Anekant Education Society's

Tuljaram Chaturchand College of Arts, Science and Commerce, Baramati

(Autonomous)

Syllabus(CBCS) for S.Y.B.Sc. Microbiology

Semester II

(2019 Pattern)

w.e.f.

June 2019

Anekant Education Society's

Tuljaram Chaturchand College, of Arts, Science & Commerce, Baramati

(Autonomous Institute)

Syllabus (CBCS) for S. Y. B. Sc. Microbiology

2019 PATTERN

COURSE STRUCTURE FOR S.Y.B.SC.MICROBIOLOGY 2019 PATTERN

Sr. No.	Class	Semester	Code	Paper	Paper Title	Credit	Marks (I + E)
1	S.Y.B.Sc.	III	MICRO2301	Theory	Bacterial Systematics and Physiology	3	50 + 50
2	S.Y.B.Sc.	III	MICRO2302	Theory	Industrial and Soil Microbiology	3	50 + 50
3	S.Y.B.Sc.	III	MICRO2303	Practical	Practical course based on MICRO2301 and MICRO2302	2	50 + 50
4	S.Y.B.Sc.	IV	MICRO2401	Theory	Air and Water Microbiology	3	50 + 50
5	S.Y.B.Sc.	IV	MICRO2402	Theory	Bacterial Genetics	3	50 + 50
6	S.Y.B.Sc.	IV	MICRO2403	Practical	Practical course based on MICRO2401 and MICRO2402	2	50 + 50

I: Internal Examination
E: External Examination

Name of the Programme: S.Y.B.Sc. Microbiology

Class	**: S.Y.B.Sc**
Semester	**: IV**
Course Type	**: Theory**
Course Name	**: Air and Water Microbiology**
Course Code	**: MICRO2401**
No. of Lectures	**: 45**
No. of Credits	**: 03**

Course Objectives :

1. Introducing students to microbial ecology principles, highlighting the distinctive features of microbial life in air and water environments.
2. Exploring the range of microorganisms present in air and water, encompassing bacteria, fungi, viruses, and other microbial entities.
3. Focusing on the microbiology of both natural and engineered water systems, spanning drinking water, wastewater, and aquatic ecosystems, and its impact on public health.
4. Delving into air microbiology, covering aspects of indoor and outdoor air quality, microbial aerosols, and their influence on human health and the environment.
5. Introducing methodologies for monitoring and analyzing microbial communities in air and water, including sampling techniques, laboratory procedures, and data analysis.
6. Assessing the influence of microbial communities on air and water quality, including their involvement in pollution, remediation efforts, and sustainability.
7. Exploring pertinent regulations and guidelines concerning air and water quality, particularly those governing microbial contamination and its management.

Course Outcomes :

CO1: Students will grasp the principles of microbial ecology, emphasizing the distinct characteristics of microbial life within air and water environments.

CO2: Students will investigate the array of microorganisms present in air and water, encompassing bacteria, fungi, viruses, and other microbial entities.

CO3: Concentrating on the microbiology of both natural and engineered water systems, including drinking water, wastewater, and aquatic ecosystems, and its impact on public health.

CO4: Students will explore the microbiology of air, encompassing aspects of indoor and outdoor air quality, microbial aerosols, and their impact on human health and the environment.

CO5: Students will be introduced to techniques for monitoring and analyzing microbial communities in air and water, covering sampling methods, laboratory procedures, and data analysis.

CO6: Evaluate the influence of microbial communities on air and water quality, encompassing their role in pollution, remediation strategies, and sustainability efforts.

CO7: Investigate pertinent regulations and guidelines associated with air and water quality, particularly those governing microbial contamination and its management.

Credit No.	Topics	Lectures
I	**AIR MICROBIOLOGY** Air flora: Transient nature of air flora Droplet, droplet nuclei, and aerosols a. Air pollution: Chemical pollutants, their sources in air and effects on human health. b. Methods of Air sampling and types of air samplers i. Impaction on solids ii. Impingement in liquid iii. Sedimentation iv. Centrifugation c. Air sanitation: Physical and chemical methods d. Air borne infections	2 2 6 3 2
II	**WATER MICROBIOLOGY** a. Types of water: surface, ground, stored, distilled, mineral and de-mineralized water b. Water purification methods, Bacteriological standards of potable water Maharashtra pollution control board (MPCB), Central pollution control board (CPCB), Bureau of Indian standards (BIS) World health Organization (WHO) c. Indicators of faecal pollution; i. *Escherichia coli* ii. *Bifidobacterium* iii. *Streptococcus faecalis* iv. *Clostridium perfringens* v. New indicators: *Campylobacter* and *Pseudomonas* d. Water borne Infections e. Bacteriological analysis of water for potability i. Presumptive coliform count ii. Confirmed test iii. Completed test iv. Eijkman test v. Membrane filter technique	2 2 5 1 5

III	**SEWAGE & WASTE WATER** a. Analysis of waste water i.Physic chemical parameters: pH, temperature, total solids, suspended solids, Chemical Oxygen Demand(C.O.D.) ii. Biological parameters: B.O.D. iii.Industrial water pollutants, their ecological effects and health hazards (Biomagnification and eutrophication) b. Methods of effluent treatment – Primary, secondary, tertiary treatment methods c. Recycling of waste water and sludge	3 10 2

References :

1) Daniel Lim., Microbiology, 2nd Edition; McGraw-Hill Publication
2) Tortora G.J., Funke B.R., Case C.L. (2006) Microbiology: An Introduction. 8th Edition.
3) Pelzar M. J., Chan E. C. S., Krieg N. R.(1986) Microbiology. 5th Edition, McGraw-Hill Publication
4) Hans G. Schlegel (1993) General Microbiology, 8th Edition, Cambridge University Press
5) Martin Frobisher (1937) Fundamentals of Microbiology, 8th Edition, Saunders, Michigan University press
6) Standard Methods for the Examination of Water and Wastewater (2005) 21st edition, Publication of the American Public Health Association (APHA), the American Water Works Association (AWWA), and the Water Environment Federation (WEF); edited by Andrew D. Eaton, Mary Ann H. Franson.

Choice Based Credit System Syllabus (2019 Pattern)

Mapping of Program Outcomes with Course Outcomes

Class :S.Y.B.Sc (Sem IV)**Subject :** Microbiology

Course: Air and Water Microbiology**Course Code:**MICRO2401

Weightage:1=weak or low relation,2=moderate or partial relation,3=strong or direct relation

Course Outcomes	**Programme Outcomes(POs)**								
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	3				2		2	2	
CO2	3				2				
CO3	3				2			2	2
CO4	3	2				3		3	
CO5	3	2		3		2	2		2
CO6	3	2	3						
CO7	3	2	3	3	3	2		2	3

Justification for the mapping

PO1: Disciplinary Knowledge

The majority of course outcomes enrich disciplinary knowledge by extensively examining microorganisms within air and water ecosystems. This study encompasses their diversity, roles, and ecological impact, offering insights into specialized microbiological principles and methodologies specific to these environments. This contributes significantly to an in-depth understanding of microbial life within the context of environmental sciences.

PO2: Critical Thinking and Problem Solving

CO3, CO4, CO5, CO6, and CO7 foster critical thinking and problem-solving skills by tasking students with analyzing intricate microbial interactions in environmental systems and evaluating their implications for human health and ecosystems.

PO3: Social Competence

CO6 and CO7 promote social competence by encouraging collaborative fieldwork and interdisciplinary research projects aimed at addressing environmental concerns related to microbial communities.

PO4: Research-related Skills and Scientific Temper

CO5 and CO7 instill research-related skills by exposing students to various sampling, isolation, and analysis techniques used in studying microorganisms within these ecosystems, preparing them for scientific research endeavors.

PO5: Trans-disciplinary Knowledge

CO1, CO2, CO3, and CO7 foster transdisciplinary knowledge by integrating principles from microbiology, environmental science, chemistry, and engineering to tackle complex environmental challenges.

PO6: Personal and Professional Competence

CO4, CO5, and CO7 enhance skills in environmental monitoring and water treatment careers, fostering a sense of responsibility for environmental stewardship and professional development across scientific and environmental fields.

PO7: Effective Citizenship and Ethics

CO1 and CO5 promote effective citizenship and ethics by emphasizing responsible environmental stewardship and equipping students with the knowledge and values necessary to make informed decisions regarding environmental conservation and sustainable water use, contributing to community and ecosystem well-being.

PO8: Environment and Sustainability

CO1, CO3, CO4, and CO7 address environmental and sustainability concerns by exploring the essential role of microorganisms in maintaining ecosystem balance and investigating the impact of human activities on air and water quality. This equips students with the knowledge and tools to develop sustainable solutions for environmental challenges.

PO9: Self-directed and Lifelong Learning

CO3, CO5, and CO7 promote self-directed and lifelong learning by encouraging students to explore cutting-edge research, adapt to evolving environmental challenges, and remain updated with advancements in microbiological techniques and technology.

Name of the Programme	**: S.Y.B.Sc. Microbiology**
Class	**: S.Y.B.Sc**
Semester	**: IV**
Course Type	**: Theory**
Course Name	**: Bacterial Genetics**
Course Code	**:MICRO2402**
No. of Lectures	**: 45**
No. of Credits	**: 03**

Course objective:

1. Providing a thorough understanding of hereditary molecules.

2. Grasping the organization of prokaryotic genomes.

3. Gaining insight into DNA replication and expression.

4. Understanding the molecular mechanisms underlying mutations.

5. Developing a comprehensive understanding of the recognized mechanism facilitating genetic material transfer among microorganisms, notably transformation.

6. Acquiring knowledge about genes and their expression.

7. Attaining a solid understanding of genetic exchange mechanisms, mutations, and their implications

Course outcome:

By the conclusion of this course, the students have –

CO1: Comprehensive idea about molecules of heredity.

CO2: Understandings of prokaryotic genome organization.

CO3: Acquired knowledge of DNA replication and expression.

CO4: Understood the molecular mechanisms that underlie mutations.

CO5: Developed a fairly good knowledge about the well-known mechanism by which genetic material is transferred among the microorganisms namely transformation.

CO6: Has acquired knowledge of gene and their expression.

CO7: Has acquired a fairly good understanding mechanisms of genetic exchange, mutations and their implications.

Credit No.	Topics	Lectures
I	**UNDERSTANDING MOLECULES OF HEREDITY** a. Discovery of transforming material (hereditary material): Griffith's Experiment. b. Evidence for nucleic acid as genetic material i. Avery and MacLeod experiment ii. Gierer and Schramm / Fraenkel-Conrat& Singer experiment (TMV virus) iii. Hershay& Chase experiment c. Prokaryotic genome organization. d. Basic structure of B form of DNA, Bonds involved in DNA, structure and properties of plasmid, type of plasmids. e. Comparative account of different forms of DNA.	2 4 1 7 1
II and III	**DNA REPLICATION AND EXPRESSION** a. DNA replication i. Messelson and Stahl's experiment (semiconservative) ii. Mechanisms of DNA replication: Semi-discontinuous, rolling circle model. b. Gene organization and expression i. What is Gene? ii. Properties of genetic code iii. Basic mechanism of transcription iv. Basic mechanism of translation	7 10
	MUTATIONS a. Spontaneous mutations i. Mechanisms ii. Fluctuation test b. Mechanisms of induced mutations Base pair substitution (Transitions, Transversions), Base analogues (2amino purine, 5bromo uracil), HNO_2, Alkylating agents (ethyl methyl sulphonate) Frame shift mutations (Insertions and deletions), Intercalating agents (EtBr, acridine orange), UV rays. c. Types of mutations: Nonsense, Missense, Conditional lethal temperature sensitive.	4 5 3 1

References:

1. Benjamin Lewin (1994) Genes I. Oxford University Press
2. Friefelder D. (1995) Molecular Biology, 2nd Edn. Narosa Publishing House.
3. Gardner E.J., Simmons M.J and Snustad D.P. (1991) Principles of Genetics. 8th Ed. John Wiley & Sons Inc.
4. Russel Peter. Essential Genetics. 2nd Edn, Blackwell Science Pub.
5. Stanier R.Y. (1985) General Microbiology. 4th and 5th Edn Macmillan Pub. Co. NY
6. Stent S.G. &Calender R. (1986) Molecular Genetics: An Introductory Narrative, 2nd Edition, CBS Publishers and Distributors, India.
7. Stricberger M.W. (1985) Genetics. 3rd Edition Macmillan Pub. Co. NY.
8. Watson J.D. (1987) Molecular Biology of the Gene, 4th Ed. The Benjamin Cummings Publishing Company Inc.

Choice Based Credit System Syllabus (2019 Pattern)

Mapping of Program Outcomes with Course Outcomes

Class :S.Y.B.Sc (Sem IV)**Subject :** Microbiology

Course: Bacterial Genetics **Course Code:** MICRO2402

Weightage:1=weak or low relation,2=moderate or partial relation,3=strong or direct relation

Course Outcomes	Programme Outcomes(POs)								
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	3	1	1		2				
CO2	3	2			2				
CO3	3	2		2	2		2	3	1
CO4	2	2		2	1		2	2	1
CO5	2	2		2	1		2		1
CO6	2				1	2			1
CO7	2		1		1				

Justification for the mapping

PO1: Disciplinary Knowledge

All the course outcomes CO1 to CO7 offer crucial insights into the mechanisms governing genetic inheritance, mutation, and recombination in bacteria. These contributions significantly enhance our comprehension of microbial genetics.

PO2: Critical Thinking and Problem Solving

CO1, CO2, CO3, CO4, and CO5 promote critical thinking by engaging students in the analysis and interpretation of intricate genetic data. They develop an understanding of genetic inheritance principles and their application across diverse bacterial species. Through tasks like solving genetic mapping problems, students cultivate analytical skills and devise innovative solutions in microbiology and related fields.

PO3: Social Competence

The study of bacterial genetics within the curriculum fosters social competence by emphasizing data sharing and discussions, nurturing effective teamwork and communication skills vital for scientific research and community engagement, aligned with all course outcomes.

PO4: Research-related Skills and Scientific Temper

CO3, CO4, and CO5 nurture research-related skills by immersing students in the scientific process. They learn hypothesis formulation, experimental design, and critical data analysis. This hands-on experience fosters a scientific temperament by encouraging curiosity, evidence-based thinking, and a commitment to knowledge pursuit. Moreover, it emphasizes the importance of rigorous experimentation and ethical considerations in scientific research, enhancing students' integrity in contributing to field advancements.

PO5: Trans-disciplinary Knowledge

Genetics holds significant importance in various domains like microbiology, biotechnology, and medicine. The bacterial genetics syllabus guides students through experimental design, data collection, and analysis, empowering them to conduct independent scientific investigations. This cultivates curiosity, critical thinking, and evidence-based inquiry—essential attributes for a research-oriented mindset, aligning with all course outcomes.

PO6: Personal and Professional Competence

CO4, CO5, and CO6 promote transdisciplinary knowledge by amalgamating genetics, microbiology, biochemistry, and biotechnology principles, fostering a comprehensive understanding of microbial life. This broad approach equips students with versatile skills applicable across diverse scientific fields and industries.

PO7: Effective Citizenship and Ethics

CO3 CO4 enhance personal and professional competence by nurturing critical thinking and problem-solving skills, enabling students to excel in both research and industry roles.

PO9: Self-directed and Lifelong Learning

CO3, CO4, and CO5 encourage self-directed and lifelong learning by motivating students to engage in independent research and stay abreast of rapidly evolving genetic technologies.

Name of the Programme	**: S.Y.B.Sc. Microbiology**
Class	**: S.Y.B.Sc**
Semester	**: IV**
Course Type	**: Practical**
Course Name	**: Practical course based on MICRO2402**
Course Code	**:MICRO2403**
No. of Credits	**: 02**

Course Objectives :

1. Investigating the breadth of microorganism diversity in air and water.
2. Concentrating on the microbiological aspects of natural and constructed water systems, encompassing drinking water, wastewater, and aquatic environments, and their implications for public health.
3. Evaluating the influence of microbial communities on air and water quality, encompassing their roles in pollution, remediation, and sustainability efforts.
4. Cultivating proficiency in analyzing air and water samples.
5. Equipping students with the ability to assess water potability.
6. Exploring pertinent regulations and guidelines concerning air and water quality, particularly those governing microbial contamination and control.
7. Nurturing critical thinking and problem-solving abilities, particularly in addressing practical challenges associated with air and water microbiology.

Course Outcomes :

CO1: Students have the opportunity to investigate the variety of microorganisms present in both air and water.

CO2: Can direct attention to studying the microbiology of natural and engineered water systems, encompassing drinking water, wastewater, and aquatic ecosystems, and considering their impact on public health.

CO3: Evaluate how microbial communities influence the quality of air and water, encompassing their role in pollution, remediation, and sustainability efforts.

CO4: Develop skills required for analyzing samples of air and water.

CO5: Capable of assessing the drinkability of water.

CO6: Delve into pertinent regulations and guidelines concerning air and water quality, particularly those governing microbial contamination and control.

CO7: Encourage students to engage in critical thinking and problem-solving skills, particularly when addressing real-world challenges associated with air and water microbiology.

EXPT. No.	Topics	Hours
1	Air sampling using an air sampler & calculation of air flora from different locations with the knowledge of respective standards of bacterial & fungal counts.	4
2-3	**Bacteriological tests of potability of water** a. MPN, confirmed and completed test. b. Membrane filter technique (Demonstration)	8
4	**Determination of B.O.D.**	4
5	**Air Flora:** a. Diversity determination. b. Simpson index and settling velocity determination	4
6	**Identification of Any one bacterial isolates at least up to genus level from soil or air. (Preferably spore forming and pigmented bacteria).**	8
7	**Visits to** a. Water purification plant/ Sewage treatment plant/Effluent treatment plant/ Fermentation industry	2

References:

1. Bergey D. H. & Holt J. G. (1994) Bergey's Manual of Determinative Bacteriology. 9th Edition. Lippincott Williams & Wilkins. (Unit I)
2. Garrity G. M. (2005) Bergey's Manual of Systematic Bacteriology. 2nd Edition. (Vols. 1 – 4). Williams & Wilkins. (Unit I)
3. Dube H.C. and Bilgrami. K.S.(1976) Text book of modern pathology. Vikas publishing house. New Delhi.
4. Daniel Lim., Microbiology, 2nd Edition; McGraw-Hill Publication
5. Tortora G.J., Funke B.R., Case C.L. (2006) Microbiology: An Introduction. 8th Edition.
6. Pelzar M. J., Chan E. C. S., Krieg N. R.(1986) Microbiology. 5th Edition, McGraw-Hill Publication
7. Hans G. Schlegel (1993) General Microbiology, 8th Edition, Cambridge University Press
8. Martin Frobisher (1937) Fundamentals of Microbiology, 8th Edition, Saunders, Michigan University press
9. Standard Methods for the Examination of Water and Wastewater (2005) 21st edition, Publication of the American Public Health Association (APHA), the American Water Works Association (AWWA), and the Water Environment Federation (WEF); edited by Andrew D. Eaton, Mary Ann H. Franson.

Choice Based Credit System Syllabus (2019 Pattern)

Mapping of Program Outcomes with Course Outcomes

Class :S.Y.B.Sc (Sem IV)**Subject:** Microbiology

Course : Practical course based on MICRO24021 & MICRO2402

Course Code :MICRO2403

Weightage:1=weak or low relation,2=moderate or partial relation,3=strong or direct relation

Course Outcomes	**Programme Outcomes(POs)**								
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	2				2		2	2	
CO2	2				2				
CO3	1				2			2	2
CO4	2	2				3		3	
CO5	2	2		3		2	2		2
CO6	2	2	3						
CO7	1	2	3	3	3	2		2	3

Justification for the mapping

PO1: Disciplinary Knowledge

The entirety of the course outcomes immerses students in the study of microorganisms inhabiting air and water ecosystems, encompassing their diversity, functions, and ecological influence. This exploration provides a deeper understanding of microbiological principles and techniques relevant to these specific environments, enriching comprehension within the realm of environmental sciences.

PO2: Critical Thinking and Problem Solving

CO3, CO4, CO5, CO6, and CO7 nurture critical thinking and problem-solving abilities by tasking students to dissect intricate microbial interactions within environmental systems. Engaging in hands-on experiments and data analysis equips them to address real-world challenges like managing water quality and combating the transmission of airborne pathogens, fostering analytical and solution-driven thinking.

PO3: Social Competence

CO6 and CO7 promote social adeptness by advocating collaborative fieldwork and interdisciplinary research aimed at tackling environmental concerns associated with microbial communities. This engagement hones effective communication, teamwork, and cooperation skills, enabling students to contribute to socially responsible solutions for air and water quality issues.

PO4: Research-related Skills and Scientific Temper

CO5 and CO7 impart research-oriented skills by exposing students to various

techniques for sampling, isolating, and analyzing microorganisms within these ecosystems, preparing them for scientific inquiry. Emphasizing critical evaluation of environmental data and scientific methodologies instills an evidence-based inquiry mindset, fostering commitment to comprehending and safeguarding our natural surroundings.

PO5: Trans-disciplinary Knowledge

CO1, CO2, CO3, and CO7 facilitate transdisciplinary understanding by integrating microbiology, environmental science, chemistry, and engineering principles. This interdisciplinary approach equips students with adaptable skills pertinent across diverse scientific and engineering fields, fostering comprehensive comprehension and sustainable management of air and water ecosystems.

PO6: Personal and Professional Competence

CO4, CO5, and CO7 enhance personal and professional abilities by imparting practical knowledge and skills essential for excelling in research, environmental monitoring, and water treatment careers. This promotes a sense of environmental responsibility, enabling individuals to make meaningful contributions while advancing professionally in scientific and environmental domains.

PO7: Effective Citizenship and Ethics

CO1 and CO5 emphasize ethical environmental stewardship and responsible conduct in research and water management. Equipping students with knowledge and values necessary for informed decisions in environmental conservation and sustainable water use contributes to community and ecosystem well-being.

PO8: Environment and Sustainability

CO1, CO3, CO4, and CO7 delve into environmental and sustainability aspects by examining microorganisms' pivotal role in maintaining ecosystem equilibrium and scrutinizing human-induced impacts on air and water quality. This equips students with tools to devise sustainable solutions for environmental challenges, such as pollution control and natural resource preservation.

PO9: Self-directed and Lifelong Learning

CO3, CO5, and CO7 encourage self-directed, continuous learning by motivatingstudents to explore cutting-edge research and adapt to evolving environmental challenges. This fosters curiosity, adaptability, and a drive for expanding expertise to address dynamic issues concerning air and water quality.