

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 (Scheme III)

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 OR Passed Equivalent Academic Level 4.0
	O: _____B	B	Under Graduate Certificate in Microbiology Academic Level 4.5 OR Passed Equivalent Academic Level 4.5
	O: _____C	C	Under Graduate Diploma in Microbiology Academic Level 5.0 OR Passed Equivalent Academic Level 5.0
	O: _____D	D	Bachelors of Microbiology with minimum CGPA of 7.5 Academic Level 5.5 OR Passed Equivalent Academic Level 5.5

	O: _____E	E	Bachelors of Microbiology with minimum CGPA of 7.5 Academic Level 5.5 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 Sem. II - R: _____B	Attached herewith	
	Credit Structure Sem. III - R: _____C Sem. IV - R: _____D		
	Credit Structure Sem. V - R: _____E Sem. VI - R: _____F		
		A	Sem I & II

8	Semesters	B	Sem III & IV
		C	Sem V & VI
		D	Sem VII & VIII
		E	Sem VII & VIII
9	Program Academic Level	A	4.5
		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 BoS
Coordinator
Dr. Aparna Dubhashi
BoS in Microbiology**

**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.

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

2) **Under Graduate Certificate in Microbiology**

Credit Structure (Sem. I & II)

	R:_____A									
Level	Semest er	Major		Min or	OE	VSC, SEC (VSEC)	AEC , VEC , IKS	OJT, FP, CEP , CC, RP	Cum. Cr. / Sem.	Degr ee/ Cum. Cr.
		Mandatory	Ele ctiv es							
4.5	I	4 <u>Course I</u> Fundamentals of Microbiology	-	-	2 Micr obes at work	VSC:2 (Practi cal based)	AEC: 2, VEC: 2, IKS: 2	CC:2	22	UG Certif icate 44
		<u>Course II</u> Practical in Microbiology I Practical techniques: Staining and Control of Microorganisms				Techni ques in Nutriti on , Cultiv ation and Preser vation of Micro organi sms SEC:2 (Practi cal based) Micro bes in Huma n welfar e				
	R:_____B									

	II	4 <u>Course I</u> Ultrastructure of the Cell : Eucaryotes and Procaryotes <u>Course II</u> Practical in Microbiology II Practical study of groups of organisms: Eukaryotes and Prokaryotes	-	2 Intro duction to Micro bial World	2 Mi cro bes in foo d	VSC:2 , (Practi cal based) Techni ques in Food and Water Analy sis SEC:2 (Practi cal based) Huma n Micro be interac tions	AEC: 2, VEC: 2	CC:2	22	
	Cum Cr.	8	-	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 <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	--	4	2	VSC:2 (Practical based) Basic Bioanalytical techniques	AEC:2	FP: 2 CC:2	22	UG Diploma 88

	R:_____D									
	IV	8 <u>Course I</u> Introducti on to Microbial metabolis m <u>Course II</u> Introducti on to Immunolo gy <u>Course III</u> Introducti on to Microbial Genetics <u>Course IV</u> Practical in Microbiol ogy IV		4	2	SEC:2 (Practi cal based) Enviro nment al micro biolog y	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			Medical lab technology : Basic techniques				
	R:_____F									

VI	10 <u>Course I</u> Introduction to Virology <u>Course II</u> Advances in Immunology <u>Course III</u> Biochemistry: Biosynthesis of Carbohydrates, lipids and amino acids and Inorganic metabolism <u>Course IV</u> Practical in Microbiology VII <u>Course V</u> Practical in Microbiology 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
MAJOR COURSE

Syllabus

B.Sc. (Microbiology)

(Sem.- I)

Sr.No.	Heading	Particulars
1	Description the course: Including but Not limited to:	The omnipresence of microorganisms makes the study of microbiology very important for society as a whole. The course aims to introduce the subject and narrate its history. The course emphasizes on the physical and chemical methods for control of microorganisms. The learners will get an overview of the eucaryotic and procaryotic cell structure. 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.
2	Vertical :	Major
3	Type :	Theory and Practical
4	Credits :	4 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:	100 Marks
7	CO1. To understand history, developments and scope of Microbiology CO2. To gain knowledge about mechanism of basic microscopy CO3.To apply basic principles and techniques of staining for observing microorganisms and their structures CO4. To demonstrate the knowledge of physical and chemical methods for control of microorganisms. CO5. To give an overview of a cell (prokaryote and eukaryote) with details of the structures and functions of cell organelles. CO6. To discuss the characteristics, types, morphology and significance of various groups of eukaryotic and prokaryotic microbes. CO7. To acquire skills for basic microbiological techniques.	
8	On completion of this course learner will be able to: OC1 recall the advent of Microbiology as a science OC2.comprehend science of microorganisms and their significance. OC3. apply the principles of control of microorganisms OC4. compare different types of control methods for their suitable application, different types of eucaryotic and procaryotic cells. OC5. evaluate the various sterilization and disinfection methods OC6. Develop application-based study of microorganisms.	
9	Modules:-	

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

Semester	Paper	Module	Description	Credits
II	Course I Ultrastructure of the cell : Eukaryotes and Prokaryotes	1.	Eukaryotic cell structure	02
		2.	Bacterial cell structure	
	Major Course II 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 and History of Microbiology	15 L
1.1	The Science of Microbiology	2L
1.2	Microbial Cells	2L
1.3	The Impact of Microorganisms on Humans	2L
1.4	The Historical Roots of Microbiology: Hooke, van Leeuwenhoek, and Cohn	3L
1.5	Pasteur and the Defeat of Spontaneous Generation	2L
1.6	Koch, Infectious Disease, and Pure Culture Microbiology	2L
1.7	Contributions of other scientists to the field of Microbiology	2L
Module 2	Basic techniques in Microbiology	15L
2.1	Study of Bright field Microscopy (Compound light microscope) 2.1.1 Principles of Microscopy 2.1.2 Optical spectrum, Lenses and mirrors 2.1.3 Parts of a microscope	4L

2.2	Introduction to dyes and stains: 2.2.1 Types, 2.2.2 Physicochemical basis of staining 2.2.3 Fixatives, Mordants, Decolorizer	4L
2.3	Physical methods of microbial control using heat Instruments: Mechanisms and their operations 2.3.1 Autoclave 2.3.2 Hot air oven 2.3.3 Inspissator 2.3.4 Fractional sterilization	3L
2.4	Chemical methods of microbial control 2.4.1 Halogens 2.4.2 Quaternary ammonium compounds 2.4.3 Sterilizing gasses 2.4.4 Surfaces active agents/Detergents	4L
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	
3.	Michael J. Pelczar Jr., E.C.S. Chan, Noel R. Krieg Microbiology TMH 5th Edition	

Course code	SEMESTER I	
	Major Course II (Microbiology Practical I) Practical Techniques: Staining and Control of microorganisms	2 Credits (60 L/hr)
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	

Sem. - II
MAJOR COURSE

Syllabus

B.Sc. (Microbiology)

(Sem.- II)

Course code		SEMESTER II	Credits
		Major Course I Ultrastructure of the cell :Eukaryotes and Prokaryotes	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		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,	3L

		fimbriae and pili	
	1.7	Bacterial endospores – structure and significance, stages in endospore formation	2L
	1.8	Comparison of Prokaryotic and Eukaryotic Cells	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 (Microbiology Practical 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 I and II

Sr.No.	Heading	Particulars
1	Description of the course: Including but Not limited to:	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. 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. Microbiologists will be support to public health authorities in management of public health
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	CO1. To understand basic principles of nutrition and cultivation of microorganisms CO2. To demonstrate various inoculation techniques for characterization and preservation of microorganisms. CO3. To explain the role played by microbes in food spoilage with emphasis on food hygiene and sanitation CO4. To explain significance of food and water microbiology for public health awareness	
8	On completion of this course learner will be able to: OC1. Identify different microorganisms on the basis of their growth characteristics. OC2. Utilize preservation methods for storage of microorganisms OC3. Apply principles of food preservation for maintenance of food quality. OC4. Evaluate different types of microbial food spoilage. OC5. Prepare a range of culture media for cultivation of different microorganisms OC6. Design an experiment for microbiological analysis of water and food	
9	Modules: -	

Semester	Course	Description	Credits
I	Vocational skill course VSC (Practical Based)	Nutrition , Cultivation and Preservation of microorganisms	02
Semester	Course	Description	Credits
II	Vocational skill course VSC (Practical Based)	Techniques in Analysis of food and water	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

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 Streptococci (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 5 th edition Food Microbiology
2.	James Jay 6 th edition Modern Food Microbiology
3.	Bibek Ray, Arun Bhunia (2007), 4 th 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 2 nd 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)

SEM I and II

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

Semester	Course	Description	Credits
II	Skill Enhancement course SEC (Practical Based)	Human - Microbe interactions	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 Rhizobium d. Isolation of Phosphate solubilizers e. Enrichment and Isolation of Azotobacter f. Isolation of Potassium solubilizers	
2.	Overview of Study of lactic acid bacteria from traditional and modern foods a. Isolation of Lactic acid bacteria b. Characterization 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

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, 14 th edition.
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:4 credits

Theory/Practical	Credits	No. of Hours	Marks
Theory Paper	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 *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
Q1A	Attempt any two out of four (5 marks each)	10	Based on Module 1
Q1B	Attempt any five out of ten objective questions (1 marks each)	5	Based on Module 1
Q2A	Attempt any two out of four (5 marks each)	10	Based on Module 2
Q2B	Attempt any five out of ten objective questions (1 marks each)	5	Based on Module 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

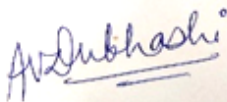
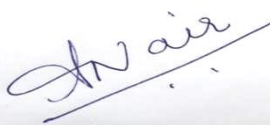
Internal Continuous Assessment: 40% (20 Marks)	Semester End Examination: 60% (30 Marks)
Minor experiment /Viva/ Assignment/ objective question test (15 Marks), Overall performance (5 Marks) = 20 Marks	Experiments (15 marks + 10 marks and 5 Marks for Journal = 30 Marks)

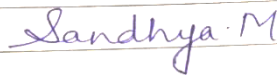
Letter Grades and Grade Points:

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
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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	B.Sc. (Microbiology) graduates can apply their professional skills in various sectors: Diagnostics,

	undertaking these courses:	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.
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**Sign of the BoS
Coordinator
Dr. Aparna Dubhashi
BoS in Microbiology**

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

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