey, Publishing Co. Ltd., New Delhi..
- 10) Dubey, Maheshwari: Practical Microbiology.

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Department of Microbiology

Course Type: Lab Course

Course Title: Lab Course –__ (Based on DSM-II)

Course Code: --

Credits: 01

Max. Marks: 50

Hours: 30

Learning Objectives

L O 1. To learn good laboratory practices and bio safety measures.

L O 2. To understand principles involved in working of light microscope and laboratory instruments.

L O 3. To stain and observe structural features of bacterial cells.

L O 4. To study preparation and sterilization of simple media.

Course outcomes

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

CO 1. Appropriately prepare slides for microscopic observations.

CO 2. Handle light microscope and observe microorganisms.

CO 3. Perform staining of cell structures and record observations

CO 4. Prepare and sterilize culture media

Practical No.	Unit
1	Study of bacterial growth curve (Demonstration)
2	Effect of physical agents on growth of bacteria: pH, Temperature U.V. rays(Demonstration)
3	Effect of chemical agents on bacterial growth: Antibiotic and Phenolic compounds
4	Effect of Heavy metal ions (Oligodynamic Action)
5	Study of laboratory equipment's used for Sterilization: Autoclave, Hot air oven, Bacterial filters.
6	Preparation and sterilization of Nutrient broth , Nutrient Agar
7	Preparation and sterilization of MacConkey's Broth, MacConkey's Agar and Sugar fermentation media
8	To study Streak plate method methods for Isolation of bacteria
9	To study spread plate method for Isolation of bacteria
10	To study Pour plate method for enumeration of microorganisms from soil sample



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(Autonomous)

UG First Year

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.

शिव छत्रपती
शिक्षण संस्था
लातूर

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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	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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