Anekant Education Society's

Tuljaram Chaturchand College of Arts, Science and Commerce, Baramati

(Autonomous)

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

Semester III

(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. (2022 Pattern)

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

Program Code	**: USMB**
Class	**: S.Y.B.Sc**
Semester	**: III**
Course Type	**: Theory**
Course Name	**: Bacterial Systematics and Physiology**
Course Code	**: USMB231**
No. of Lectures	**: 45**
No. of Credits	**: 03**

Course Objectives :

1. Understand bacterial taxonomy and classification principles.
2. Explore bacterial metabolic diversity and ecological significance.
3. Study bacterial growth, replication, and regulation.
4. Analyze bacterial physiology in the context of human health and disease.
5. Familiarize with laboratory techniques for bacterial research.
6. Explore the evolutionary history of bacterial diversity.
7. Develop critical thinking skills for bacterial research.

Course Outcomes :

CO1:Students will be able to classify bacteria based on morphological, biochemical, and genetic characteristics.

CO2:Students will comprehend the metabolic strategies of bacteria and their roles in ecosystems.

CO3 Students will gain insight into bacterial growth mechanisms, replication, and regulatory processes.

CO4:Students will relate bacterial pathogenicity, antibiotic resistance, and symbiotic relationships to human health.

CO5:Students will gain practical experience in bacterial isolation, culture, and molecular analysis.

CO6:Students will understand the evolution of bacteria and its impact on ecological adaptation.

CO7:Students will learn to critically evaluate scientific literature and design research projects.

Credit No.	Topics	Lectures
I	**BIOCATALYSTS** a. Introduction to Enzymes: Nature and properties of enzymes, coenzymes, apoenzyme, prosthetic group and cofactors. ribozyme, Enzyme unit. b. Structure of active site; common amino acids at active site Models for catalysis – i. Lock and key ii. Induced fit iii. Transition state. c. Effect of pH & temperature, substrate concentration & enzyme concentration, activators and inhibitors of enzyme d. Nomenclature & classification as per IUB (up to class level).	5 5 5
II	**BACTERIAL SYSTEMATICS** a. Definition of species b. Introduction to Bergey's Manual of Systematic bacteriology c. Chemotaxonomy d. Numerical taxonomy e. Genetic basis of taxonomy i G + C content ii DNA hybridization iii Base sequence similarity (Use of 16s rRNA databanks)	1 1 4 3 6
III	**BACTERIAL PHYSIOLOGY** a. Definitions of Metabolism,catabolism, anabolism, respiration and Fermentation. b. Metabolic pathways (with structures) EMP, ED, Glyoxylate, TCA (with emphasis on amphibolism), Homofermentative and heterofermentative pathways. c. Concepts of : i. High Energy Compounds ii. Bacterial electron transport chain iii. Phosphorylation	1 9 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 (2022 Pattern)

Mapping of Program Outcomes with Course Outcomes

Class:S.Y.B.Sc (Sem III)**Subject:** Microbiology
Course: Bacterial Systematics and Physiology **Course Code:** USMB231

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			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

All the course outcomes CO1 to CO7 imparts disciplinary knowledge by delving into the study of principles of bacterial classification and taxonomy.It provides insights into bacterial physiology, contributing to a deeper understanding.

PO2: Critical Thinking and Problem Solving

The CO2 , CO3 ,CO4, CO7 cultivates critical thinking and problem-solving skills by requiring students to analyze metabolic strategies of bacteria and their roles in ecosystems, bacterial growth mechanisms, replication, and regulatory processes, bacterial pathogenicity, antibiotic resistance, and symbiotic relationships to human health. CO7: Students will learn to critically evaluate scientific literature and design research projects.

PO3: Social competence

CO1, CO2, CO5, CO6 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

CO2, CO3,CO4, CO5, CO7imparts research-related skills by exposing students to to study microorganisms in these ecosystems, metabolic strategies of bacteria and their roles in ecosystems, bacterial growth mechanisms, replication, and regulatory processes. All these arepreparing them for scientific research

PO5: Trans-disciplinary knowledge

CO1, CO2, CO3 CO4, CO6, promotes transdisciplinary knowledge by integrating principles from microbiology, environmental science, chemistry to address complex environmental challenges.

PO6: Personal and professional competence

CO1, CO5, CO6 enhances practical experience in bacterial isolation, culture, and molecular analysis and ablility to classify bacteria based on morphological, biochemical, and genetic characteristics. It makes a positive impact on society while fostering their professional development in various scientific and environmental fields.

PO7: Effective citizenship and ethics

CO4, CO6 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 CO2, CO6 addresses environmental and sustainability concerns by exploring the vital role of microorganisms in maintaining ecosystem balance and by investigating the impact of human activities.

PO9: Self –directed and life –long learning

CO1, CO3,CO4, CO5 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	**: III**
Course Type	**: Theory**
Course Name	**: Fundamentals of Soil & Industrial Microbiology**
Course Code	**:USMB232**
No. of Lectures	**: 45**
No. of Credits	**: 03**

Course objectives

1. Understand the role of microorganisms in soil ecosystems.
2. Explore the diversity of soil microorganisms and their functions.
3. To learn different phases of cell growth and their kinetics.
4. Analyze the impact of industrial microbiology on various industries.
5. Familiarize with techniques for soil and industrial microbiology research.
6. Develop critical thinking skills by evaluating the ethical and sustainable aspects of industrial microbiology.
7. Students will critically analyze the ethical and sustainability issues related to the use of microorganisms in industrial applications and propose responsible solutions.

Course outcome:

CO1: Students will grasp the significance of microorganisms in nutrient cycling, soil fertility, and the maintenance of soil health.

CO2: Students will be able to describe different types of soil microorganisms and their roles in decomposition, nitrogen fixation, and soil structure improvement

CO3:Student will able to apply mathematics in biology.

CO4: Students will comprehend the applications of microbiology in food, pharmaceutical, biotechnology, and environmental sectors, and evaluate their economic and environmental implications.

CO5: Students will gain knowledge hands-on experience in soil sampling, microbial culture, and molecular techniques used in microbiological research.

CO6: Students will be able to explain the use of microorganisms in cleaning up environmental pollutants and enhancing agricultural productivity.

CO7: Students will connect the role of microorganisms in food production and spoilage, and assess their importance in ensuring food safety and quality.

Credit No.	Topics	Lectures
I	**SOIL MICROBIOLOGY**	**15**
	a. Soil microorganisms, composition and types of soil.	1
	b. Rhizosphere micro flora and its role in the rhizosphere	2
	c. Role of microorganisms in composting	2
	d. Role of microorganisms in following elemental cycles in nature : Carbon, Nitrogen, Phosphorous.	6
	e. Degradation of cellulose, hemicelluloses	4
II	**INTRODUCTION TO INDUSTRIAL MICROBIOLOGY**	**15**
	a. Strains of industrially important microorganisms:	
	i. Desirable characteristics of industrial strain	1
	ii. Principles and methods of primary and secondary screening	2
	iii. Inoculum preparation.	2
	b. Equipment: Design & types of bioreactor.	2
	c. Media for industrial fermentations:	6
	Constituents of media (Carbon source, nitrogen source, buffers, antifoam agents, precursors, inhibitors).	2
	d. Contamination: Sources, precautions, and consequences.	
III	**GROWTH KINETICS**	**15**
	a. Concept of Function	1
	b. Linear function	2
	c. Growth phases	3
	d. Kinetics of log phase	3
	e. Concept of Growth rate constant	2
	f. Mean generation time	1
	g. Problems based on Growth kinetics	3

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 (2022 Pattern)

Mapping of Program Outcomes with Course Outcomes

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

Course : Fundamentals of Soil & Industrial Microbiology **Course Code :** USMB232

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 the course outcomes CO1 to CO7 imparts disciplinary knowledge by delving into the study of principles of bacterial classification and taxonomy. It provides insights into bacterial physiology, contributing to a deeper understanding.

PO2: Critical Thinking and Problem Solving

The CO1 , CO2 ,CO4 cultivates critical thinking and problem-solving skills by requiring students to analyze significance of microorganisms in nutrient cycling, soil fertility, and the maintenance of soil health, different types of soil microorganisms and their roles in decomposition, nitrogen fixation, and soil structure improvement and the applications of microbiology in food, pharmaceutical, biotechnology, and environmental sectors, and evaluate their economic and environmental implications.

PO3: Social competence

CO1, CO3, CO4 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

CO2, CO3,CO4 imparts research-related skills by exposing students to to study soil microorganisms and their roles in decomposition, nitrogen fixation, and soil structure improvement, CO3 mathematics in biology and CO4 for the applications of microbiology in food, pharmaceutical, biotechnology, and environmental sectors, and evaluate their economic and environmental implications.

PO5: Trans-disciplinary knowledge

CO2, CO3 CO4, CO6, promotes transdisciplinary knowledge by integrating principles from microbiology, environmental science, chemistry to address complex environmental challenges.

PO6: Personal and professional competence

CO3 fosters application of mathematics in biology.

CO4: Students will comprehend the applications of microbiology in food, pharmaceutical, biotechnology, and environmental sectors, and evaluate their economic and environmental implications.

CO5: Students will gain hands-on experience in soil sampling, microbial culture, and molecular techniques used in microbiological

PO7: Effective citizenship and ethics

CO1, CO2, CO4 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, CO2 addresses environmental and sustainability concerns by exploring the vital role of microorganisms in maintaining ecosystem balance and by investigating the impact of human activities.

PO9: Self –directed and life –long learning

CO4,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 : III
Course Type : Practical
Course Name : Practical course based onUSMB231 and USMB232
Course Code :USMB233
No. of Credits : 02

Course Objectives :

1. To learn microbial growth and identification of microorganisms.
2. To introduce industrial microbiology..
3. Develop hands-on skills in bacterial isolation, culture, and identification techniques.
4. Investigate the role of microorganisms in industrial processes.
5. Analyze microbial communities and diversity in real-world settings.
6. Gain proficiency in food microbiology techniques.
7. Apply ethical considerations to practical microbiological applications.

Course Outcomes :

CO1: Understand bacterial growth curve .

CO2: Introduction ofuse of computer softwaresin study.

CO3: Screening of industrially important organisms for Organic acid orAntibiotic production.

CO4: Students will be proficient in isolating and identifying bacteria from soil samples, industry-related materials, and other environmental sources.

CO5: Students will be able to use microbiological methods to evaluate soil parameters and health indicators, contributing to sustainable agriculture and land management.

CO6: Students will gain practical experience in using microorganisms for biotechnological applications, including fermentation, enzyme production.

CO7: Students will be able to critically evaluate the ethical and sustainable aspects of microbiological practices in soil and industry and propose 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 (2022 Pattern)

Mapping of Program Outcomes with Course Outcomes

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

Course: Practical course based onUSMB231 and USMB232 **Course Code:** USMB233

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 the course outcomes CO1 to CO7 imparts disciplinary knowledge by delving into the study of principles of bacterial classification and taxonomy. It provides insights into bacterial physiology, contributing to a deeper understanding.

PO2: Critical Thinking and Problem Solving

The CO2 , CO3 ,CO4 cultivates critical thinking and problem-solving skills by requiring students to analyze.CO2: Use of computer softwares in study.CO3: Screening of industrially important organisms for Organic acid orAntibiotic production.CO4: Students will be proficient in isolating and identifying bacteria from soil samples, industry-related materials, and other environmental sources.

PO3: Social competence

CO2, CO5 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

CO3: Screening of industrially important organisms for Organic acid orAntibiotic production.

CO4: Students will be proficient in isolating and identifying bacteria from soil samples, industry-related materials, and other environmental sources.CO5: Students will be able to use microbiological methods to evaluate soil parameters and health indicators, contributing to sustainable agriculture and land management.CO6: Students will gain practical experience in using microorganisms for biotechnological applications, including fermentation, enzyme production

PO5: Trans-disciplinary knowledge

CO2, CO4, CO5, promotes transdisciplinary knowledge by integrating principles from microbiology, environmental science, chemistry to address complex environmental challenges.

PO6: Personal and professional competence

CO2 fosters application of mathematics in biology.CO3: Students will comprehend the applications of microbiology in food, pharmaceutical, biotechnology, and environmental sectors, and evaluate their economic and environmental implications.CO4: Students will gain hands-on experience in soil sampling, microbial culture, and molecular techniques used in microbiological

PO7: Effective citizenship and ethics

CO5, CO6, CO7 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 CO4, CO5, 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.

PO9: Self –directed and life –long learning

CO1, CO2,CO3,CO5,CO6,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.