

As Per NEP 2020

University of Mumbai



Title of the program

- A- U.G. Certificate in **Microbiology**
- B- U.G. Diploma in **Microbiology**
- C- B.Sc. (**Microbiology**)
- D- B.Sc. (Hons.) in **Microbiology**
- E- B.Sc. (Hons. with Research) in **Microbiology**

Syllabus for

Semester – Sem I & II

Ref: GR dated 20th April, 2023 for Credit Structure of UG

**(With effect from the academic year 2024-25
Progressively)**

University of Mumbai



(As per NEP 2020)

Sr. No.	Heading	Particulars	
1	Title of program O: _____A	A	U.G. Certificate in Microbiology
	O: _____B	B	U.G. Diploma in Microbiology
	O: _____C	C	B.Sc. (Microbiology)
	O: _____D	D	B.Sc. (Hons.) in Microbiology
	O: _____E	E	B.Sc. (Hons. with Research) in Microbiology
2	Eligibility O: _____A	A	HSC OR Passed Equivalent Academic Level 4.0
	O: _____B	B	Under Graduate Certificate in Microbiology OR Passed Equivalent Academic Level 4.5
	O: _____C	C	Under Graduate Diploma in Microbiology OR Passed Equivalent Academic Level 5.0
	O: _____D	D	Bachelors of Microbiology with minimum CGPA of 7.5 OR Passed Equivalent Academic Level 5.5
	O: _____E	E	Bachelors of Microbiology with minimum CGPA of 7.5 OR Passed Equivalent Academic Level 5.5

3	Duration of program R: _____	A	One Year
		B	Two Years
		C	Three Years
		D	Four Years
		E	Four Years
4	Intake Capacity R: _____	120 per division	
5	Scheme of Examination R: _____	NEP 40% Internal 60% External, Semester End Examination Individual Passing in Internal and External Examination	
6	R: _____ Standards of Passing	40%	
7	Credit Structure Sem. I - R: _____ A	Attached herewith	
	Sem. II - R: _____ B		
	Credit Structure Sem. III - R: _____ C		
	Sem. IV - R: _____ D		
8	Semesters	A	Sem I & II
		B	Sem III & IV
		C	Sem V & VI
		D	Sem VII & VIII
		E	Sem VII & VIII
		A	4.5

9	Program Academic Level	B	5.0
		C	5.5
		D	6.0
		E	6.0
10	Pattern	Semester	
11	Status	New	
12	To be implemented from Academic Year Progressively	From Academic Year: 2024-25	

**Sign of the Offg. Dean
Prof. Shivram S. Garje
Faculty of Science &
Technology**

**Sign of the
Offg. Associate Dean
Dr. Madhav R. Rajwade
Faculty of Science &
Technology**

**Sign of the Offg. Dean
Prof. Shivram S. Garje
Faculty of Science &
Technology**

Preamble

1. Introduction

The National Education Policy 2020 i.e. NEP 2020 is a comprehensive education policy introduced by the Government of India in July 2020. It aims at producing engaged, productive, and contributing citizens for building an equitable, inclusive, and plural society as envisaged by our Constitution.

Microbiology is a study of the microscopic world. It is an indispensable part of our routine life. It is the branch of science which deals with study of microorganisms with the emphasis on their morphology, biochemistry and industrial applications in diverse fields.

2. Aims and Objectives

The B. Sc (Microbiology) program is designed to provide learners with an experiential learning of the principles, concepts, skills and scope of the subject in day-to-day life as well as in the industry and research.

The objectives are:

- to develop deeper interest in the subject to progress to higher education.
- to sharpen learners' creativity, analytical thinking skills, and logical reasoning.
- to inculcate a scientific temper.
- to acquire skill sets to make them industry ready and independent researchers.

3. Learning Outcomes

On completion of this program the learners will be able to

- apply their knowledge to interdisciplinary sciences in higher education.
- contribute as an efficient professional to an industry as well as research laboratories.
- spread awareness about the importance of Microbiology to the society at local and global level.

5) Credit Structure of the Program (Sem I, II, III, IV, V & VI)

Under Graduate Certificate in Microbiology

Credit Structure (Sem. I & II)

R: _____ A										
Level	Semester	Major		Minor	OE	VSC, SEC (VSEC)	AEC, VEC, IKS	OJT, FP, CEP, CC, RP	Cum. Cr. / Sem.	Degree/ Cum. Cr.
		Mandatory	Electives							
4.5	I	6	-	-	2+2 Microbes at work	VSC:2 (Practical based) Techniques in Nutrition, Cultivation and Preservation of Microorganisms SEC:2 (Practical based) Microbes in Human welfare	AEC:2, VEC:2, IKS:2	CC:2	22	UG Certificate 44
	R: _____ B									
	II	6	-	2	2+2 Microbes in food	VSC:2, (Practical based) Techniques in Food and Water Analysis	AEC:2, VEC:2	CC:2	22	
		<u>Course I</u> Eukaryotes: Cell structure and Microbial Diversity <u>Course II</u> Prokaryotes: Ultrastructure		Intr odu ctio n to Mi cro bia l W						

	of Cell and Diversity of Microorganisms		ord		SEC:2 (Practical based)				
	<u>Course III</u> Practical in Microbiology II Practical study of groups of organisms: Eukaryotes and Prokaryotes				Human - Microbe interactions				
Cum Cr.	12	-	2	8	4+4	4+4+2	4	44	

Exit option: Award of UG Certificate in Major with 40-44 credits and an additional 4 credits core NSQF course/ Internship OR Continue with Major and Minor

Under Graduate Diploma in Microbiology

Credit Structure (Sem. III & IV)

R: _____ C										
Level	Semester	Major		Minor	OE	VSC, SEC (VSEC)	AEC, VEC, IKS	OJT, FP, CEP, CC, RP	Cum. Cr. / Sem.	Degree / Cum. Cr.
		Mandatory	Electives							
5.0	III	8	--	4	2	VSC:2 (Practical based) Basic Bioanalytical techniques	AEC:2	FP: 2 CC:2	22	UG Diploma 88
	<u>Course I</u> Chemical foundations for Basis of life <u>Course II</u> Fermentation technology, Biosafety and Biohazards <u>Course III</u> Basics of Medical Microbiology and Epidemiology <u>Course IV</u> Practical in Microbiology III									
R: _____ D										

IV	8 <u>Course I</u> Introduction to Microbial metabolism <u>Course II</u> Introduction to Immunology <u>Course III</u> Introduction to Microbial Genetics <u>Course IV</u> Practical in Microbiology IV		4	2	SEC:2 (Practical based) Environmental microbiology	AEC:2	CEP: 2 CC:2	22	
Cum Cr.	28		10	12	6+6	8+4+2	8+4	88	

Exit option; Award of UG Diploma in Major and Minor with 80-88 credits and an additional 4 credits core NSQF course/ Internship OR Continue with Major and Minor

B.Sc. (Microbiology)

Credit Structure (Sem. V & VI)

R: _____ E										
Level	Semester	Major		Minor	OE	VSC, SEC (VSEC)	AEC, VEC, IKS	OJT, FP, CEP, CC, RP	Cum. Cr. / Sem.	Degree / Cum. Cr.
		Mandatory	Electives							
5.5	V	10	4	4		VSC: 2 (Practical based)		FP/CEP: 2	22	UG Degree 132
		<u>Course I</u> Mendelian genetics and Mutations <u>Course II</u> Medical Microbiology <u>Course III</u> Biochemistry: Carbohydrate, Lipid and Protein catabolism <u>Course IV</u> Practical in Microbiology V <u>Course V</u> Practical in Microbiology VI	1. Biostatistics and Bioinformatics 2. Recombinant DNA technology							
R: _____ F										

VI	10 <u>Course I</u> Introductio n to Virology <u>Course II</u> Advances in Immunolo gy <u>Course III</u> Biochemistr y: Biosynthesi s of Carbohydrat es, lipids and amino acids and Inorganic metabolism <u>Course IV</u> Practical in Microbiolo gy VII <u>Course V</u> Practical in Microbiolo gy VIII	4	4					OJT :4	22
Cum Cr.	48	8	18	12	8+6	8+4+2	8+6+4	132	

Exit option: Award of UG Degree in Major with 132 credits OR Continue with Major and Minor

[Abbreviation - OE – Open Electives, VSC – Vocation Skill Course, SEC – Skill Enhancement Course, (VSEC), AEC – Ability Enhancement Course, VEC – Value Education Course, IKS – Indian Knowledge System, OJT – on Job Training, FP – Field Project, CEP – Continuing Education Program, CC – Co-Curricular, RP – Research Project]

Sem. - I

Syllabus
B.Sc. (Microbiology)
(Sem.- I)

Sr.No.	Heading	Particulars
1	Description the course : Including but Not limited to:	<p>The omnipresence of microorganisms makes the study of microbiology very important for society as a whole. The study involves all the areas like food, dairy and beverage, medical and diagnostics, agricultural, environmental, computational biology and space biology.</p> <p>The interdisciplinary nature of the subject is relevant to all fields including Chemistry, Biochemistry, Biophysics, Bioinformatics, Biostatistics, Nanotechnology and Pharmaceutical sectors .</p> <p>As a microbiologist, the learner of this program can find opportunities in QC-QA, production, R and D of pharma, diagnostics, Clinical research and drug designing , food production and processing, and environmental labs .</p> <p>To summarize, the subject contributes to community welfare with respect to prevention, control and treatment of diseases, development of sustainable agricultural practices, and monitoring of the environment with green technology.</p>
2	Vertical :	Major
3	Type :	Theory / Practical
4	Credits :	2 credits (1 credit = 15 Hours for Theory or 30 Hours of Practical work in a semester)
5	Hours Allotted :	30 Hours / 60 Hours
6	Marks Allotted:	50 Marks
7		<p>CO1. To understand history, developments and scope of Microbiology</p> <p>CO2. To study importance of microorganisms in human life and in an environment</p> <p>CO3. To gain knowledge about mechanism of basic and advanced microscopy</p> <p>CO4. To apply basic principles and techniques of staining for observing microorganisms and their structures</p> <p>CO5. To demonstrate the knowledge of physical and chemical methods for control of microorganisms.</p> <p>CO6 To give an overview of a cell (prokaryote and eukaryote) with details of the structures and functions of cell organelles.</p> <p>CO7 To discuss the characteristics, types, morphology and significance of various groups of eukaryotic and prokaryotic microbes.</p> <p>CO8. To acquire skills for basic microbiological techniques.</p>

8	<p>On completion of this course learner will be able to:</p> <p>OC1. Comprehend science of microorganisms and their significance with appreciation of scientific contributions and scope.</p> <p>OC2. Analyze a relationship between human, environment and microorganisms.</p> <p>OC3. Compare different types of control methods for their suitable application</p> <p>OC4. Differentiate various types of microorganisms on the basis of microscopic and cultural characteristics.</p> <p>OC5. Appraise the significance of diverse microbial groups.</p> <p>OC6. Develop application-based study of microorganisms.</p>
9	Modules:-

Semester	Paper	Module	Description	Credits
I	Course I Fundamentals of Microbiology	1.	Introduction to Microbiology	02
		2.	History of Microbiology	
	Course II Basic techniques in Microbiology	1.	Microscopy and Staining	02
		2.	Control of microorganisms	
	Major Course III Practical	Practical	Techniques: Staining and Control of microorganisms	02

Semester	Paper	Module	Description	Credits
II	Course I Eukaryotes: Cell structure and Microbial Diversity	1.	Eukaryotes: Cell structure	02
		2.	Eukaryotes: Microbial Diversity	
	Course II Prokaryotes: Ultra structure of cell and Diversity of Microorganisms	1.	Bacterial cell structure	02
		2.	Diversity of Prokaryotic Microorganisms	
	Major Course III Practical	Practical	Practical study of Groups of organisms : Eukaryotes and Prokaryotes	02

Course code	SEMESTER I	Credits
	Major Course I Fundamentals of Microbiology	2 Credits (30 L/hr)
Module 1	Introduction to Microbiology	15 L
1.1	The Science of Microbiology	2L
1.2	Microbial Cells	2L
1.3	Microorganisms and Their Environments	2L
1.4	Evolution and the Extent of Microbial Life	3L
1.5	The Impact of Microorganisms on Humans	3L
1.6	Scope, Relevance and Future of Microbiology	3L
Module 2	History of Microbiology	15L
2.1	The Historical Roots of Microbiology: Hooke, van Leeuwenhoek, and Cohn	2L
2.2	Pasteur and the Defeat of Spontaneous Generation	2L
2.3	Koch, Infectious Disease, and Pure Culture Microbiology	2L
2.4	Contributions of other scientists to the field of Microbiology	4L
2.5	The Rise of Microbial Diversity	3L
2.6	The Modern Era of Microbiology	2L
Reference books		
1.	Prescott, Hurley Klein-Microbiology, 7 th edition, International edition, McGraw Hill	
2.	Michael T. Madigan & J. M. Martinnko, D. Stahl, D. Clark Brock Biology of Microorganisms 13 th ed. International Edition 2012, Pearson Prentice Hall	

Course code		SEMESTER I	Credits
		Major Course II Basic techniques in Microbiology	2 Credits (30 L/hr)
Module 1		Microscopy and Staining	15L
	1.1	History of microscopy, Optical spectrum, Lenses and mirrors	3L
	1.2	Study of Bright field Microscopy (Compound light microscope) 1.2.1 Principles of Microscopy 1.2.2 Parts of a microscope	3L
	1.3	Dark Field Microscope	2L
	1.4	Phase Contrast Microscope	2L
	1.5	Introduction to dyes and stains: 1.5.1 Types, 1.5.2 Physicochemical basis of staining 1.5.3 Fixatives, Mordants, Decolorizer	5L
Module 2		Control of microorganisms	15L
	2.1	Definition of frequently used terms & Rate of microbial death, Factors affecting the effectiveness of antimicrobial agents & Properties of an ideal disinfectants	3L
	2.2	Physical methods of microbial control using heat Instruments: Mechanisms and their operations 2.2.1 Autoclave 2.2.2 Hot air oven 2.2.3 Inspissator 2.2.4 Fractional sterilization	3L
	2.3	Physical methods of microbial control using Electromagnetic radiations :Mechanisms and their operations 2.3.1 Gamma rays 2.3.2 X rays	1L
	2.4	Physical methods of microbial control using Filtration : Mechanisms and their operations 2.4.1 Membrane filters 2.4.2 HEPA filters	1L
	2.5	Chemical methods of microbial control 2.5.1 Halogens 2.5.2 Quaternary ammonium compounds	7L

	2.5.3 Aldehydes 2.5.4 Peroxygens 2.5.5 Sterilizing gasses 2.5.6 Surfaces active agents/Detergents	
Reference books		
1.	Prescott Harley Klein-Microbiology, 7th edition, International edition, McGraw Hill	
2.	Michael T. Madigan & J. M. Martinnko, D. Stahl, D. Clark Brock Biology of Microorganisms 13 th ed.International Edition 2012, Pearson Prentice Hall	
3.	Michael J.Pelczar Jr., E.C.S. Chan, Noel R. Krieg Microbiology TMH 5th Edition	

Course code	SEMESTER I		
	<p align="center">Major Course III (Practical in Microbiology)</p> <p align="center">Practical Techniques: Staining and Control of microorganisms</p>		<p align="center">2 Credits (60 L/hr)</p>
1.	Basic steps of staining a. Preparation of suspension b. Preparation of a smear c. Staining		
2.	Simple staining techniques a. Positive (Monochrome) staining b. Negative staining		
3.	Differential staining techniques: Gram Staining		
4.	Efficiency of sterilization using autoclave (Chemical/Biological indicators)		
5.	Effect of desiccation		
6.	Effect of Ultraviolet radiation		
7.	Effect of Alcohols		
8.	Effect of Heavy metals		
9.	Effect of antibiotics		
10.	Effect of dyes		

**VOCATIONAL SKILL COURSE (VSC)
SEM I**

Sr.No.	Heading	Particulars
1	Description of the course : Including but Not limited to:	<p>A learner of Microbiology must have additional skill sets with respect to designing of media, inoculation techniques and knowledge of analytical methods. These are required in food and water testing laboratories where quality of both have to be maintained for the betterment of humankind. The Microbiology learner with their skills can complement chemical testing of food and water.</p> <p>On gaining these skills the learner will be able to acquire a job as a microbiologist in laboratories dealing with isolation and cultivation of microorganisms from pathological samples, natural samples such as soil ,water etc. Additionally they can have job opportunities in government and private laboratories. Besides, the learning of these courses can help them to carry out experiments related to R and D in these areas. Small and large scale industries such as Media manufacturing industries, QC-QA labs, Pharmaceuticals, Food manufacturing and processing, Environmental testing laboratories, culture collection centers can offer jobs to these learners.</p> <p>Microbiologists will be support to public health authorities in management of public health</p>
2	Vertical :	Vocational Skill course
3	Type :	Practical
4	Credits :	2 credits (1 credit = 30 Hours of Practical work in a semester)
5	Hours Allotted :	60 Hours
6	Marks Allotted:	50 Marks
7		<p>CO1. To understand basic principles of nutrition and cultivation of microorganisms</p> <p>CO2. To demonstrate various inoculation techniques for characterization and preservation of microorganisms.</p> <p>CO3. To explain the role played by microbes in food spoilage with emphasis on food hygiene and sanitation</p> <p>CO4. To explain significance of food and water microbiology for public health awareness</p>
8		<p>On completion of this course learner will be able to:</p> <p>OC1. Identify different microorganisms on the basis of their growth characteristics.</p> <p>OC2. Utilize preservation methods for storage of microorganisms</p> <p>OC3. Apply principles of food preservation for maintenance of food quality.</p> <p>OC4. Evaluate different types of microbial food spoilage.</p> <p>OC5. Prepare a range of culture media for cultivation of different microorganisms</p> <p>OC6. Design an experiment for microbiological analysis of water and food</p>
9	Modules:-	

Semester	Course	Description	Credits
I	Vocational skill course VSC (Practical Based)	Nutrition , Cultivation and Preservation of microorganisms	02

Course Code	SEMESTER I	Credits
	Vocational Skill Course (VSC) Practical based	2 credits (60 L/hr)
	Techniques in Nutrition, Cultivation and Preservation of Microorganisms	
1.	Basics of macro, micro and trace elements along with laboratory ingredients satisfying these needs to be covered Explain Components of culture media - peptone, meat extract, yeast extract, salts, agar, growth factors, agar, etc Preparation of Culture Media: a. Liquid media (Nutrient broth, Sabouraud's broth) b. Solid Media (Nutrient agar, Sabouraud's agar)	
2.	Preparation of slant, butts and plates	
3.	Inoculation techniques and Study of Growth: Inoculation of Liquid Medium Inoculation of Solid Media (Slants, Butts and Plates)	
4.	Nutritional types of microorganisms Principle and application of types of media i. General purpose media (Nutrient agar- <i>Escherichia coli</i> , <i>Bacillus subtilis</i> , one pigment producer) ii. Differential and (MacConkey's agar, Salt mannitol agar,) iii. Selective (Cetrimide agar) iv. Enrichment media (Ashby's mannitol agar, Mc Beth's medium) v. Enriched (Superimposed blood agar, Milk agar) vi. Synthetic and complex media (M9, Chu no 10) vii. Anaerobic media (Fluid Thioglycollate medium, Differential Reinforced Clostridial medium)	
5.	Study of Colony Characteristics of Bacteria	
6.	Concepts and techniques of Preservation of cultures i. Periodic transfer ii. Soil stock	

- iii. Glycerol stock
- iv. Paraffin oil overlaying
- iv. Lyophilization, storage in liquid nitrogen (Virtual labs)
- v. Culture collections (tabulation)

References

1.	Prescott, Hurley, Klein Microbiology, 10 th edition, International edition, McGraw Hill.
2.	Tortora, Funke & Case Microbiology, an Introduction 9 th and 11 th edition, Pearson education
3.	Michael J. Pelczar Jr., E.C.S. Chan, Noel R. Krieg Microbiology TMH 5 th Edition
4.	Varghese N., Joy P. P. Microbiology Laboratory Manual, (2014) 1 st ed, Aromatic and Medicinal Plants Research Station, Ernakulam, Kerala, India

**SKILL ENHANCEMENT COURSE (SEC)
SEM I**

Sr.No.	Heading	Particulars
1	Description of the course : Including but Not limited to:	A learner of Microbiology must have additional skill sets to understand the importance of microorganisms and their products in human welfare . The course will familiarize the students with the beneficial role of microbes to enhance soil fertility, improve human health with an introduction to probiotics and the applications of enzymes in day to day life and fermented foods. The course will further emphasize an understanding of positive and negative interactions of microorganisms with humans, in terms of studying normal flora as well as disease causing organisms . The role of fomites and aerosols in infections and their control will be studied. An understanding of virulence factors and related diseases is introduced. The course will include practical application of various media commonly used in clinical laboratories.
2	Vertical :	Skill Enhancement course
3	Type :	Practical
4	Credits :	2 credits (1 credit = 30 Hours of Practical work in a semester)
5	Hours Allotted :	60 Hours
6	Marks Allotted:	50 Marks
7		CO1.To familiarize learners with antibiotic producers and the method of isolating them from soil. CO2 .To explain the concept of improvement of soil fertility by microbes. CO3.To enable learners to understand the use of microbes in fermented foods ,probiotic foods and enzymes in human welfare CO4 To differentiate between beneficial and harmful microorganisms associated with humans CO5. To emphasize the role of fomites and aerosols in the spread of infections. CO6. To evaluate pathogens based on growth characteristics and virulence factors
8		On completion of this course learner will be able to: OC1. Enlist the microbes from various sources which are useful and harmful to mankind in different ways OC2. Understand the benefits of microbes from soil, fermented foods, commercial probiotic products and enzymes obtained from them. OC3. Perform experiments to isolate and detect beneficial and pathogenic microbes from various samples. OC4. Analyze the benefits of soil microbes as biofertilizers. antibiotic producers , enzyme producers as well as food microbes beneficial for human health. OC5. Design experiments to study growth patterns and detect virulence factors of selected pathogens.
9	Modules:-	

Skill Enhancement course (SEC)

Semester	Course	Description	Credits
I	Skill Enhancement course SEC (Practical Based)	Microbes in Human Welfare	02

Course Code	SEMESTER I	Credits
	Skill Enhancement Course (SEC) Practical based	2 credits (60 L/hr)
	Microbes in Human Welfare	
1.	Overview of Soil microbes and their products in human welfare a. Screening for Antibiotic producers by crowded plate technique b. Confirmation of Antibiotic producers by Wilkins overlay technique c. Isolation of <i>Rhizobium</i> d. Isolation of Phosphate solubilizers e. Enrichment and Isolation of <i>Azotobacter</i> f. Isolation of Potassium solubilizers	
2.	Overview of Study of lactics from traditional and modern foods a. Isolation of Lactic acid bacteria b. Characterisation of lactic acid bacteria. c. Study of Indian fermented foods - Idli batter/Pickles . d. Isolation of probiotic bacteria from different commercial products e. Preparation of curd and its study.	
3.	Overview of Microbial enzymes and their applications a. Isolation and detection of lipase producers b. Isolation and detection of Protease producers c. Isolation and detection of Amylases producers d. Application of the enzymes in textile/ detergents/ tanning	
4.	Overview of Beverages and Fermented Foods a. Leavening of Bread dough b. Production of Alcohol from jaggery c. Production of wine	
References		
1.	Soil Microbiology by Subbarao N.S. , 3rd Ed.	
2.	A Handbook of Elementary Microbiology, 2014 by H.A. Modi.	
3.	Michael J. Pelczar Jr., E.C.S. Chan, Noel R. Krieg Microbiology TMH 5 th Edition	
4.	Practical Microbiology by Maheshwari D.K. (Author), 2010	

Sem. - II

Syllabus

B.Sc. (Microbiology)

(Sem.- II)

Course code		SEMESTER II	Credits
		Major Course I Eukaryotes: Cell structure and Microbial Diversity	Credits 2 (30L/hr)
Module 1	1.	Eukaryotes: Cell structure	15L
	1.1	Overview of Eukaryotic cell structure	2L
	1.2	The plasma membrane	2L
	1.3	Cytoplasmic matrix, microfilaments, intermediate filaments, and microtubules	2L
	1.4	Organelles of biosynthetic -secretory and endocytic pathways – Endoplasmic reticulum & Golgi apparatus. Definitions of Lysosome, Endocytosis, Phagocytosis, Autophagy, Proteasome	3L
	1.5	Eukaryotic ribosomes	1L
	1.6	Mitochondria	1L
	1.7	Chloroplasts	1L
	1.8	Nucleus	1L
	1.9	External Cell appendages: Cilia and Flagella	2L
Module 2		Eukaryotes: Microbial Diversity	15L
	2.	Protozoa	5L
	2.1	2.1.1 Major Categories of Protozoa based on motility, reproduction. Class, 2.1.2 General characteristics and examples (Tabulation)	
	2.2	Medically important Protozoa - Life cycle of <i>Entamoeba histolytica</i> (Schematic representation)	
	3	Algae	4L
	3.1	Characteristics of major group of algae: Morphology, Pigments, Reproduction (Tabulation)	
	3.2	Biological, Medical and Economic importance of Algae	

	3.3	Differences between Algae and Cyanobacteria	
	4	Fungi and Yeast	5L
	4.1	Characteristics: Structure, Reproduction	
	4.2	Major fungal divisions- Overview (Tabulation)	
	4.3	Life cycle of yeast (Schematic representation) Medical and Economic importance	
	5.	Slime molds and Myxomycetes	1L
References			
1.	Lansing M. Prescott, Harley and Klein, Microbiology (2005),6th Edition. McGraw Hill Higher Education, New York.		
2.	Michael J.Pelczar Jr., E.C.S. Chan ,Noel R , Microbiology TMH 5th Edition.		
3.	Michael T. Madigan & J.M. Martin, Brock's Biology of Microorganisms 13th Ed. International edition 2012, Pearson Prentice Hall.		
4.	Willey, Sherwood and Woolverton, Prescott's Microbiology, 8th edition, 2011, International edition, McGraw Hill		
5.	Kathleen Park Talaro & Arthur Talaro - Foundations in Microbiology International edition 2002, McGraw Hill		

Course code		SEMESTER II	Credits
		Major Course II Prokaryotes: Ultrastructure of cell and Diversity of Microorganisms	Credits 2 (30 L/hr)
Module 1	1.	Bacterial cell structure	15L
	1.1	Morphology of Prokaryotic cells: Size, Shape and Arrangement	1L
	1.2	Plasma Membrane: The Fluid Mosaic model, Functions	1L
	1.3	Cytoplasm – Ribosomes, Magnetosomes, gas vesicles, PHB granules, Metachromatic granules.	2L
	1.4	Bacterial genome - Nucleoid, Plasmids	1L
	1.5	Cell wall structure: Peptidoglycan Structure, Gram- Positive and Gram-Negative Cell Walls, Lipopolysaccharide layer, Functions of the cell wall	4L
	1.6	Components external to cell wall- capsule, slime layer, flagella, fimbriae and pili	3L
	1.7	Bacterial endospores – structure and significance, stages in endospore formation	2L
	1.8	Comparison of Prokaryotic and Eukaryotic Cells	1L
Module 2	2.	Diversity of Prokaryotic Microorganisms	15L
	2.1	General features and medical significance of <i>Rickettsia</i> , <i>Coxiella</i> , <i>Chlamydia</i> , <i>Mycoplasma</i>	4L
	2.2	2.2.1 Ecological, Commercial and Medical importance of <i>Actinomycetes</i> 2.2.2 General features of <i>Nocardia</i> and <i>Streptomyces</i>	3L
	2.3	Introduction- to the Major Archaeal physiological groups and their Ecological importance	2L
	2.4	Viruses: 2.4.1 General properties of Viruses 2.4.2 Structure of viruses-capsids, envelopes, genomes 2.4.3 Medical significance 2.4.4 Cultivation of viruses- overview	6L
References			
1.	Lansing M. Prescott, Harley and Klein, Microbiology (2005),6th Edition. McGraw Hill Higher Education, New York.		

2.	Michael J.Pelczar Jr., E.C.S. Chan ,Noel R , Microbiology TMH 5th Edition.
3.	Michael T. Madigan & J.M. Martin, Brock's Biology of Microorganisms 13th Ed. International edition 2012, Pearson Prentice Hall.
4.	Willey, Sherwood and Woolverton, Prescott's Microbiology, 8th edition, 2011, International edition, McGraw Hill
5.	Kathleen Park Talaro & Arthur Talaro - Foundations in Microbiology International edition 2002, McGraw Hill

Course Code	SEMESTER II	Credits
	Major Course III (Practical in Microbiology II)	2 credits (60 L/hr)
	Practical study of groups of organisms: Eukaryotes and Prokaryotes	
1.	Staining of Nucleus – Giemsa's Method	
2.	Isolation of yeast on Sabouraud's agar	
3.	Cultivation of fungi on a) Sabouraud's agar b) Potato dextrose agar	
4.	Slide Culture technique a) Actinomycetes b) Fungal Culture (Penicillium/Aspergillus, Mucor/Rhizopus)	
5.	Fungal Wet mounts & Study of morphological characteristics : <i>Mucor,Rhizopus,Aspergillus,Penicillium</i>	
6.	Cultivation of Algae Permanent slides of algae and protozoa	
7.	Spot assay and plaque assay of Bacteriophage (Demonstration)	
8.	Special staining: a) Cell wall b) Capsule c) Endospore d) Flagella(demonstration) e) Lipid f) Metachromatic granules g) Spirochaetes(demonstration)	
9.	Measurement of bacterial cell size- Micrometry	

**VOCATIONAL SKILL COURSE (VSC)
SEM II**

Semester	Course	Description	Credits
II	Vocational skill course VSC (Practical Based)	Techniques in Analysis of food and water	02

Course Code	SEMESTER II	Credits
	VOCATIONAL SKILL COURSE (PRACTICAL BASED)	2 credits (60 L/hr)
	Techniques in Food and Water Analysis	
	Food analysis	
1.	Physical and microscopic observation of spoilt Fruit and Vegetable, canned foods	
2.	Isolation of Pectinolytic organism from spoilt fruit	
3.	Isolation of saccharolytic organisms from spoilt foods	
4.	Isolation of thermophilic organisms from pasteurized milk	
5.	Isolation of psychrophiles from ice creams	
6.	Determination of TDT and TDP for gram positive and gram negative food pathogens	
7.	MIC of Salt and sugar	
8.	MIC of preservatives (Sodium benzoate)	
	Water analysis	
9.	Standard Plate Count of potable water	

10.	Indicator organisms and their detection in water a. <i>Escherichia coli</i> MPN b. Fecal <i>Streptococci</i> (Membrane filtration Slanetz and Bartley) c. <i>Clostridium perfringens</i> using DRCM
11.	Detection of Coliforms in water: Presumptive Test, Confirmed Test, and completed Test
12.	Rapid Detection of <i>E.coli</i> by MUG Technique (Demonstration)

REFERENCES

1.	Frazier 5th ed Food Microbiology
2.	James Jay 6th ed Modern Food Microbiology
3.	Bibek Ray, Arun Bhunia (2007), 4th edition CRC Press Fundamental Food Microbiology
4.	Montville and Mathews (2008) Food Microbiology – An Introduction, ASM Press
5.	Food Science by Sumati R. Mudambi, Shalini Rao, M.V. Rajagopal, revised 2nd edition, (2006), New Age international publications
6.	Prescott's Microbiology, 8 th Edition; Joanne M. Willey, Linda M. Sherwood, Christopher J. Woolverton, 2011, Mc Graw Hill International Edition
7.	Waites and Morgan Industrial Microbiology Blackwell Science
8.	Frobisher, Hinsdill, Crabtree, Goodheart Fundamentals of Microbiology, 9 th Edition, 1974, Saunders College Publishing

Skill Enhancement course (SEC)

Semester	Course	Description	Credits
I	Skill Enhancement course SEC (Practical Based)	Human - Microbe interactions	02

Course Code	SEMESTER II	Credits
	Skill Enhancement Course (SEC) Practical based	2 credits (60 L/hr)
	Human - Microbe interactions	
1.	Overview of Normal flora of the human body : Skin, Nose & Nasopharynx, Oropharynx, Respiratory tract, Eye, External ear, Mouth, Stomach, Small intestine, Large intestine, Genitourinary tract Study of normal flora a) Skin- Gram staining, isolation on NA, SIBA b) Oral cavity - Gram staining, isolation on NA, SIBA, Sabouraud's agar	
2.	Common terminologies : Fomite, aerosols, droplet nuclei a) Cough plate technique Study of Fomites b) Table top c) Door handles d) Cell phones/Ear pods/Earphones e) Hand bags	
3.	Effect of sanitation of the microbial flora Fingerprints on NA plate- before and after sanitization	
4.	Overview of Microbial virulence factors and common terms Study of virulence factors a) Haemolysin b) Coagulase c) Lecithinase	
4.	Overview of common microbial diseases like Typhoid/ Gastroenteritis /Malaria / skin infections/Influenza Use of Enrichment / Selective / Differential media for pathogens a) Enrichment media - Tetrathionate / Selenite F b) Differential - SS/ XLD c) Selective - Baird Parker/Salt Mannitol agar d) Transport media - Cary and Blair Medium / Stuart's medium	

References

1.	Practical medical microbiology by Mackie and McCartney , 1996, 14th edi.
2.	Tortora, Funke & Case Microbiology, an Introduction 9 th and 11 th edition, Pearson education
3.	Michael J. Pelczar Jr., E.C.S. Chan, Noel R. Krieg Microbiology TMH 5 th Edition

Guidelines for examination and evaluation (External and Internal)

Evaluation Pattern for Major Courses

MAJOR:6 credits

Theory/Practical	Credits	No. of Hours	Marks
Theory: Paper 1	2	30	50
Theory: Paper 2	2	30	50
Practical	2	60	50

Theory courses

Internal Continuous Assessment: 40% (20 Marks)	Semester End Examination: 60% (30 Marks)	Duration for End semester examination
Continuous Evaluation through: Quizzes, Class Tests, presentation, project, role play, creative writing, assignment etc.	As per paper pattern*	1hour

*Paper Pattern for 30 marks :

30 Marks per paper Semester End Theory Examination:

Duration - These examinations shall be of one hour duration

Question	Option	Marks	Questions Based on
Q1.	Attempt any two out of three questions (5 marks each)	10	Module 1
Q2.	Attempt any two out of three questions (5 marks each)	10	Module 2
Q3.	Attempt any two out of three questions (5 marks each) OR Attempt any five out of eight questions (2 marks each)	10	Module 1,2
	Total	30	

Practical courses

Internal Continuous Assessment: 40% (20 Marks)	Semester End Examination: 60% (30 Marks)	Duration for End semester examination
Minor experiment /Viva/ Assignment/ objective question test (15 Marks), Overall performance (5 Marks) = 20 Marks	Experiments (15 marks Major + 5 marks Viva/Spots + 5 marks Quiz and 5 Marks for Journal = 30 Marks)	2 hours each day (2days)

Evaluation Pattern for Vocational Skill Course

Practical course of 2 credits, Duration: 60 h, Total marks: 50

Internal Continuous Assessment: 40% (20 Marks)	Semester End Examination: 60% (30 Marks)
Minor experiment /Viva/ Assignment/ objective question test (15 Marks), Overall performance (5 Marks) = 20 Marks	Experiments (15 marks + 10 marks and 5 Marks for Journal = 30 Marks)

Evaluation Pattern for Skill Enhancement Course

Practical course of 2 credits, Duration: 60 h, Total marks: 50

Internal Continuous Assessment: 40% (20 Marks)	Semester End Examination: 60% (30 Marks)
Minor experiment /Viva/ Assignment/ objective question test (15 Marks), Overall performance (5 Marks) = 20 Marks	Experiments (15 marks + 10 marks and 5 Marks for Journal = 30 Marks)

Letter Grades and Grade Points:

Semester GPA/ Programme CGPA Semester/ Programme	% of Marks	Alpha-Sign/ Letter Grade Result	Grading Point
9.00 - 10.00	90.0 - 100	O (Outstanding)	10
8.00 - < 9.00	80.0 - < 90.0	A+ (Excellent)	9
7.00 - < 8.00	70.0 - < 80.0	A (Very Good)	8
6.00 - < 7.00	60.0 - < 70.0	B+ (Good)	7
5.50 - < 6.00	55.0 - < 60.0	B (Above Average)	6
5.00 - < 5.50	50.0 - < 55.0	C (Average)	5
4.00 - < 5.00	40.0 - < 50.0	P (Pass)	4
Below 4.00	Below 40.0	F (Fail)	0
Ab (Absent)	-	Ab (Absent)	0

This syllabus is applicable to IDOL students as well, w.e.f. 2025-26

Signatures of Team Members

Name	College Name	Sign
<p>Dr. Aparna Dubhashi (Coordinator)</p>	<p>Associate Professor, Department of Microbiology, Guru Nanak Khalsa College (Autonomous), Nathalal Parekh Marg, Matunga, Mumbai 400019 Email: aparna.dubhashi@gnkhalsa.edu.in Contact no: 9820658260</p>	
<p>Dr. Radhika Birmole</p>	<p>Associate Professor, Department of Microbiology, Wilson college (Autonomous), Sea face road, Chowpatty, Mumbai 400007 Email: radhika.birmole@wilsoncollege.edu Contact no: 9372187273</p>	
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Appendix B

Justification for B.Sc. (Microbiology)

1.	Necessity for starting the course:	The necessity for starting the Certificate, Diploma and Undergraduate degree program in B.Sc. (Microbiology) lies in its significance as a fundamental , interdisciplinary, skill and research based , science. Due to its multidisciplinary scope in research related to medical, industrial, environmental, etc. the course prepares the learners for higher education, job opportunities and active participation in addressing national and global challenges
2.	Whether the UGC has recommended the course:	Yes
3.	Whether all the courses have commenced from the academic year 2023-24	The course has commenced in the university , but restructured under NEP 2020 in the academic year 2024-25 .
4.	The courses started by the University are self-financed, whether adequate number of eligible permanent faculties are available?:	This course is aided / self-financed based on the sanction given by University of Mumbai to affiliated colleges from time to time.
5.	To give details regarding the duration of the Course and is it possible to compress the course?:	The duration of the program is three years (6 semesters). It is not possible to compress the course.
6.	The intake capacity of each course and no. of admissions given in the current academic year:	The intake capacity is variable from college to college based on sanctions received from the University.
7.	Opportunities of Employability / Employment available after undertaking these courses:	B.Sc. (Microbiology) graduates can apply their professional skills in various sectors: Diagnostics, Pharmaceuticals, Food, Environment management, Agriculture, Astrobiology, etc. making them key players in the lives of humans and society at large. They have diversified opportunities of jobs in both government and private sectors in India as well as globally. They can contribute immensely to nation building.

**Sign of the Offg. Dean
Prof. Shivram S. Garje
Faculty of Science &
Technology**

**Sign of the
Offg. Associate Dean
Dr. Madhav R. Rajwade
Faculty of Science &
Technology**

**Sign of the Offg. Dean
Prof. Shivram S. Garje
Faculty of Science &
Technology**