Anekant Education Society's

Tuljaram Chaturchand College of Arts, Science and Commerce, Baramati

(Autonomous)

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

Semester I

(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	**: III**
Course Type	**: Theory**
Course Name	**: Bacterial Systematics and Physiology**
Course Code	**:MICRO2301**
No. of Lectures	**: 45**
No. of Credits	**: 03**

Course Objectives :

1. Grasp the principles governing bacterial taxonomy and classification.
2. Investigate the diversity of bacterial metabolism and its ecological importance.
3. Examine bacterial growth, replication, and regulatory mechanisms.
4. Evaluate bacterial physiology concerning its impact on human health and disease.
5. Acquaint oneself with laboratory methodologies used in bacterial research.
6. Investigate the evolutionary background of bacterial diversity.
7. Cultivate critical thinking abilities applicable to bacterial research.

Course Outcomes :

CO1: Students will demonstrate proficiency in categorizing bacteria through analysis of their morphological, biochemical, and genetic traits.

CO2: Students will grasp the diverse metabolic tactics employed by bacteria and their ecological functions within ecosystems.

CO3: Students will acquire a deep understanding of bacterial growth mechanisms, replication processes, and regulatory mechanisms.

CO4: Students will establish connections between bacterial pathogenicity, antibiotic resistance, and symbiotic relationships, elucidating their implications for human health.

CO5: Students will acquire hands-on experience in the isolation, culturing, and molecular analysis of bacteria.

CO6: Students will comprehend the evolutionary journey of bacteria and its significance in adapting to ecological variations.

CO7: Students will develop the skills to critically assess scientific literature and craft research projects proficiently.

Credit No.	Topics	Lectures
I	**BACTERIAL SYSTEMATICS** a. Definition of species b. Chemotaxonomy c. Numerical taxonomy d. Genetic basis of taxonomy i. G + C content ii. DNA hybridization iii. Base sequence similarity (Use of 16s rRNA databanks)	1 5 3 6
II	**BACTERIAL PHYSIOLOGY** a. Definitions of Metabolism, catabolism, anabolism, respiration and Fermentation. b. Metabolic pathways (with structures) EMP, HMP, ED, Phosphoketolase, Glyoxylate, TCA (with emphasis on amphibolism), Homofermentative and heterofermentative pathways. c. High Energy Compounds, Electron transport chain, Oxidative phosphorylation and Substrate level phosphorylation, Chemiosmotic hypothesis of ATP formation.	1 9 5
III	**BIOCATALYSTS** a. Introduction to Enzymes: Nature of active site, ribozymes, coenzymes, apoenzymes, prosthetic group and cofactors. b. Nomenclature & classification as per IUB (up to class level). c. Structure of active site; common amino acids at active site Models for catalysis – i. Lock and key ii. Induced fit iii. Transition state. d. Effect of pH & temperature, substrate concentration & enzyme concentration, activators and inhibitors of enzyme	2 3 5 5

References:

1. Conn E., Stumpf P.K., Bruuening G., Doi RH. (1987) Outlines of Biochemistry 5thEd , John Wiley and Sons, New Delhi. (Unit I & II)
2. Moat A.G. & Foster J.W. (1988) Microbial Physiology 2nd Ed. John Wiley and Sons New York. (Unit II & III)
3. Nelson D. L. & Cox M. M. (2005) Lehninger's Principles of Biochemistry, 4th edition, W. H. Freeman & Co. NY (Unit II & III)
4. Voet D. &Voet J. G. (1995) Biochemistry, 2nd Ed.. John Wiley & sons New York. (Unit II & III)
5. Bergey D. H. & Holt J. G. (1994) Bergey's Manual of Determinative Bacteriology. 9th Edition. Lippincott Williams & Wilkins. (Unit I)
6. Garrity G. M. (2005) Bergey's Manual of Systematic Bacteriology. 2nd Edition. (Vols. 1 – 4). Williams & Wilkins. (Unit I)
7. Madigan M. T., Martinko J. M. (2006) Brock's Biology of Microorganisms. 11th Edition. Pearson Education Inc. (Unit I, II& III)
8. Prescott L. M., Harley J. P. and Klein D. A. (2005) Microbiology, 6th Edition. MacGraw Hill Companies Inc.(Unit II)
9. Priest F. G. & Brian Austin. (1993) Modern Bacterial Taxonomy. Edn 2, Springer. (Unit I)

Choice Based Credit System Syllabus (2019 Pattern)

Mapping of Program Outcomes with Course Outcomes

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

Course : Bacterial Systematics and Physiology**Course Code :** MICRO2301

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

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

Justification for the mapping

PO1: Disciplinary Knowledge

The encompassing course outcomes CO1 to CO7 immerse students in the principles of

bacterial classification and taxonomy, delving into bacterial physiology to foster a comprehensive understanding.

PO2: Critical Thinking and Problem Solving
CO2, CO3, CO4, and CO7 develop critical thinking and problem-solving prowess by challenging students to analyze bacterial metabolic strategies in ecosystems, bacterial growth mechanisms, replication, regulatory processes, pathogenicity, antibiotic resistance, and symbiotic relationships' impact on human health. CO7 focuses on honing skills in critically evaluating scientific literature and crafting research projects.

PO3: Social Competence
CO1, CO2, CO5, and CO6 enhance social competence through collaborative fieldwork and interdisciplinary research projects aimed at addressing environmental concerns tied to microbial communities.

PO4: Research-related Skills and Scientific Temper
CO2, CO3, CO4, CO5, and CO7 cultivate research-related skills by immersing students in the study of microorganisms, metabolic strategies, bacterial growth mechanisms, replication, regulatory processes, and prepare them for scientific research endeavors.

PO5: Trans-disciplinary Knowledge
CO1, CO2, CO3, CO4, and CO6 promote transdisciplinary knowledge by integrating microbiology, environmental science, and chemistry principles to confront multifaceted environmental challenges.

PO6: Personal and Professional Competence
CO1, CO5, and CO6 enhance practical skills in bacterial isolation, culture, molecular analysis, and the ability to classify bacteria based on morphological, biochemical, and genetic characteristics. This contributes positively to society while nurturing professional development in diverse scientific and environmental domains.

PO7: Effective Citizenship and Ethics
CO4 and CO6 instill values of responsible environmental stewardship, enabling informed decisions regarding environmental conservation, sustainable water use, and fostering the well-being of communities and ecosystems.

PO8: Environment and Sustainability
CO2 and CO6 address environmental and sustainability concerns by exploring the pivotal role of microorganisms in maintaining ecosystem balance and scrutinizing the impact of human activities.

PO9: Self-directed and Lifelong Learning
CO1, CO3, CO4, and CO5 foster self-directed, lifelong learning by encouraging exploration of cutting-edge research, adaptability to evolving environmental challenges, and staying abreast of advancements in microbiological techniques and technology.

Name of the Programme : S.Y.B.Sc. Microbiology
Class : S.Y.B.Sc
Semester : III
Course Type : Theory
Course Name :Fundamentals of Soil & Industrial Microbiology
Course Code :MICRO2302
No. of Lectures : 45
No. of Credits : 03

Course objectives

1. Comprehend the involvement of microorganisms within soil ecosystems.
2. Investigate the array of soil microorganisms and their respective roles.
3. Acquire knowledge of various stages of cell growth and their kinetics.
4. Assess the influence of industrial microbiology across diverse industries.
5. Gain familiarity with methodologies for conducting research in soil and industrial microbiology.
6. Cultivate critical thinking abilities by assessing the ethical and sustainable facets within industrial microbiology.
7. Engage in critical analysis of ethical and sustainability concerns regarding microorganismsutilization in industrial applications, proposing responsible solutions

Course outcome:

CO1: Students will understand the importance of microorganisms in cycling nutrients, maintaining soil fertility, and preserving soil health.

CO2: Students will articulate the diversity of soil microorganisms and their functions in decomposing matter, fixing nitrogen, and enhancing soil structure.

CO3: Students will apply mathematical concepts in biological contexts.

CO4: Students will comprehend microbiology's applications in the food, pharmaceutical, biotechnology, and environmental sectors, assessing their economic and environmental impacts.

CO5: Students will acquire practical experience in soil sampling, microbial cultivation, and molecular techniques employed in microbiological research.

CO6: Students will elucidate the role of microorganisms in remediation of environmental pollutants and improvement of agricultural yield.

CO7: Students will link microorganisms to food production and spoilage, evaluating their significance in ensuring food safety and quality.

Credit No.	Topics	Lectures
I, II and III	**INTRODUCTION TO INDUSTRIAL MICROBIOLOGY** a. Strains of industrially important microorganisms: i. Desirable characteristics of industrial strain ii. Principles and methods of primary and secondary screening iii. Inoculum preparation. b. Equipment: Design of a basic Fermenter and its parts. c. Process Control and Monitoring of different fermentation parameters (temperature, pH, foam) d. Media for industrial fermentations: Constituents of media (Carbon source, nitrogen source, buffers, antifoam agents, precursors, inhibitors). e. Contamination: Sources, precautions, and consequences.	2 3 2 3 4 7 2
	SOIL MICROBIOLOGY a. Soil microorganisms, composition and types of soil. b. Rhizosphere microflora and its role in the rhizosphere c. Role of microorganisms in composting and humus formation d. Role of microorganisms in following elemental cycles in nature Carbon, Nitrogen, Sulphur, Phosphorous. e. Degradation of cellulose, hemicelluloses, lignin and pectin f. Brief account of microbial interactions Symbiosis, Neutralism, Commensalism, Competition, Ammensalism, Synergism, Parasitism, and Predation	1 2 2 6 6 5

References :

1. Casida LE. (1984) Industrial Microbiology. Wiley Easterbs, New Delhi
2. Ingraham J. L. and Ingraham C.A. (2004) Introduction to Microbiology. 3nd Edition. Thomson Brooks / Cole.
3. Modi H. A., (2008) Fermentation Technology – Volumes I and II, Pointer Publishers, Jaipur, India
4. Patel A.H. (1985) Industrial Microbiology, Macmillan India Ltd.
5. Peppler H.L. (1979) Microbial Technology, Vol I and II, Academic Press.
6. Prescott S.C. and Dunn C.G. (1983) Industrial Microbiology.

7. Reed G. AVI tech books. 16.Salle A.J. (1971) Fundamental Principles of Bacteriology. 7th Edition. Tata MacGraw Publishing Co.
8. Martin A. Introduction to Soil Microbiology (1961) John Wiley& Sons, New York and London publication
9. SubbaRao N. S. (1977) Soil Microbiology, 4th Ed., Oxford & IBH Publishing Co. Pvt. Ltd.
10. Dubey R.C., and Maheswari, D.K. Textbook of Microbiology, S. Chand & Co.
11. Mexander M. (1977) Introduction to soil microbiology, John Wilery NY.
12. Dube H.C. and Bilgrami. K.S.(1976) Text book of modern pathology. Vikas publishing house. New Delhi.
13. Rangaswami G. (1979) Recent advances in biological nitrogen fixation. Oxford and IBH. New Delhi.
14. Stanbury P. F. and Whittaker A. (1984) Principles of Fermentation technology. Pergamon Press

Choice Based Credit System Syllabus (2019 pattern)

Mapping of Program Outcomes with CourseOutcomes

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

Course : Fundamentals of Soil & Industrial Microbiology**Course Code :** MICRO2302

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	3	
CO2	3	3		3	2		2	3	
CO3	3		3	3	2	3			
CO4	3	2	2	2	2	2	2		2
CO5	3					2			2
CO6	3				2				
CO7	3								2

Justification for the mapping

PO1: Disciplinary Knowledge

All course outcomes, CO1 to CO7, impart disciplinary knowledge by extensively exploring the principles of bacterial classification and taxonomy, thus offering deeper insights into bacterial physiology.

PO2: Critical Thinking and Problem Solving

CO1, CO2, and CO4 foster critical thinking and problem-solving skills by necessitating students to analyze the significance of microorganisms in nutrient cycling, soil fertility, and soil health maintenance, as well as different types of soil microorganisms and their

roles. Additionally, students evaluate the applications of microbiology in diverse sectors while assessing their economic and environmental implications.

PO3: Social Competence
CO1, CO3, and CO4 promote social competence by encouraging collaborative fieldwork and interdisciplinary research projects aimed at addressing environmental concerns linked to microbial communities.

PO4: Research-related Skills and Scientific Temper
CO2, CO3, and CO4 instill research-related skills by involving students in the study of soil microorganisms, their functions, the application of mathematics in biology, and the diverse applications of microbiology in various sectors, with an emphasis on evaluating their economic and environmental impact.

PO5: Trans-disciplinary Knowledge
CO2, CO3, CO4, and CO6 promote transdisciplinary knowledge by integrating microbiology, environmental science, and chemistry principles to tackle complex environmental challenges.

PO6: Personal and Professional Competence
CO3 focuses on applying mathematics in biology. CO4 emphasizes understanding the applications of microbiology across various sectors, evaluating their economic and environmental implications. CO5 involves students gaining practical experience in soil sampling, microbial culture, and molecular techniques used in microbiological research.

PO7: Effective Citizenship and Ethics
CO1, CO2, and CO4 encourage effective citizenship and ethical behavior by highlighting responsible environmental stewardship. This equips students with knowledge and values necessary for informed decision-making regarding environmental conservation and sustainable water use.

PO8: Environment and Sustainability
CO1 and CO2 address environmental and sustainability concerns by exploring the pivotal role of microorganisms in maintaining ecosystem balance and investigating the impact of human activities.

PO9: Self-directed and Lifelong Learning
CO4, CO5, and CO7 foster self-directed and lifelong learning by encouraging students to explore advanced research, adapt to evolving environmental challenges, and stay updated with advancements in microbiological techniques and technology.

Name of the Programme	**: S.Y.B.Sc. Microbiology**
Class	**: S.Y.B.Sc**
Semester	**: III**
Course Type	**: Practical**
Course Name and MICRO2302	**: Practical course based on MICRO2301**
Course Code	**:MICRO2303**
No. of Credits	**: 02**

Course Objectives :

1. Acquiring knowledge in the growth and identification of microorganisms.
2. Introduction to the field of industrial microbiology.
3. Cultivating practical expertise in bacterial isolation, culture, and identification methods.
4. Exploring the involvement of microorganisms in industrial procedures.
5. Evaluating microbial communities and their diversity in authentic environments.
6. Developing adeptness in techniques pertinent to food microbiology.
7. Implementing ethical considerations in practical applications of microbiology.

Course Outcomes :

CO1: Comprehend the bacterial growth curve.

CO2: Introduction to utilizing computer software in studies.

CO3: Screening organisms of industrial significance for organic acid or antibiotic production.

CO4: Attain proficiency in isolating and identifying bacteria from soil samples, industry-related materials, and other environmental sources.

CO5: Apply microbiological methods to assess soil parameters and health indicators, contributing to sustainable agriculture and land management.

CO6: Acquire practical experience in employing microorganisms for biotechnological applications, such as fermentation and enzyme production.

CO7: Develop the ability to critically assess the ethical and sustainable facets of microbiological practices in soil and industry, proposing responsible solutions.

EXPT. No.	Topics	Hours
1	**Growth curve:** a. Absorbance measurement for bacterial culture b. Growth curve plotting by using computer software	4
2-7	**Biochemical characterization of bacteria:** a. Sugar utilization test (minimal medium + sugar) b. Sugar fermentation test c. IMViC d. Enzyme detection – Amylase, Gelatinase, Catalase, Oxidase e. Oxidative-fermentative test	 2 2 4 10 4
8	**Primary screening of industrially important organisms:** a. Organic acid producing microorganisms OR b. Antibiotic producing microorganisms (crowded plate technique)	4

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 III) **Subject:** Microbiology

Course: Practical course based onMICRO2301 and MICRO2302

Course Code:MICRO2303

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
CO2	3	3	2		2	2			2
CO3	3	2		3		3			3
CO4	3	2	2	2	2	2		2	
CO5	3			2	2		2	2	2
CO6	3			2			2		2
CO7	3						2	2	2

Justification for the mapping

PO1: Disciplinary Knowledge

All course outcomes, from CO1 to CO7, impart disciplinary knowledge by extensively exploring the principles of bacterial classification and taxonomy, thereby enhancing understanding of bacterial physiology.

PO2: Critical Thinking and Problem Solving

CO2, CO3, and CO4 foster critical thinking and problem-solving skills, requiring students to analyze the use of computer software in studies, screen industrially significant organisms for organic acid or antibiotic production, and demonstrate proficiency in isolating and identifying bacteria from various sources.

PO3: Social Competence

CO2 and CO5 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

CO3 emphasizes screening industrially significant organisms for organic acid or antibiotic production. CO4 focuses on proficiency in isolating and identifying bacteria from diverse environmental sources, while CO5 involves using microbiological methods to evaluate soil parameters, contributing to sustainable agriculture and land management. CO6 enables practical experience in utilizing microorganisms for biotechnological applications.

PO5: Trans-disciplinary Knowledge
CO2, CO4, and CO5 integrate microbiology, environmental science, and chemistry principles to address complex environmental challenges.

PO6: Personal and Professional Competence
CO2 underscores the application of mathematics in biology. CO3 highlights understanding the applications of microbiology in various sectors, evaluating their economic and environmental implications. CO4 involves hands-on experience in soil sampling, microbial culture, and molecular techniques used in microbiological research.

PO7: Effective Citizenship and Ethics
CO5, CO6, and CO7 promote effective citizenship and ethical awareness by emphasizing responsible environmental stewardship, equipping students with the knowledge and values required to make informed decisions regarding environmental conservation and sustainable water use.

PO8: Environment and Sustainability
CO4, CO5, and CO7 address environmental and sustainability concerns by exploring the essential role of microorganisms in maintaining ecosystem balance and examining the impact of human activities.

PO9: Self-directed and Lifelong Learning
CO1, CO2, CO3, CO5, CO6, and CO7 encourage self-directed, lifelong learning by inspiring students to explore advanced research, adapt to evolving environmental challenges, and remain updated with advancements in microbiological techniques and technology.