Anekant Education Society's

Tuljaram Chaturchand College of Arts, Science and Commerce, Baramati

(Autonomous)

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

Semester IV

(2022 Pattern)

w.e.f.

June 2022

Anekant Education Society's

Tuljaram Chaturchand College of Arts, Science & Commerce, Baramati

(Autonomous)

SYLLABUS (CBCS) FOR S. Y. B. SC. MICROBIOLOGY

(2022 Pattern)

COURSE STRUCTURE FOR S. Y. B. SC. MICROBIOLOGY (2022 Pattern)

Sr. No.	Class	Semester	Code	Paper	Paper Title	Credit	Marks (I + E)
1	S.Y.B.Sc.	III	USMB231	Theory	Bacterial Systematics and Physiology	3	40 + 60
2	S.Y.B.Sc.	III	USMB232	Theory	Fundamentals of Soil & Industrial Microbiology	3	40 + 60
3	S.Y.B.Sc.	III	USMB233	Practical	Practical course based on USMB231 and USMB232	2	40 + 60
4	S.Y.B.Sc.	IV	USMB241	Theory	Bacterial Genetics	3	40 + 60
5	S.Y.B.Sc.	IV	USMB242	Theory	Air and Water Microbiology	3	40 + 60
6	S.Y.B.Sc.	IV	USMB243	Practical	Practical course based USMB242	2	40 + 60

I: Internal Examination
E: External Examination

SYLLABUS (CBCS) FOR S. Y. B. SC. MICROBIOLOGY (2022 Pattern)

Name of the Programme	**: S.Y.B.Sc. Microbiology**
Program Code	**: USMB**
Class	**: S.Y.B.Sc**
Semester	**: IV**
Course Type	**: Theory**
Course Name	**: Bacterial Genetics**
Course Code	**:USMB 241**
No. of Lectures	**: 45**
No. of Credits	**: 03**

Learning objective:

1. To give comprehensive idea about molecules of heredity.
2. Understanding of prokaryotic genome organization.
3. Acquire knowledge of DNA replication and expression.
4. To give the knowledge of molecular mechanisms that underlie mutations.
5. To develop a fairly good knowledge about the well-known mechanism by which genetic material is transferred among the microorganisms namely transformation.
6. To acquire knowledge of gene and their expression.
7. To acquire a fairly good understanding mechanisms of genetic exchange, mutations and their implications

Learning 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	**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 expression c. What is Gene? d. Basic mechanism of transcription (Initiation, elongation, termination) e. Basic mechanism of translation (Initiation, elongation, termination)	7 10
III	**MUTATIONS** a. Mechanisms of Spontaneous mutations b. Mechanisms of induced mutations i. Base pair substitution (Transitions, Transversions), Base analogues (2amino purine, 5bromo uracil), HNO2, Alkylating agents (ethyl methyl sulphonate) ii. Frame shift mutations (Insertions and deletions), iii. Intercalating agents (EtBr), UV rays. c. Types of mutations: Nonsense, Missense	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 (2022 Pattern)

Mapping of Program Outcomes with Course Outcomes

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

Course: Bacterial Genetics **Course Code:** USMB241

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 outcomes CO1 to CO7 provides essential insights into the mechanisms of genetic inheritance, mutation, andrecombination in bacteria, contributing to our understanding of microbial genetics.

PO2: Critical Thinking and Problem Solving

CO1, CO2, CO3, CO4 and CO5 encourages critical thinking by requiring students to analyzeand interpret complex genetic data, understand the principles of genetic inheritance, and apply them

to diverse bacterial species. Problem-solving skills are developed through tasks like solving genetic mapping problems, This equips students with the ability to approach complex biological problems with analytical thinking and devise innovative solutions in the field of microbiology and beyond.

PO3: Social competence

Studying bacterial genetics in a syllabus fosters social competence by emphasizingdata sharing, and discussions, promoting effective teamwork and communication skills crucial for scientific research and community engagement reference to the all Course outcomes.

PO4: Research related skills and scientific temper

The CO3,CO4, CO5 cultivates research-related skills by immersing students in the scientific process, where they learn to formulate hypotheses, design experiments, and analyze data critically. This hands-on experience fosters a scientific temper by encouraging curiosity, evidence-based thinking, and a commitment to the pursuit of knowledge. Additionally, it promotes an understanding of the importance of rigorous experimentation and ethical considerations in scientific research, enhancing students' ability to contribute to advancements in the field with integrity.

PO5: Trans-disciplinary knowledge

Genetics plays a crucial role in various disciplines, such as microbiology, biotechnology, and medicine. The syllabus of bacterial genetics imparts research-related skills by guiding students through experimental design, data collection, and analysis, enabling them to conduct rigorous scientific investigations independently. This experience instills a scientific temper by encouraging curiosity, critical thinking, and a commitment to evidence-based inquiry, which are essential attributes for a research-oriented mindset. Reference all the course outcomes.

PO6: Personal and professional competence

CO 4,CO5, CO6 promotes transdisciplinary knowledge by integrating principles from genetics, microbiology, biochemistry, and biotechnology, encouraging a holistic understanding of microbial life. This cross-cutting approach equips students with a versatile skill set applicable across various scientific fields and industries.

PO7: Effective citizenship and ethics

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

PO9: Self –directed and life –long learning

The CO3,CO4, CO5 promotes self-directed and lifelong learning by encouraging students to engage in independent research and stay updated on rapidly evolving genetic technologies.

SYLLABUS (CBCS) FOR S. Y. B. SC. MICROBIOLOGY (2022 Pattern)

Name of the Programme	**: S.Y.B.Sc. Microbiology**
Program Code	**: USMB**
Class	**: S.Y.B.Sc**
Semester	**: IV**
Course Type	**: Theory**
Course Name	**: Air and Water Microbiology**
Course Code	**: USMB242**
No. of Lectures	**: 45**
No. of Credits	**: 03**

CourseObjectives :

1. To introduce students to the principles of microbial ecology, emphasizing the unique characteristics of microbial life in air and water environments.
2. To explore the diversity of microorganisms in the air and water, including bacteria, fungi, viruses, and other microorganisms.
3. To focus on the microbiology of natural and engineered water systems, including drinking water, wastewater, and aquatic ecosystems, and the implications for public health.
4. To delve into the microbiology of the air, including indoor and outdoor air quality, microbial aerosols, and their effects on human health and the environment.
5. To introduce techniques for the monitoring and analysis of microbial communities in air and water, including sampling methods, laboratory techniques, and data analysis
6. To assess the impact of microbial communities on the quality of air and water, including their contributions to pollution, remediation, and sustainability.
7. To explore relevant regulations and guidelines related to air and water quality, especially those governing microbial contamination and control.

CourseOutcomes :

CO1: Students will understand the principles of microbial ecology, emphasizing the unique characteristics of microbial life in air and water environments.

CO2: Students can explore the diversity of microorganisms in the air and water, including bacteria, fungi, viruses, and other microorganisms.

CO3: Focused on the microbiology of natural and engineered water systems, including drinking water, wastewater, and aquatic ecosystems, and the implications for public health.

CO4: Students can delve into the microbiology of the air, including indoor and outdoor air quality, microbial aerosols, and their effects on human health and the environment.

CO5: Students will introduced with the techniques for the monitoring and analysis of microbial communities in air and water, including sampling methods, laboratory techniques, and data analysis

CO6: Assess the impact of microbial communities on the quality of air and water, including their contributions to pollution, remediation, and sustainability.

CO7: Explore relevant regulations and guidelines related to air and water quality, especially those governing microbial contamination and control.

Credit No.	Topics	Lectures
I	**AIR MICROBIOLOGY** a. Air flora: Transient nature of air flora b. Droplet, droplet nuclei, and aerosols c. Air pollution: Chemical pollutants, their sources in air and effects on human health. d. Methods of Air sampling and types of air samplers i. Impaction on solids ii. Impingement in liquid iii. Sedimentation iv. Centrifugation e. Air sanitation: Physical and chemical methods f. 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. 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 f. Water purification methods : Chlorination, Ozonization, U.V	2 2 5 1 4 1

	Radiation.	
III	**SEWAGE & WASTE WATER ANALYSIS** a. Analysis of waste water i. Physico-chemical parameters: pH, temperature, total solids, suspended solids, Chemical Oxygen Demand (C.O.D.) ii. Biological parameters: Biological Oxygen Demand (B.O.D.) iii. Industrial water pollutants, their ecological effects and health hazards (Biomagnifications 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(2022 Pattern)

Mapping of Program Outcomes with Course Outcomes

Class:S.Y.B.Sc (Sem IV) **Subject:** Microbiology
Course: Air and Water Microbiology **Course Code:**USMB242

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

Almost all the course outcomes imparts disciplinary knowledge by delving into the study of microorganisms present in air and water ecosystems, including their diversity, roles, and ecological impact. It provides insights into microbiological principles and methodologies specific to these environments, contributing to a deeper understanding of microbial life in the context of environmental sciences.

PO2: Critical Thinking and Problem Solving

The CO3 ,CO4, CO 5, CO6, CO7 cultivates critical thinking and problem-solving skills by requiring students to analyze complex microbial interactions in environmental systems and assess their implications for human health and ecosystems.

PO3: Social competence

CO6, CO7 promotes social competence by encouraging collaborative fieldwork and research projects that involve interdisciplinary teams working to address environmental concerns related to microbial communities.

PO4: Research related skills and scientific temper

CO5, CO7 imparts research-related skills by exposing students to various sampling, isolation, and analysis techniques used to study microorganisms in these ecosystems, preparing them for scientific research

PO5: Trans-disciplinary knowledge

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

PO6: Personal and professional competence

The CO4, CO5, CO7enhancesenvironmental monitoring, and water treatment careers. It also instills a sense of responsibility for environmental stewardship, preparing individuals to make a positive impact on society while fostering their professional development in various scientific and environmental fields.

PO7: Effective citizenship and ethics

The CO1, CO5 promotes effective citizenship and ethics by emphasizing the importance of responsible environmental stewardship. It equips students with the knowledge and values needed to make informed decisions regarding environmental conservation and sustainable water use, contributing to the well-being of communities and ecosystems.

PO8: Environment and sustainability

The CO1, CO3, CO4,CO7 addresses environmental and sustainability concerns by exploring the vital role of microorganisms in maintaining ecosystem balance and by investigating the impact of human activities on air and water quality. It equips students with the knowledge and tools to develop sustainable solutions for environmental challenges, such as pollution control, wastewater treatment, and the preservation of natural resources.

PO9: Self –directed and life –long learning

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

SYLLABUS (CBCS) FOR S. Y. B. SC. MICROBIOLOGY (2022 Pattern)

Name of the Programme	**: S.Y.B.Sc. Microbiology**
Program Code	**: USMB**
Class	**: S.Y.B.Sc**
Semester	**: IV**
Course Type	**: Practical**
Course Name	**: Practical course based on USMB242**
Course Code	**:USMB243**
No. of Credits	**: 02**

CourseObjectives :

1. To explore the diversity of microorganisms in the air and water
2. To focus on the microbiology of natural and engineered water systems, including drinking water, wastewater, and aquatic ecosystems, and the implications for public health.
3. To assess the impact of microbial communities on the quality of air and water, including their contributions to pollution, remediation, and sustainability.
4. To develop skills for analysis of air and water samples.
5. To make students able to check potability of water.
6. To explore relevant regulations and guidelines related to air and water quality, especially those governing microbial contamination and control.
7. To encourage critical thinking and problem-solving skills, particularly in addressing real-world challenges related to air and water microbiology.

CourseOutcomes :

CO1: Students can explore the diversity of microorganisms in the air and water

CO2: Can focus on the microbiology of natural and engineered water systems, including drinking water, wastewater, and aquatic ecosystems, and the implications for public health.

CO3: Assess the impact of microbial communities on the quality of air and water, including their contributions to pollution, remediation, and sustainability.

CO4: Development of skills for analysis of air and water samples.

CO5: Able to check potability of water.

CO6: Explore relevant regulations and guidelines related to air and water quality, especially those governing microbial contamination and control.

CO7: Students can encouraged with critical thinking and problem-solving skills, particularly in addressing real-world challenges related to 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	**Air Flora:** a. Diversity determination. b. Simpson index and settling velocity determination	4
3-4	**Bacteriological tests of potability of water** a. MPN, confirmed and completed test. b. Membrane filter technique (Demonstration)	8
5	**Determination of B.O.D.**	4
6	**Identification of Any one bacterial isolates at least up to genus level from soil or air using Bergys manual of systematic bacteriology.**	8
7	**Visits to** 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 (2022 Pattern)

Mapping of Program Outcomes with Course Outcomes

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

Course: Practical course based on USMB242 **Course Code:** USMB243

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

Almost all the course outcomes imparts disciplinary knowledge by delving into the study of microorganisms present in air and water ecosystems, including their diversity, roles, and ecological impact. It provides insights into microbiological principles and methodologies specific to these environments, contributing to a deeper understanding of microbial life in the context of environmental sciences.

PO2: Critical Thinking and Problem Solving

The CO3 ,CO4, CO 5, CO6, CO7 cultivates critical thinking and problem-solving skills by requiring students to analyze complex microbial interactions in environmental systems and assess their implications for human health and ecosystems. Through hands-on experiments and data interpretation, students develop the ability to address real-world challenges, such as water quality management and the spread of airborne pathogens, fostering analytical and solution-oriented thinking.

PO3: Social competence

CO6, CO7 promotes social competence by encouraging collaborative fieldwork and research projects that involve interdisciplinary teams working to address environmental concerns related to microbial communities. This experience fosters effective communication, teamwork, and cooperation, enabling students to engage with diverse stakeholders and contribute to solutions for air and water quality issues in a socially responsible manner.

PO4: Research related skills and scientific temper

CO5, CO7 imparts research-related skills by exposing students to various sampling, isolation, and analysis techniques used to study microorganisms in these ecosystems, preparing them for scientific research. It also fosters a scientific temper by emphasizing the critical evaluation of environmental data and the application of the scientific method, nurturing a mindset of evidence-based inquiry and a commitment to understanding and protecting our natural surroundings.

PO5: Trans-disciplinary knowledge

The CO1, CO2, CO3, CO7 promotes transdisciplinary knowledge by integrating principles from microbiology, environmental science, chemistry, and engineering to address complex environmental challenges. This cross-cutting approach equips students with a versatile skill set applicable across diverse scientific and engineering fields, allowing them to contribute to the holistic understanding and sustainable management of air and water ecosystems.

PO6: Personal and professional competence

The CO4, CO5, CO7enhances personal and professional competence by providing students with the knowledge and practical skills needed to excel in research, environmental monitoring, and water treatment careers. It also instills a sense of responsibility for environmental stewardship, preparing individuals to make a positive impact on society while fostering their professional development in various scientific and environmental fields.

PO7: Effective citizenship and ethics

The CO1, CO5 promotes effective citizenship and ethics by emphasizing the importance of responsible environmental stewardship and ethical conduct in research and water management practices. It equips students with the knowledge and values needed to make informed decisions regarding environmental conservation and sustainable water use, contributing to the well-being of communities and ecosystems.

PO8: Environment and sustainability

The CO1, CO3, CO4,CO7 addresses environmental and sustainability concerns by exploring the vital role of microorganisms in maintaining ecosystem balance and by investigating the impact of human activities on air and water quality. It equips students with the knowledge and tools to develop sustainable solutions for environmental challenges, such as pollution control, wastewater treatment, and the preservation of natural resources.

PO9: Self –directed and life –long learning

CO3, CO5, CO7 fosters self-directed and lifelong learning by encouraging students to explore cutting-edge research, adapt to evolving environmental challenges, and stay current with advancements in microbiological techniques and technology. It instills a sense of curiosity, adaptability, and the motivation to continuously expand their knowledge and expertise in order to address the dynamic and complex issues related to air and water quality.