Academic Council Meeting No. and Date: 10 / 26 April, 2025

Agenda Number: 3 **Resolution Number: 46, 47 / 3.4, 3.9**

Vidya Prasarak Mandal's
B. N. Bandodkar College of Science (Autonomous), Thane

Syllabus for

Programme: Bachelor of Science

Specific Programme: Microbiology
[T.Y.B.Sc. Microbiology]

Level 5.5

CHOICE BASED GRADING SYSTEM

Revised under NEP

From academic year 2025 - 2026

Preamble

The Third Year B.Sc. Microbiology programme at Vidya Prasarak Mandal's B.N. Bandodkar College of Science (Autonomous), Thane, is designed in alignment with the Choice-Based Grading System (CBGS) and revised under the National Education Policy (NEP) 2020. The programme aims to provide a comprehensive understanding of microbiology with a focus on theoretical concepts, practical skills, and their applications in various domains including health, environment, industry and research.

This one-year programme (comprising Semester V and Semester VI) builds upon the foundation laid during the first two years of study. It integrates core areas such as genetics, immunology, biochemistry, molecular biology and medical microbiology, along with elective and skill enhancement courses like fermentation technology, sustainable development, tissue culture, dairy technology and chemotherapy. The curriculum emphasizes experiential learning through laboratory work, field projects, internships, and hands-on skill-building modules. As a part of interdisciplinary learning, two theoretical units of chemistry subject are also offered at semester V as minor.

The programme equips students with:

- The ability to understand and apply microbiological principles in diverse sectors.
- Practical expertise in laboratory techniques and analytical methods relevant to microbiology.
- Skills necessary for contributing to community welfare, sustainable development, and scientific advancement.

This syllabus is implemented from the academic year 2025–26, with a total of 132 credits required for graduation, ensuring a balanced blend of discipline-specific knowledge, interdisciplinary learning, vocational training and research exposure.

Prof. Dr. Kalpita Mulye
HOD, Microbiology
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PROGRAMME OUTCOMES (POs) OF BACHELOR OF SCIENCE (B.Sc.)

The Undergraduate Programmes of Science are intended to cater quality education and attain holistic development of learners through the following programme outcomes:

PO1 - Disciplinary Knowledge
Lay a strong foundation of conceptual learning in science. Instil ability to apply science in professional, social and personal life.

PO2 - Inculcation of Research Aptitude
Ignite spirit of inquiry, critical thinking, analytical skills and problem-solving approach which will help learners to grasp concepts related to research methodology and execute budding research ideas.

PO3 - Digital Literacy
Enhance ability to access, select and use a variety of relevant information e-resources for curricular, co-curricular and extracurricular learning processes.

PO4 - Sensitization towards Environment
Build a cohesive bond with nature by respecting natural resources, encouraging eco-friendly practices and creating awareness about sustainable development.

PO5 - Individuality and Teamwork
Encourage learners to work independently or in collaboration for achieving effective results through practical experiments, project work and research activities.

PO6 - Social and Ethical Awareness
Foster ethical principles which will help in developing rational thinking and becoming sociallyawarecitizens. Build an attitude of unbiased, truthful actions and avoid unethical behaviour in all aspects of life.

Eligibility: Learnt S. Y. B.Sc. in Microbiology
Degree Programme: B.Sc. Duration: 1 Year (includes SEM V and SEM VI)
Level: 5.5
Duration: 3 years (Syllabus for Third Year semester V & VI)
Mode of Conduct: Offline Laboratory Practicals / Offline lectures / Online lectures
Discipline/Subject: Microbiology
Specific Programme: B.Sc. Microbiology
Qualification Title: UG certificate

Discipline/Subject: **MICROBIOLOGY**

Program Specific Outcomes

1	Recall and define fundamental concepts related to microorganisms, including their diversity, structure, physiology, genetics, and ecological interactions.	L1
2	Explain the principles underlying microbiological, biochemical, immunological, and molecular biology techniques used in laboratory investigations, with emphasis on biosafety and scientific practices.	L2
3	Apply microbial principles to industrial, clinical, agricultural, and environmental	L3

	contexts, and demonstrate how microorganisms are utilized in various biotechnological processes.	
4	Analyze and interpret microbiological data related to health and disease, including basic diagnostic, immunological, and antimicrobial concepts in clinical microbiology.	L4
5	Evaluate microbiological problems using critical thinking, data interpretation, and experimental reasoning to propose evidence-based and scientifically sound solutions.	L5
6	Design and propose microbiology-based approaches to address societal and environmental challenges, emphasizing sustainability, public health, and community welfare.	L6

Specific Programme: T.Y.B.Sc. (Microbiology -Major/ Minor) Theory 40% 60%		
Assessment: Weightage for assessments (in percentage) For Major and Minor		
Type of Course	Formative Assessment / IA	Summative Assessment
Theory	40 %	60 %

VPM's B. N. Bandodkar College of Science (Autonomous), Thane
T. Y. B. Sc. (Microbiology)
Structure of Programme

Semester V

Semester V				
	Course Code	**Course Title**	**No. of lectures In hrs.**	**Credits**
Major	25BUMB5T01	Translation, mutation and repair	30	2
	25BUMB5T02	Immunology I	30	2
	25BUMB5T03	Microbial Biochemistry I	30	2
	25BUMB5P01	Practicals based on 25BUMB5T01	60	2
	25BUMB5P02	Practicals based on 25BUMB5T02	60	2
	25BUMB5P03	Practicals based on 25BUMB5T03	60	2
DSE	25BUMB5TE1	Bioprocess Technology	30	2
	25BUMB5PE1	Practicals based on 25BUMB5TE1	60	2
	OR			
	25BUMB5TE2	Microbiology for Sustainable Development	30	2
	25BUMB5PE2	Practicals based on 25BUMB5TE2	60	2
VSC	25BUMB5VSC	Medical Microbiology	15	1
		Practicals based on 25BUMB5VSC	30	1
FP or OJT	25BUMB5OJT	On Job Training in Microbiology I	60	2
	OR			
	25BUMB5FPR	Field Project in Microbiology III	60	2
		Total	**495**	**22**

	Semester VI			
	Course Code	**Course Title**	**No. of lectures In hrs.**	**Credits**
Major	25BUMB6T01	Regulation of gene expression and genetic exchange	30	2
	25BUMB6T02	Immunology II	30	2
	25BUMB6T03	Microbial Biochemistry II	30	2
	25BUMB6T04	Molecular Biology and Virology	30	2
	25BUMB6P01	Practicals based on 25BUMB6T01	60	2
	25BUMB6P02	Practicals based 25BUMB6T02 and 25BUMB6T03	60	2
	25BUMB6P03	Practicals based 25BUMB6T04	60	2
DSE	25BUMB6TE1	Tissue Culture	30	2
	25BUMB6PE1	Practicals based on 25BUMB6TE1	60	2
	OR			
	25BUMB6TE2	Dairy Microbiology & QA/QC	30	2
	25BUMB6PE2	Practicals based on 25BUMB6TE2	60	2
VSC	25BUMB6VSC	Chemotherapy	15	1
		Practicals	30	1
FP or OJT	25BUMB6OJT	On Job Training in Microbiology II	60	2
	OR			
	25BUMB6FPR	Field Project in Microbiology IV	60	2
		Total	**495**	**22**

Semester V

Course Code 25BUMB5T01	Course Title Translation, mutation and repair	Credits (02)	No. of Lectures in hours: 30

COURSE OUTCOME

On completion of this course, students will be able to learn:

CO1	Explain the process of translation in prokaryotic and eukaryotic systems.	L2
CO2	Explain the genetic code, components of translation machinery (tRNA and ribosomes), the role of inhibitors in translation, and the process of protein sorting in cells.	L2
CO3	Compare various types of mutations	L4
CO4	Summarize types of DNA repair mechanisms	L2

Grading will be as 3: High (>60%), 2: Moderate (40%-60%), 1: Low (<40%), 0: No mapping

	PO1	PO2	PO3	PO4	PO5	PO6
CO1	3	0	1	0	0	0
CO2	3	0	1	0	0	0
CO3	3	1	1	0	0	0
CO4	3	1	1	0	0	0

Units	Description	No of lecture
Unit I Translation	1. Nature of Genetic Code a. Overlapping Vs non- overlapping code (1L) b. Revision of genetic code; concept of reading frame (1L) 2. Transfer RNA, structure of tRNA, tRNA genes (3L) 3. Translation: Process of Protein Synthesis (Initiation, Elongation, Translocation, Proofreading on the ribosome, Termination) (4L) 4. From an RNA World to a Protein World (3L) a. Ribozyme in protein synthesis b. The Wobble Hypothesis c. The significance of GTP in protein synthesis 5. Protein synthesis in eukaryotes (1L) 6. Inhibitors and modifiers of protein synthesis in prokaryotes and eukaryotes (1L) 7. Protein sorting in the cell (1L)	**15**
Unit II Mutation & Repair	1. Mutations (10L) a. Definition and Types of Mutations. b. Mutation rate and mutation frequency. c. Types of Point Mutations: transition, transversion, missense, nonsense, neutral, silent, frameshift, leaky mutations d. Reverse Mutations and Suppressor Mutations: Induced Variation in the Genetic Code: Nonsense Suppression. e. Spontaneous Vs Induced mutations; Mutagenesis and Mutagens (Examples of Physical, Chemical and Biological Mutagens); mutator genes and mutational hotspots f. Ames test g. loss- of- function and gain- of -function mutation. h. Conditionally expressed mutants 2. DNA Repair (5L) Photo-reversal, Base Excision Repair, Nucleotide Excision Repair, Mismatch Repair, SOS Repair and Recombination Repair	**15**

Course Code 25BUMB5T02	Course Title Immunology I	Credits (02)	No. of Lectures in hours: 30

COURSE OUTCOME

On completion of this course, students will be able to learn:

CO1	Explain concepts of antigen and immunogen, immunogenicity, types of antigen and basic structure, types of antibody	L2
CO2	Summarize significance, production, use of monoclonal antibodies and nomenclature, activation pathways, functions and regulation of complement system	L2
CO3	Illustrate Development ,maturation, Activation, differentiation of B cells	L2
CO4	Compare different antigen antibody reactions, protocols, applications	L4

Grading will be as 3: High (>60%), 2: Moderate (40%-60%), 1: Low (<40%), 0: No mapping

	PO1	PO2	PO3	PO4	PO5	PO6
CO1	3	0	1	0	0	0
CO2	3	0	1	0	0	0
CO3	3	0	1	0	0	0
CO4	3	0	1	0	0	0

Units	Description	No of lecture
Unit I Fundamentals of Immunology	1. Types of antigen (1L) 2. Antigen Vs Immunogen, factors responsible for Immunogenicity (1L) 3. Epitopes , T cell and B cell epitopes,Hapten (2L) 4. Basic structure of antibody (1L) 5. Types of antibody , (2L) 6. Isotype,allotype and idiotype , Ig superfamily (2L) 7. Monoclonal antibodies, concept, production, significance and use (3L) 8. Complement System: nomenclature, activation pathways, functions, regulation (3L)	**15**
Unit II Humoral Immunity	1. B cells: major players of HI, 2. Development and maturation (2L), Activation (4L), differentiation (1L) 3. Humoral response : a. Primary and secondary (1L) b. *In vivo* sites for induction, following events - overview(2L) c. *In vitro* antigen antibody reactions (5L) properties , types , : precipitation, agglutination Classic and Modern serodiagnostic tests : (principles and significance) Audin's, ouchterlony, DID, SRID, immunoelectrophoresis, rocket immunoelectrophoresis, hemagglutination, bacterial and passive agglutination Immunofluorescence, RIA, ELISA	**15**

Course Code 25BUMB5T03	Course Title Microbial Biochemistry I	Credits (02)	No. of Lectures in hours: 30

COURSE OUTCOME

On completion of this course, students will be able to learn:

CO1	Illustrate and compare major fermentative pathways, highlighting key enzymes and intermediates	L2
CO2	Describe alternative microbial fermentation modes and outline key anabolic pathways involved in carbohydrate biosynthesis	L2
CO3	Explain the biochemical processes involved in ATP generation, electron transport systems in mitochondria and prokaryotes.	L2
CO4	Describe the chemiosmotic mechanism of ATP synthesis and discuss alternative microbial strategies for electrochemical energy generation along with bioluminescence.	L2

Grading will be as 3: High (>60%), 2: Moderate (40%-60%), 1: Low (<40%), 0: No mapping

	PO1	PO2	PO3	PO4	PO5	PO6
CO1	3	0	1	0	0	0
CO2	3	0	1	0	0	0
CO3	3	0	1	0	0	0
CO4	3	0	1	0	0	0

Units	Description	No of lecture
Unit I Fermentative Pathways & Anabolism of Carbohydrates	1. Fermentative pathways (with structures and enzymes) a. Lactic acid fermentation b. Homofermentation c. Heterofermentation d. Bifidum pathway e. Alcohol fermentation by ED pathway in bacteria & EMP in yeasts 2. Other modes of fermentation in microorganisms a. Mixed acid b. Butanediol c. Butyric acid d. Acetone-Butanol e. Propionic acid (Acrylate and succinate propionate pathway) 3. Anabolism of Carbohydrates a. General pattern of metabolism leading to synthesis of a cell from glucose b. Sugar nucleotides c. Biosynthesis of glycogen	**15**

Unit II **Bioenergetics & Bioluminescence**	1. Biochemical mechanism of generating ATP: Substrate-Level Phosphorylation, Oxidative Phosphorylation and Photophosphorylation 2. Electron transport chain a. Universal Electron acceptors that transfer electrons to E.T.C. b. Carriers in E.T.C: Hydrogen carriers (NADH, Flavoproteins, Quinones), Electron carriers (Iron Sulphur proteins, Cytochrome) c. Mitochondrial ETC d. Biochemical anatomy of mitochondria e. Complexes in Mitochondrial ETC 3. Prokaryotic ETC a. Organization of electron carriers in bacteria b. Generalized electron transport pathway in Bacteria c. Different terminal oxidases d. Branched bacterial ETC e. Pattern of electron flow in E. coli - aerobic and anaerobic 4. ATP synthesis a. Explanation of terms – Proton motive force, Proton pump, Coupling sites, P:O ratio, Redox potential (definition of Standard reduction potential) b. Free energy released during electron transfer from NADH to O2 c. Chemiosmotic theory (only explanation) d. Structure and function of Mitochondrial ATP synthase e. Structure of bacterial ATP synthase f. Mechanism by Rotational catalysis g. Inhibitors of ETC, ATPase and uncouplers 5. Other modes of generation of electrochemical energy a. ATP hydrolysis b. Oxalate formate exchange c. End product efflux, Definition, Lactate efflux d. Bacteriorhodopsin: Definition, function as proton pump & significance 6. Bioluminescence: Introduction, biochemistry, Schematic diagram, Significance	**15**

Course Code 25BUMB5P01	Course Title Practicals based on 25BUMB5T01	Credits (02)	No. of Lectures in hours: 60

COURSE OUTCOME

On completion of this course, students will be able to learn:

CO1	Determine the effect of UV on bacterial growth and the repair mechanisms involved in it.	L5
CO2	Estimate percentage mutants in UV mutagenesis	L5
CO3	Experiment with various mutants through gradient plate technique and/or replica plate technique	L3
CO4	Interpret different mutants and their effects	L5

Grading will be as 3: High (>60%), 2: Moderate (40%-60%), 1: Low (<40%), 0: No mapping

	PO1	PO2	PO3	PO4	PO5	PO6
CO1	3	2	1	1	1	1
CO2	3	2	1	1	1	1
CO3	3	2	1	1	1	1
CO4	3	2	1	1	1	1

Course Code 25BUMB5P02	Course Title Practicals based on 25BUMB5T02	Credits (02)	No. of Lectures in hours: 60

COURSE OUTCOME

On completion of this course, students will be able to learn:

CO1	Determine concentration of given antigen by SRID, relatedness of provided antigens by DID	L5
CO2	Compare applications of diagnostic tests namely Widal and VDRL	L4
CO3	Summarize principle, procedure and results of CFT	L2
CO4	Identify types of ELISA and their principle	L3

Grading will be as 3: High (>60%), 2: Moderate (40%-60%), 1: Low (<40%), 0: No mapping

	PO1	PO2	PO3	PO4	PO5	PO6
CO1	3	2	1	0	1	0
CO2	3	2	1	0	1	0
CO3	3	2	1	0	1	0
CO4	3	2	1	0	1	0

COURSE OUTCOME

Course Code 25BUMB5P03	Course Title Practicals based on 25BUMB5T03	Credits (02)	No. of Lectures in hours: 60

COURSE OUTCOME

On completion of this course, students will be able to learn:

CO1	Plan and perform isolation of lactic acid bacteria	L3
CO2	Interpret homo and heterolactic fermentation	L5
CO3	Estimate the yield of alcohol	L5
CO4	Explain on bioluminescent organisms, vinegar production	L2

Grading will be as 3: High (>60%), 2: Moderate (40%-60%), 1: Low (<40%), 0: No mapping

	PO1	PO2	PO3	PO4	PO5	PO6
CO1	3	2	1	0	1	0
CO2	3	2	1	0	1	0
CO3	3	2	1	0	1	0
CO4	3	2	1	0	1	0

25BUMB5P01	1. UV survival curve 2. UV repair 3. UV mutagenesis 4. Gradient plate technique for isolation of mutants 5. Replica plate technique 6. Study of gene mutation using simulation	**60**

25BUMB5P02	1. SRID 2. DID 3. Widal : Qualitative and quantitative 4. VDRL test 5. CFT 6. ELISA card test 7. ELISA	**60**
25BUMB5P03	1. Isolation of lactic acid bacteria 2. Homo and heterolactic fermenters 3. Alcohol production 4. Alcohol estimation 5. Calculation of yield 6. Vinegar production 7. Isolation of bioluminescent organisms	**60**

Course Code 25BUMB5TE1	Course Title Bioprocess Technology	Credits (02)	No. of Lectures in hours: 30

COURSE OUTCOME

On completion of this course, students will be able to learn:

CO1	Explain the development of inoculum, media formulation, and methods of sterilization (batch and continuous).	L2
CO2	Discuss the sterilization of fermenter and feeds, scale-up/scale-down strategies, computer control, and fermentation economics.	L2
CO3	Compare the criteria for choice of recovery, compare different cell disruption methods used in the same	L2
CO4	Differentiate between extraction protocols, purification methods in downstream processing.	L4

Grading will be as 3: High (>60%), 2: Moderate (40%-60%), 1: Low (<40%), 0: No mapping

	PO1	PO2	PO3	PO4	PO5	PO6
CO1	3	1	1	0	1	0
CO2	3	0	2	0	0	0
CO3	3	1	1	0	1	0
CO4	3	1	1	0	0	0

Units	Description	No of lecture
Unit I Upstream processing	1. Development of inoculum (2L) 2. Fermentation media formulation (3L) 3. Sterilization of medium: Batch Vs continuous sterilization (2L) 4. Sterilization of fermenter, feeds (2L) 5. Scale up and scale down of fermentation (2L) 6. Computer control (3L) 7. Fermentation economics (1L)	**15**
Unit II Downstream Processing	1. Concept of Fermentation Product Recovery: Criteria for choice of recovery process (1L) 2. Removal of insoluble product (5L): Biomass separation from fermentation media a. Foam Fractionation (Floatation) b. Precipitation c. Filtration, filter aids, plate frame, Pressure leaf, rotary vacuum filters d. Centrifugation - Cell aggregation and flocculation (Basket centrifuge, Tubular bowl centrifuge & Decanter centrifuge) 3. Cell Disruption for intracellular products (2L) Physico-mechanical and Chemical & biological methods 4. Extraction: (2L) Liquid-Liquid Extraction, Solvent extraction and recovery, Reversed Micelle Extraction, Supercritical Fluid Extraction 5. Purification: (4L) a. Chromatography b. Carbon decolorization c. Removal of Volatile Products d. Membrane processes (Ultra filtration, Reverse osmosis, Liquid membranes) e. Drying (Liquid Phase Moisture removal, Solid Phase Moisture Removal) f. Crystallization g. Whole broth processing 6. Treatment of waste in Industry (1L)	**15**

Course Code 25BUMB5PE1	Course Title Practicals based on 25BUMB5TE1	Credits (02)	No. of Lectures in hours: 30

COURSE OUTCOME

On completion of this course, students will be able to learn:

CO1	Estimate the tolerance level of the organism to alcohol and sugar	L6
CO2	Determine the yield based on media formulations, extent of microbial remediation	L5
CO3	Infer the results of chromatography, algal biomass production, cell disruption	L4
CO4	Plan and perform bioassay of vitamin	L3

Grading will be as 3: High (>60%), 2: Moderate (40%-60%), 1: Low (<40%), 0: No mapping

	PO1	PO2	PO3	PO4	PO5	PO6
CO1	3	2	1	1	1	0
CO2	3	2	1	1	1	0
CO3	3	2	1	0	1	0
CO4	3	2	1	0	1	0

25BUMB5PE1	1. Yield analysis based on fermentation media formulation: 2. Cell disruption 3. Sugar tolerance 4. Alcohol tolerance 5. Microbial remediation of industrial waste 6. Algal cultivation, biomass production 7. Extraction of Vitamin C 8. Bioassay of Vitamin B12 9. Chromatographic techniques for checking purity of the products	**60**

Course Code 25BUMB5TE2	Course Title Microbiology for Sustainable Development	Credits (02)	No. of Lectures in hours: 30

COURSE OUTCOME

On completion of this course, students will be able to learn:

CO1	Distinguish between types of pollutants and select the appropriate approach to monitor the environment	L4
CO2	Relate microbiology with environmental applications as bioindicators, biomarkers	L3
CO3	Summarize the role of IPCC in climate change monitoring	L2
CO4	Discuss the principles of green microbiology	L2

Grading will be as 3: High (>60%), 2: Moderate (40%-60%), 1: Low (<40%), 0: No mapping

	PO1	PO2	PO3	PO4	PO5	PO6
CO1	3	2	1	1	1	0
CO2	3	2	1	1	1	0
CO3	3	2	1	0	1	0
CO4	3	2	1	0	1	0

Units	Description	No of lecture

Unit I	1. Biodiversity, Hotspots of biodiversity and biosphere reserve. Strategies for biodiversity conservation. 2. Micropia: World's first museum of microbes 3. Types of pollution:Water pollution: Pesticides and heavy metals, Air pollution: Challenges posed by present day pollutants, Soil Pollution, Noise and nuclear pollution 4. Environmental monitoring: Approaches used to monitor the environment-air, water and soil. 5. Bioindicators, Biomarkers, Biochemical Indicators, Genetic Indicators, toxicity testing using biological material, Biosensors	**15**
Unit II	1. Introduction to climate change, global warming and its effects. 2. Greenhouse substances: Sources & effects 3. Role of IPCC in climate change monitoring; Kyoto Protocol, Montreal Protocol, Earth Summit & UN Convention on Climate Change. 4. Sustainable Development Goals 5. Principles of green microbiology: The microbial blueprint for sustainable development 6. Microbial eco-friendly products: microbial polymers, microbial plastic	**15**

Course Code 25BUMB5PE2	Course Title Practicals based on 25BUMB5TE2	Credits (02)	No. of Lectures in hours: 30

COURSE OUTCOME

On completion of this course, students will be able to learn:

CO1	Compare physicochemical properties of water and soil sample	L4
CO2	Demonstrate effects of global warming	L2
CO3	Study of microbial flora and fauna of select ecosystem samples	L4
CO4	Determine salinity and hardness of water	L3

Grading will be as 3: High (>60%), 2: Moderate (40%-60%), 1: Low (<40%), 0: No mapping

	PO1	PO2	PO3	PO4	PO5	PO6
CO1	3	2	1	1	1	0
CO2	3	2	1	1	1	0
CO3	3	2	1	0	1	0
CO4	3	2	1	0	1	0

25BUMB5PE2	1. Study of Physico-chemical properties of sewage/ effluent water: conductivity, turbidity 2. Comparative analysis of physical and chemical properties of soil with respect to soil pollution 3. Observation & study of indicator species. 4. Manufacturing eco friendly microbial product 5. Demonstrate effects of global warming using a jar experiment. 6. Comparative analysis of biodegradable plastic products, bio pesticides brands 7. Study of microbial flora and fauna of Lakes with seasonal variation 8. Determination of salinity of water sample by Mohr's method 9. Determination of hardness of water	**60**

Course Code 25BUMB5VSC	Course Title Medical Microbiology	Credits (02)	No. of Lectures in hours: 30

COURSE OUTCOME

On completion of this course, students will be able to learn:

CO1	Discuss clinical symptoms, diagnostic scheme, prevention and treatment of respiratory infection, gastrointestinal tract infection urinary tract infection	L2
CO2	Elaborate on pathogenesis and diagnostics of bacterial and fungal infections of skin	L2
CO3	Plan and perform culturing techniques and tests to identify etiological agents of Skin, GI tract, respiratory tract infections	L3
CO4	Explain principle and procedure of acid fast staining	L2

Grading will be as 3: High (>60%), 2: Moderate (40%-60%), 1: Low (<40%), 0: No mapping

	PO1	PO2	PO3	PO4	PO5	PO6
CO1	3	1	2	0	2	1
CO2	3	1	1	0	2	1
CO3	3	1	1	1	2	1
CO4	3	1	1	0	2	1

Units	Description	No of lecture
Unit I Medical Microbiology	1. Study of respiratory tract infections Upper respiratory and lower respiratory infections 2. Study of gastrointestinal tract infection 3. Study of urinary tract infection 4. Study of bacterial and fungal skin infections 5. Predisposing factors, clinical symptoms, diagnostic scheme, prevention and treatment)	**15**

Practicals based on 25BUMB5 VSC	1. Respiratory: S. pyo, Kp 2. Gastro: E. coli, Salmonella, Shigella 3. Urinary: Proteus 4. Skin: S. aureus & Pseudomonas 5. Acid fast staining 6. Differentiation of candida species 7. Germ tube	**30**

Course Code 25BUMB5OJT	On Job Training in Microbiology I	Credits 02	No. of hours: 60

COURSE OUTCOMES

On completion of this course, students will be able to:

CO1	Demonstrate practical, hands-on skills directly applicable to their roles defined by the organization.	L2
CO2	Relate the direct impact of good laboratory practices with quality standards.	L2
CO3	Build a professional skill set, including soft skills.	L3
CO4	Explain outcomes clearly through written reports, visual displays, or oral presentations.	L5

Grading will be as 3: High (>60%), 2: Moderate (40%-60%), 1: Low (<40%), 0: No mapping

	PO1	PO2	PO3	PO4	PO5	PO6
CO1	3	2	2	1	3	2
CO2	3	2	2	1	3	2
CO3	3	2	2	1	3	2
CO4	3	2	3	1	3	2

Description

In this course, the learner is required to get engaged in ‘On job training’ at a professional institute/ organization from the field related to Microbiology. The learner is expected to acquire field-based skills, professional planning and execution of activities undertaken by the organization. The learner needs to complete 60 hrs. of training.

The learner would be required to qualify the assessment where he /she would be required to communicate outcomes clearly, interpret findings logically through written report, and visual oral presentation and viva.

Course Code 25BUMB5FPR	Field Project in Microbiology III	Credits 02	No. of hours: 60

COURSE OUTCOME

On completion of this course, students will be able to learn:

CO1	Demonstrate practical, hands-on competence in essential laboratory techniques	L2
CO2	Develop analytical skills like designing experiment, data collection, statistical analysis and interpretation of results	L3
CO3	Experiment with basic knowledge integration from allied fields like molecular biology, bioinformatics, and biotechnology to address complex, multidisciplinary challenges	L3
CO4	Build written and oral communication skills through report writing, presentations	L3

Grading will be as 3: High (>60%), 2: Moderate (40%-60%), 1: Low (<40%), 0: No mapping

	PO1	PO2	PO3	PO4	PO5	PO6
CO1	3	3	3	1	3	2
CO2	3	3	3	1	3	2
CO3	3	3	3	1	3	2
CO4	3	3	3	1	3	2

Description

The learner can undertake the field project to apply knowledge of core topics of basic Microbiology to solve a real-world problem in areas such as healthcare, environmental sustainability, food safety, agriculture etc.

The learner would be required to qualify the assessment where he /she would be required to communicate outcomes clearly, interpret findings logically through written report, visual displays, or oral presentations and viva.

References

SEMESTER V

Sr. No.	Title	Author/s	Publisher	Edition	Year
1	Genetics: A Conceptual Approach	Benjamin A. Pierce	WH Freeman	3rd	2007
2	iGenetics: A Molecular Approach	Peter Russel	Benjamin Cummings	3rd	2010
3	Fundamental bacterial genetics	Trun & Trempy	Wiley-Blackwell	1st	2004
4	Microbiology- an evolving science	John W. Foster, Joan L. Slonczewski	W. W. Norton & company Ltd.	4th	2017
5	Kuby Immunology	Kindt, Thomas J, Osborne, Barbara A., Goldsby, Richard A.	WH Freeman	6th	2006
6	Immunology: Essential & Fundamental	Pathak & Palan	Capital Publising	2nd	2005
7	Bacterial Metabolism	Gottschalk	Springer Verlag	2nd	1985
8	Lehninger's Principles of Biochemistry	Nelson, D. L. and M.M. Cox	W.H. Freeman & Company	4th	2005
9	The Physiology and Biochemistry of Prokaryotes	White, D	Oxford University Press	3rd	1995
10	General Microbiology	Stanier, R.Y., M. Doudoroff and E. A. Adelberg	Macmillan Press Ltd	5th	2004
11	Principles of Fermentation Technology	P. F. Stanbury, A. Whitaker, S.	Butterworth Heinemann,	2nd	2000

		J. Hall	Oxford		
12	Environmental Science	S C Santra	-	1st	2011
13	https://doi.org/10.1016/j.envadv.2023.100440				
14	Jawetz, Melnick and Adelberg's Medical Microbiology	G.F.Brooks, Morse, Carroll, Mietzner, Butel	Lange publication	26th	2013
15	Mim's Medical Microbiology	Goering, Mark Zuckerman, Dockrell, chiodini	Elsevier limited	6th	2019
16	Ananthanarayan and Paniker's Textbook of Microbiology	R Ananthanarayan	The Orient Blackswan	10th	2017

Semester VI

Course Code 25BUMB6T01	Course Title Regulation of gene expression and genetic exchange	Credits (02)	No. of Lectures in hours: 30

COURSE OUTCOME

On completion of this course, students will be able to learn:

CO1	Describe fundamental aspects of gene regulation in prokaryotes and eukaryotes, including operon models, transcriptional control mechanisms, regulation of the lac operon and riboswitches	L2
CO2	Analyze regulatory strategies in bacteria including the trp operon, lambda phage pathways, sigma factor control and post-transcriptional regulation by sRNAs	L4
CO3	Illustrate gene transfer mechanism of transformation and transduction	L2
CO4	Elaborate on transduction process and recombination in bacteria	L2

Grading will be as 3: High (>60%), 2: Moderate (40%-60%), 1: Low (<40%), 0: No mapping

	PO1	PO2	PO3	PO4	PO5	PO6
CO1	3	1	1	0	0	0
CO2	3	1	1	0	0	0
CO3	3	1	1	0	0	0
CO4	3	1	1	0	0	0

Units	Description	No of lecture
Unit I Regulation of gene expression	1. Introduction (2L) Aspects of gene regulation similar and different in bacteria and eukaryotes: Genes and regulatory elements, Levels of gene regulation, DNA binding proteins 2. Control of transcription in bacteria: Operon structure, Negative and positive control- Inducible and repressible operons a. Lac operon: Mutations and regulation (4L) b. Trp operon (2L) c. Regulation of lytic and lysogenic pathway of lambda phage (3L) 3. Regulation of Sigma factor during growth: Sigma factor control by RNA thermometers and proteolysis (1L) 4. Regulatory RNAs: Intro, Mechanism of sRNA function, sRNA molecules expand the reach of regulatory proteins (2L) Riboswitches: a. In synthesis of Vitamin B12 & b. As Ribozymes (1L)	**15**

Unit II Genetic Exchange	1. Genetic analysis of Bacteria (1L) 2. Gene transfer mechanisms in bacteria 3. Transformation (3L) a. Introduction and History b. Types of transformation in prokaryotes—Natural transformation in Streptococcus pneumoniae, Haemophilus influenzae and Bacillus subtilis c. Mapping of bacterial genes using transformation d. Problems based on transformation 4. Conjugation (5L) a. Discovery & Properties of F plasmid/Sex factor b. The conjugation machinery c. Hfr strains, their formation and mechanism of conjugation d. F' factor, origin and behavior of F' strains, sexduction e. Mapping of bacterial genes using conjugation (Wolman and Jacob experiment) and Problems based on conjugation 5. Transduction (3L) a. Introduction and discovery b. Generalized transduction & its use for mapping genes c. Specialized transduction d. Problems based on transduction 6. Recombination in bacteria (3L) a. General/Homologous recombination b. Molecular basis of recombination c. Holliday model (Single strand DNA break model only) d. Enzymes required for recombination e. Site –specific recombination	**15**

Course Code 25BUMB6T02	Course Title Immunology II	Credits (02)	No. of Lectures in hours: 30

COURSE OUTCOME

On completion of this course, students will be able to learn:

CO1	Summarize various aspects of antigen presentation, MHC and cytokines	L2
CO2	Discuss T cell Development, activation, differentiation, Cell mediated effector responses	L3
CO3	Recall properties of ideal vaccine, various types of vaccines, Modern vaccine development, challenges	L2
CO4	Compare immunohematological tests and immunodeficiencies	L4

Grading will be as 3: High (>60%), 2: Moderate (40%-60%), 1: Low (<40%), 0: No mapping

	PO1	PO2	PO3	PO4	PO5	PO6
CO1	3	0	1	0	0	0
CO2	3	0	1	0	0	0
CO3	3	0	1	0	0	0
CO4	3	0	1	0	0	0

Units	Description	No of lecture
Unit I **Cell Mediated Immunity**	1. Antigen presenting cells (1L), Types, examples 2. Antigen processing and presentation (2L) 3. MHC (2L): Introduction, classes, Structures, Functional significance 4. Cytokines(2L): Concept, attributes, Biological functions 5. T cell Development, activation, differentiation (5L) 6. Cell mediated effector responses CTL, NK cell activity, ADCC (3L)	**15**
Unit II **Immunization & Immunohematology**	1. Active and passive immunization (1L) 2. Properties of Ideal Vaccine (1L) 3. Types of vaccines: attenuated, Killed, Subunit, recombinant, DNA vaccine (2L) 4. Vaccine schedule in India (1L) 5. Modern vaccine development (2L) 6. Challenges (1L) 7. Immunohematology: (2L) Introduction, Blood grouping, HDN, Coombs 8. Immunodeficiencies (4L)	**15**

Course Code 25BUMB6T03	Course Title Microbial Biochemistry II	Credits (02)	No. of Lectures in hours: 30

COURSE OUTCOME

On completion of this course, students will be able to learn:

CO1	Explain the catabolic and anabolic pathways of amino acids, including enzymatic reactions, nitrogen metabolism, and the biosynthesis of key amino acid families.	L2
CO2	Describe the biosynthesis and catabolism of nucleotides, including purine and pyrimidine pathways, salvage mechanisms, and degradation to uric acid.	L2
CO3	Explain the structure, classification, and function of bacterial lipids, and describe the pathways involved in fatty acid and PHB catabolism.	L2
CO4	Describe the biosynthesis of fatty acids, phosphoglycerides, and PHB in bacteria, and explain microbial pathways for the degradation of aliphatic hydrocarbons.	L2

Grading will be as 3: High (>60%), 2: Moderate (40%-60%), 1: Low (<40%), 0: No mapping

	PO1	PO2	PO3	PO4	PO5	PO6
CO1	3	1	1	0	0	0
CO2	3	1	1	0	0	0
CO3	3	1	1	0	0	0
CO4	3	1	1	0	0	0

Units	Description	No of lecture
Unit I Metabolism of Proteins and Nucleic Acids	1. Protein / amino acid catabolism (3L) a. Enzymatic degradation of proteins b. General reactions of amino acids catalyzed by i. Amino acid decarboxylases ii. Amino acid deaminases iii. Amino acid transaminases iv. Amino acid racemases c. Metabolic fate of amino acids - Glucogenic and ketogenic amino acids d. Fermentation of single amino acid - Glutamic acid by Clostridium tetanomorphum e. Fermentation of pair of amino acids -Stickland reaction (include enzymes) f. Incorporation & Detoxification of Ammonia g. Nitrogen excretion & urea cycle 2. Anabolism of amino acids (3L) a. Schematic representation of amino acid families b. Overview of amino acid biosynthesis (Lehninger fig. 22.11) c. Biosynthesis of amino acids of Serine family (Serine, Glycine and Cysteine) d. Biosynthesis of Phenylalanine, Tyrosine & Tryptophan from Chorismate 3. Catabolism of Nucleotides (5L) a. Degradation of purine nucleotides up to uric acid formation b. Salvage pathway for purine and pyrimidine nucleotides 4. Biosynthesis of nucleotides (4L) a. Nomenclature and structure of nucleotides b. Biosynthesis of pyrimidine nucleotides c. Biosynthesis of purine nucleotides d. Biosynthesis of deoxyribonucleotides	**15**

Unit II **Lipid Metabolism & Catabolism of Hydrocarbons**	1. Introduction to Lipids (3L) a. Lipids –Definition, classification & functions b. Types and role of fatty acids found in bacteria c. Common phosphoglycerides in bacteria d. Action of lipases on triglycerides /tripalmitate 2. Catabolism of Fatty Acids and PHB (4L) a. Oxidation of saturated fatty acid by β oxidation pathway b. Energetics of β oxidation of Palmitic acid c. Oxidation of propionyl CoA by acrylyl- CoA pathway and methyl citrate pathway d. PHB as a food reserve and its degradation 3. Anabolism of Fatty Acids & Lipids (4L) a. Biosynthesis of straight chain even carbon saturated fatty acid (palmitic acid) b. Biosynthesis of phosphoglycerides in bacteria c. Biosynthesis of PHB 4. Catabolism of aliphatic hydrocarbons (4L) a. Organisms degrading aliphatic hydrocarbons b. Hydrocarbon uptake mechanisms c. Omega oxidation pathway- i. Pathway in *Corynebacterium* and yeast ii. Pathway in *Pseudomonas*	**15**

Course Code 25BUMB6T04	Course Title Molecular Biology & Virology	Credits (02)	No. of Lectures in hours: 30

COURSE OUTCOME

On completion of this course, students will be able to learn:

CO1	Explain the general characteristics, types, transfer mechanisms, and incompatibility behavior of plasmids in prokaryotes.	L2
CO2	Apply knowledge of cloning vectors and transposable elements to explain their roles in gene manipulation and genetic variability in prokaryotic and eukaryotic systems.	L3
CO3	Summarize the classification systems, replication strategies of key viruses, and cultivation methods used in virology.	L2
CO4	Explain commonly used techniques for virus quantification and outline the role of DNA viruses in cancer development.	L2

Grading will be as 3: High (>60%), 2: Moderate (40%-60%), 1: Low (<40%), 0: No mapping

	PO1	PO2	PO3	PO4	PO5	PO6
CO1	3	1	1	0	0	0
CO2	3	1	1	0	0	0
CO3	3	1	1	0	0	0
CO4	3	1	1	0	0	0

Units	Description	No of lecture
Unit I Plasmids and transposable elements	1. Plasmids (9L) a. General properties and Types of plasmids b. Transfer of plasmid DNA c. Incompatibility d. Properties of bacterial plasmids (F plasmid, R plasmid, Col plasmids, Ti plasmid) e. Plasmids in eukaryotes 2. Cloning Vectors: Plasmids as cloning vectors: pUC, lambda phage replacement vectors, cosmids, YAC, BAC, Expression vector (introduction) 3. Transposable Elements in Prokaryotes (3L) a. Insertion sequences b. Transposons: Types, Structure and properties, Mechanism of transposition, c. Integrons	**15**

Unit II **Virology**	1. Viral classification (Baltimore classification) Concept of satellite and helper viruses, largest virus Mimi virus (1L) 2. Structure & Life cycle of Influenza & HIV in detail (4L) 3. Cultivation of viruses- cell culture techniques, embryonated egg, laboratory animals (2L) 4. Visualization and enumeration of virus particles (4L) a. Measurement of infectious units i. Plaque assay ii. Fluorescent focus assay iii. Infectious center assay iv. Transformation assay v. Endpoint dilution assay b. Measurement of virus particles and their components i. Electron microscopy ii. Atomic force microscopy iii. Haemagglutination iv. Measurement of viral enzyme activity 5. Role of viruses in cancer: Introduction to Cancer, development & causes of cancer, Important definitions, characteristics of cancer cell, Human DNA tumour viruses- EBV, Kaposi's sarcoma virus, Hepatitis B and C virus, HPV (4L)	**15**

Course Code 25BUMB6P01	Course Title Practicals based on 25BUMB6T01	Credits (02)	No. of Lectures in hours: 60

COURSE OUTCOME

On completion of this course, students will be able to learn:

CO1	Estimate activity of β-galactosidase	L5
CO2	Solve problems related to gene mapping using transformation data, conjugation	L6
CO3	Explain preparation of competent cells and conjugation	L5
CO4	Enlist various facts related to diauxic growth curve	L1

Grading will be as 3: High (>60%), 2: Moderate (40%-60%), 1: Low (<40%), 0: No mapping

	PO1	PO2	PO3	PO4	PO5	PO6
CO1	3	2	1	0	1	0
CO2	3	2	1	0	1	0
CO3	3	2	1	0	1	0
CO4	3	2	1	0	1	0

Course Code 25BUMB6P02	Course Title Practicals based on 25BUMB6T02 and 25BUMB6T03	Credits (02)	No. of Lectures in hours: 60

COURSE OUTCOME

On completion of this course, students will be able to learn:

CO1	Determine blood group of an unknown sample using forward and reverse typing, isoagglutinin titre	L5
CO2	Analyze antigen-antibody interactions and hemolytic conditions using Coomb's test	L4
CO3	Select appropriate method for isolation and identification of poly-β-hydroxybutyrate (PHB) producing and phenol-degrading microorganisms from environmental samples.	L5

CO4	Estimate phenol concentration in samples using standard chemical methods and interpret the results in the context of biodegradation efficiency.	L6

Grading will be as 3: High (>60%), 2: Moderate (40%-60%), 1: Low (<40%), 0: No mapping

	PO1	PO2	PO3	PO4	PO5	PO6
CO1	3	2	1	0	1	0
CO2	3	2	1	0	1	1
CO3	3	2	1	2	1	0
CO4	3	2	1	2	1	0

COURSE OUTCOME

Course Code 25BUMB6P03	Course Title Practicals based on 25BUMB6T04	Credits (02)	No. of Lectures in hours: 60

On completion of this course, students will be able to learn:

CO1	Plan an experiment to isolate plasmid DNA from bacterial cells	L6
CO2	Analyze plasmid size and integrity using agarose gel electrophoresis.	L4
CO3	Evaluate phage titers	L5
CO4	Explain egg inoculation technique	L2

Grading will be as 3: High (>60%), 2: Moderate (40%-60%), 1: Low (<40%), 0: No mapping

	PO1	PO2	PO3	PO4	PO5	PO6
CO1	3	2	1	0	1	0
CO2	3	2	1	0	1	1
CO3	3	2	1	2	1	0
CO4	3	2	1	2	1	0

25BUMB6P01	1. Beta galactosidase assay 2. Diauxic growth curve 3. Mapping of bacterial genes using transformation 4. Problems based on transformation 5. Competent cell preparation 6. conjugation	**60**
25BUMB6P02	1. Blood grouping: forward and reverse 2. Determination of isoagglutinin titre 3. Coomb's test 4. Detection of PHB producers 5. Enrichment and Isolation of phenol degraders 6. Estimation of phenol	**60**
25BUMB6P03	1. Plasmid isolation 2. Visualization of plasmid 3. Phage assay spot assay 4. Enumeration of phage plaque assay 5. Egg inoculation technique	**60**

Course Code 25BUMB6TE1	Course Title Tissue Culture	Credits (02)	No. of Lectures in hours: 30

COURSE OUTCOME

On completion of this course, students will be able to learn:

CO1	Describe the layout of a tissue culture lab and explain the types and preparation of culture media.	L2
CO2	Explain aseptic plant tissue culture procedures and describe the principles of callus culture and organogenesis.	L2
CO3	Illustrate the theoretical framework of plant tissue culture laboratory design and media formulation for various in vitro applications.	L3
CO4	Implement theoretical concepts of plant tissue culture techniques to explain the processes of callus formation and organogenesis.	L3

Grading will be as 3: High (>60%), 2: Moderate (40%-60%), 1: Low (<40%), 0: No mapping

	PO1	PO2	PO3	PO4	PO5	PO6
CO1	3	2	1	1	3	2
CO2	3	3	1	1	3	2
CO3	3	3	0	3	3	2
CO4	3	3	0	3	3	2

Units	Description	No of lecture
Unit I Animal Tissue Culture	1. Introduction to animal tissue culture and its types 2. Design of ATC laboratory 3. Glassware, plasticware and Equipment for ATC 4. Sterilization protocols 5. Tissue culture media 6. Culture of cell lines: Procurement, Initiation, Evolution, Maintenance, Phases and growth curve, Subculturing, Cryopreservation 7. Applications & Limitations of Cell Cultures 8. Cell proliferation and cytotoxicity assays: principle and significance 9. Cell culture-scale up and automation	**15**
Unit II Plant Tissue Culture	1. Introduction 2. Tissue Culture Laboratory: a. General Laboratory b. Laboratory for aseptic inoculation c. Culture room d. Glass goods and instruments 3. Plant tissue culture media a. Culture medium and the preparation of stock solution b. Selection of new medium 4. Techniques in plant tissue culture: Preparation of Culture Medium, Sterilization procedure, Preparation of aseptic plants, Aseptic techniques, Incubation of culture 5. Callus Culture: Introduction, Principle, Protocol, Formation, Morphology, internal structure and other characteristics of callus culture, Significance 6. Organogenesis	**15**

Course Code 25BUMB6PE1	Course Title Practicals based on 25BUMB6TE1	Credits (02)	No. of Lectures in hours: 30

COURSE OUTCOME

On completion of this course, students will be able to learn:

CO1	Explain basic mammalian cell culture techniques including osmotic fragility testing, cell counting, enzymatic cell disaggregation, cell viability and relate observations to cell health.	L3
CO2	Carry out calculations to prepare stock solutions and culture media for plant tissue culture.	L3
CO3	Evaluate aseptic techniques and plant tissue culture protocols by executing the steps involved in explant preparation, callus induction, organogenesis, and synthetic seed production.	L5
CO4	Summarize the layout, workflow and essential practices observed during a visit to a professional tissue culture laboratory.	L2

Grading will be as 3: High (>60%), 2: Moderate (40%-60%), 1: Low (<40%), 0: No mapping

	PO1	PO2	PO3	PO4	PO5	PO6
CO1	3	2	1	1	3	0
CO2	3	2	1	1	3	0
CO3	3	2	1	1	3	1
CO4	3	2	1	1	3	0

25BUMB6PE1	1. Preparation of Stock Solutions and Preparation of Media for PTC 2. Surface Sterilization and raising sterile explants 3. Callus Culture 4. Organogenesis: Induction of roots and shoots 5. Synthetic seed production 6. Study of osmotic fragility of RBC 7. Counting of cells during passaging using haemocytometer 8. Study of enzymatic cell disaggregation 9. Viable staining using trypan blue 10. Visit to tissue culture laboratory	**60**

Course Code 25BUMB6TE2	Course Title Dairy Technology & QA/QC	Credits (02)	No. of Lectures in hours: 30

COURSE OUTCOME

On completion of this course, students will be able to learn:

CO1	Explain the microbiological quality parameters of milk and milk products, methods of preservation and the role of microorganisms in various dairy fermentations	L2
CO2	Summarize the role of microorganisms in dairy fermentation, the diversity of cheese types based on microbial activity, and current diagnostic methods for identifying milk-borne pathogens	L2
CO3	Explain the principles of Quality Assurance (QA) and Quality Control (QC), and their application	L5
CO4	Compare different sterilization controls and bioassay methods	L4

Grading will be as 3: High (>60%), 2: Moderate (40%-60%), 1: Low (<40%), 0: No mapping

	PO1	PO2	PO3	PO4	PO5	PO6
CO1	3	1	1	0	1	1
CO2	3	1	1	0	1	1
CO3	3	1	1	0	1	1
CO4	3	1	1	0	1	1

Units	Description	No of lecture
Unit I Dairy Technology	1. Normal flora of milk, Changes in raw milk, Microbiological Quality of Milk & Milk Products: SPC, coliform count, LPC, thermophilic, psychrophilic counts and DMC. 2. Raw and fluid milk products Pasteurization & Ultra-pasteurization, Preservation methods (drying, evaporation, condensation). 3. Microbiology of butter, Yogurt, cultured buttermilk, dry milk and whey (flowsheet). 4. Cheese: Cheddar, Cottage, Processed Cheese, Cheese Defects. Enlist other cheese and associated microorganisms. 5. Rapid detection of milk borne pathogens- Nucleic acid based methods, immunological assays, biosensors.	**15**
Unit II QA, QC and Assays	1. Quality assurance and Quality control (5L) a. Definitions, Chemical and pharmaceutical products b. Variables of batch process c. Q.A and Q.C with respect to Raw materials, method of manufacturing, in process items, finished products, label and labeling, packaging materials d. Control of microbial contamination during manufacturing 2. Sterilization control and assurance (4L) 3. Bioassay (6L) a. Introduction b. Types: Diffusion, End Point, Turbidimetric, Metabolic Response, Enzymatic	**15**

Course Code 25BUMB6PE2	Course Title Practicals based on 25BUMB6TE2	Credits (02)	No. of Lectures in hours: 30

COURSE OUTCOME

On completion of this course, students will be able to learn:

CO1	Interpret microbiological quality tests of milk and analyze differences in quality between unpackaged and packaged milk products.	L5
CO2	Explain the underlying principles of protein precipitation and separation techniques used in dairy biochemistry with special reference to casein from milk.	L3
CO3	Evaluate the results of bioassay and chemical assay of penicillin, in terms of potency and purity according to standard protocols.	L5
CO4	Test sterility of injectables and their compliance with pharmaceutical standards	L6

Grading will be as 3: High (>60%), 2: Moderate (40%-60%), 1: Low (<40%), 0: No mapping

	PO1	PO2	PO3	PO4	PO5	PO6
CO1	3	2	1	1	3	0
CO2	3	2	1	1	3	0
CO3	3	2	1	1	3	1
CO4	3	2	1	1	3	0

25BUMB6PE2	1. DMC 2. MBRT 3. RRT 4. SPC 5. LPC 6. Thermophilic count 7. Coliform count 8. Caesin Extraction from milk 9. Comparative analysis of quality of Unpacked and packaged milk products 10. Bioassay of Penicillin 11. Chemical assay of penicillin 12. Sterility check of an injectable 13. Checking the purity of a drug	**60**

Course Code 25BUMB6VSC	Course Title Chemotherapy	Credits (02)	No. of Lectures in hours: 30

COURSE OUTCOME

On completion of this course, students will be able to learn:

CO1	Explain the classification, selective toxicity, LD50, MIC, MBC and modes of action of antimicrobial agents targeting cell wall synthesis, plasma membrane and protein synthesis.	L2
CO2	Illustrate using suitable examples, the modes of action of antimicrobial agents targeting nucleic acid synthesis, Enzyme inhibitors, Anti viral, fungal and parasitic and metabolic pathways and mechanisms of drug resistance.	L3
CO3	Select correct method of antimicrobial susceptibility testing as per the objective	L5
CO4	Analyze the data to determine minimum inhibitory concentration and/or minimum bactericidal concentration of the provided antibiotic.	L4

Grading will be as 3: High (>60%), 2: Moderate (40%-60%), 1: Low (<40%), 0: No mapping

	PO1	PO2	PO3	PO4	PO5	PO6
CO1	3	2	1	1	1	0
CO2	3	2	1	1	1	0
CO3	3	2	1	1	1	0
CO4	3	2	1	1	1	0

Units	Description	No of lecture
Unit I Chemotherapy	1. Discovery and Design of antimicrobial agents (1L) 2. Attributes of an ideal chemotherapeutic agent - Selective toxicity, Bioavailability of drug, routes of drug administration, LD50, MIC, MBC (2L) 3. Mode of action of antibiotics on (8L) a. Cell wall (Beta-lactams- Penicillin and Cephalosporins, Carbapenems) b. Cell Membrane (Polymyxin and Imidazole) c. Protein Synthesis (Streptomycin, Tetracycline and Chloramphenicol) d. Nucleic acid (Quinolones, Nalidixic acid, Rifamycin) e. Enzyme inhibitors (Sulfa drugs, Trimethoprim) f. List of common antibiotics - used for treating viral, fungal and parasitic diseases 4. Mechanisms of drug resistance - Evolution, pathways and origin for ESBL, VRE, MRSA (2L) a. Selection and testing of antibiotics for bacterial isolates by Kirby-Bauer method b. Methods to detect S. aureus resistance to methicillin, and determination of ESBL strains (2L)	**15**

Practicals based on 25BUMB6VSC	1. Antimicrobial susceptibility testing a. Kirby-Bauer method b. Agar cup method 2. Synergistic action of drugs 3. E test (Demo) 4. Stokes method 5. Determination of MIC 6. Determination of MBC	**30**

Course Code 25BUMB6OJT	On Job Training in Microbiology II	Credits 02	No. of hours: 60

COURSE OUTCOMES

On completion of this course, students will be able to:

CO1	Demonstrate practical, hands-on skills directly applicable to their roles defined by the organization.	L2
CO2	Relate the direct impact of good laboratory practices with quality standards.	L2
CO3	Build a professional skill set, including soft skills.	L3
CO4	Explain outcomes clearly through written reports, visual displays, or oral presentations.	L5

Grading will be as 3: High (>60%), 2: Moderate (40%-60%), 1: Low (<40%), 0: No mapping

	PO1	PO2	PO3	PO4	PO5	PO6
CO1	3	2	2	1	3	2
CO2	3	2	2	1	3	2
CO3	3	2	2	1	3	2
CO4	3	2	3	1	3	2

Description

In this course, the learner is required to get engaged in ‘On job training’ at a professional institute/ organization from the field related to Microbiology. The learner is expected to acquire field-based skills, professional planning and execution of activities undertaken by the organization. The learner needs to complete 60 hrs. of training.

The learner would be required to qualify the assessment where he /she would be required to communicate outcomes clearly, interpret findings logically through written report, and visual oral presentation and viva.

Course Code 25BUMB6FPR	Field Project	Credits 02	No. of hours: 60

COURSE OUTCOME

On completion of this course, students will be able to learn:

CO1	Demonstrate practical, hands-on competence in essential laboratory techniques	L2
CO2	Develop analytical skills like designing experiment, data collection, statistical analysis and interpretation of results	L3
CO3	Experiment with basic knowledge integration from allied fields like molecular biology, bioinformatics, and biotechnology to address complex, multidisciplinary challenges	L3
CO4	Build written and oral communication skills through report writing, presentations	L3

Grading will be as 3: High (>60%), 2: Moderate (40%-60%), 1: Low (<40%), 0: No mapping

	PO1	PO2	PO3	PO4	PO5	PO6
CO1	3	3	3	1	3	2
CO2	3	3	3	1	3	2
CO3	3	3	3	1	3	2
CO4	3	3	3	1	3	2

Description

The learner can undertake the field project to apply knowledge of core topics of basic microbiology to solve a real-world problem in areas such as healthcare, environmental sustainability, food safety, agriculture etc.

The learner would be required to qualify the assessment where he /she would be required to communicate outcomes clearly, interpret findings logically through written report, visual displays, or oral presentations and viva.

References

SEMESTER VI

Sr. No.	Title	Author/s	Publisher	Edition	Year
1	Genetics: A Conceptual Approach	Benjamin A. Pierce	WH Freeman	3rd	2007
2	iGenetics: A Molecular Approach	Peter Russel	Benjamin Cummings	3rd	2010
3	Fundamental bacterial genetics	Trun & Trempy	Wiley-Blackwell	1st	2004
	Molecular Biology	David Friefelder	Narosa Publishing House	2nd	2004
	Principles of Gene Manipulation and Genomics	S.B. Primrose	Wiley Blackwell	7th	2013
4	Microbiology- an evolving science	John W. Foster, Joan L. Slonczewski	W. W. Norton & company Ltd.	4th	2017
5	Kuby Immunology	Kindt, Thomas J, Osborne, Barbara A., Goldsby, Richard A.	WH Freeman	6th	2006
6	Immunology: Essential & Fundamental	Pathak & Palan	Capital Publising	2nd	2005
7	Textbook of basic and clinical Immunology	Sudha Gangal and Shubhangi Sontakke	Universities press	1st	2013
8	Bacterial Metabolism	Gottschalk	Springer Verlag	2nd	1985
9	Lehninger's Principles of Biochemistry	Nelson, D. L. and M.M. Cox	W.H. Freeman & Company	4th	2005
10	The Physiology and	White, D	Oxford	3rd	1995

	Biochemistry of Prokaryotes		University Press		
11	General Microbiology	Stanier, R.Y., M. Doudoroff and E. A. Adelberg	Macmillan Press Ltd	5th	2004
12	Understanding Viruses	Teri Shors	Jones & Bartlett Learning	3rd	2016
13	Principles of Virology	Flint, Racaniello, Rall, Skalka, Enquist	ASM Press	4th	2015
14	Principles of Fermentation Technology	P. F. Stanbury, A. Whitaker, S. J. Hall	Butterworth Heinemann, Oxford	2nd	2000
15	Fermentation Technology	H.A. Modi	Pointer Publications	8th	2009
16	Modern Industrial Microbiology and Biotechnology	Okafor Nduka	Science publication USA	1st	2007
17	Microbial Technology Vol. 1 & 2	Peppler, H. J. and Perlman	Academic Press	2nd	2009
18	Biotechnology: A Textbook of Industrial	Crueger W. and Crueger A.	Panima Publishing	2nd	2004
19	Outlines Of Dairy Technology	Sukumar De	Oxford	1st	2004
20	Environmental Science	S C Santra	-	1st	2011
21	https://doi.org/10.1016/j.envadv.2023.100440				
22	Jawetz, Melnick and Adelberg's Medical Microbiology	G.F.Brooks, Morse, Carroll, Mietzner, Butel	Lange publication	26th	2013
23	Mim's Medical Microbiology	Goering, Mark Zuckerman, Dockrell,	Elsevier limited	6th	2019

		chiodini			
24	Ananthanarayan and Paniker's Textbook of Microbiology	R Ananthanarayan	The Orient Blackswan	10th	2017
25	Principle and Practice of Animal Tissue Culture	Sudha Gangal	University Press	2nd	2010
26	Introduction to Plant Tissue Culture	M.K. Razdan	Oxford and IBH Publishing	2nd	2019
27	Plant Tissue Culture	Kalyan Kumar De	New Central Book Agency	1st	2008

VPM's B.N. Bandodkar College of Science (Autonomous), Thane

Curriculum Structure for the Undergraduate Degree Programme T.Y.B.Sc Microbiology

	SEMESTER – V	Course imparts Employability (EM), Entrepreneurship (EN), Skill Development (SD)			Course integrates with Professional Ethics (PE), Gender Equity (GE), Human Value (HV), Environmental Sustainability (ES)			
Course Code	**Course Title**	**EM**	**EN**	**SD**	**PE**	**GE**	**HV**	**ES**
25BUMB5T01	Translation, mutation and repair	-	-	-	-	-	-	-
25BUMB5T02	Immunology I	-	-	✔	-	-	-	-
25BUMB5T03	Microbial Biochemistry I	✔	-	✔	-	-	-	-
25BUMB5P01	Practicals based on 25BUMB5T01	✔	✔	✔	-	-	-	-
25BUMB5P02	Practicals based on 25BUMB5T02	✔	✔	✔	-	-	-	-
25BUMB5P03	Practicals based on 25BUMB5T03	✔	✔	✔	-	-	-	-
25BUMB5TE1	Bioprocess Technology	-	-	✔	-	-	-	-
25BUMB5PE1	Practicals based on 25BUMB5TE1	✔	✔	✔	-	-	-	-
25BUMB5TE2	Microbiology for Sustainable Development	-	-	-	-	-	-	✔
25BUMB5PE2	Practicals based on 25BUMB5TE2	-	-	✔	-	-	-	✔
25BUMB5VSC	Medical Microbiology	✔	✔	✔	-	-	-	-
25BUMB5OJT	On Job Training in Microbiology I	✔	✔	✔	✔	✔	✔	✔

25BUMB5FPR	Field Project in Microbiology III	✔	✔	✔	✔	✔	✔	✔

	SEMESTER – VI	Course imparts Employability (EM), Entrepreneurship (EN), Skill Development (SD)			Course integrates with Professional Ethics (PE), Gender Equity (GE), Human Value (HV), Environmental Sustainability (ES)			
Course Code	**Course Title**	**EM**	**EN**	**SD**	**PE**	**GE**	**HV**	**ES**
25BUMB6T01	Regulation of gene expression and genetic exchange	-	-	-	-	-	-	-
25BUMB6T02	Immunology II	-	-	✔	-	-	-	-
25BUMB6T03	Microbial Biochemistry II	-	-	-	-	-	-	-
25BUMB6T04	Molecular Biology & Virology	-	-	✔	-	-	-	-
25BUMB6P01	Practicals based on 25BUMB6T01	✔	✔	✔	-	-	-	-
25BUMB6P02	Practicals based on 25BUMB6T02 & 25BUMB6T03	✔	✔	✔	-	-	-	-
25BUMB6P03	Practicals based on 25BUMB6T04	✔	✔	✔	-	-	-	-
25BUMB6TE1	Tissue Culture	-	-	-	-	-	-	✔
25BUMB6PE1	Practicals based on 25BUMB6TE1	✔	✔	✔	-	-	-	✔
25BUMB6TE2	Dairy Microbiology & QA/QC	✔	-	✔	-	-	-	-
25BUMB6PE2	Practicals based on 25BUMB6TE2	✔	✔	✔	-	-	-	✔
25BUMB6VSC	Chemotherapy	✔	-	✔	-	-	-	-
25BUMB6OJT	OOn Job Training in Microbiology II	✔	✔	✔	✔	✔	✔	✔

25BUMB6FPR	Field Project	✔	✔	✔	✔	✔	✔	✔