Bharatiya Vidya Bhavan

BHAVAN'S VIVEKANANDA COLLEGE OF SCIENCE, HUMANITIES AND COMMERCE, SAINIKPURI, SECUNDERABAD.

Autonomous College

Affiliated to Osmania University, Hyderabad.

(*Accredited with 'A' grade by NAAC*)

Department of Microbiology

Effective for 2026-28

M.Sc. Microbiology Semester I

Syllabus Ref No	Subject	Credits	Teaching Hours	Marks		
				Internal Assessment	Semester Exam	Total
THEORY						
PMB 101	General Microbiology& Microbial Physiology **(Core)**	4	4	30	70	100
PMB 102	Virology **(Core)**	4	4	30	70	100
PMB 103	Molecular Biology and Microbial Genetics**(Core)**	4	4	30	70	100
PMB 104	Microbial Biochemistry **(Core)**	4	4	30	70	100
PRACTICALS						
PMB 151	General Microbiology& Microbial Physiology	2	4	-	50	50
PMB 152	Virology	2	4	-	50	50
PMB 153	Molecular Biology and Microbial Genetics	2	4	-	50	50
PMB 154	Microbial Biochemistry	2	4	-	50	50
	Total	**24**	**32**	**120**	**480**	**600**

CHAIRPERSON
BOS in Microbiology
Bhavan's Vivekananda College
Sainikpuri

Dr. Hameeda Bee
Professor
Department of Microbiology
Osmania University, Hyd-07

Bharatiya Vidya Bhavan

BHAVAN'S VIVEKANANDA COLLEGE

of Science, Humanities and Commerce

Sainikpuri Secunderabad- 500094
Reaccredited with 'A' Grade by NAAC
Autonomous College, Affiliated to O. U

Syllabus –M.Sc I Year Microbiology

(w.e.f academic year: 2026-27)

Semester I

Course: General Microbiology and Microbial Physiology **Hour/week:** 4
Course Code: PMB 101 (60 Hours) **Credits:** 4

Course Objectives:

The objectives of this course are

1. Remember the contributions of pioneers in Vedic microbiology along with modern microbiologists.
2. Understand the principles of microscopy and microbial cell structure, including prokaryotic and eukaryotic organization and endospore formation.
3. Apply sterilization, cultivation, isolation, and preservation techniques for microorganisms under laboratory conditions.
4. Analyze microbial identification methods including staining, biochemical, immunological, and molecular approaches.
5. Evaluate microbial taxonomy, classification systems, and nutritional and metabolic diversity of microorganisms.
6. Analyze and interpret microbial growth patterns, environmental factors affecting growth, and stress responses in microbes.

Contents of the course

UNIT 1	**15Hrs**
Concept of Vedic Microbiology, Pioneers of Vedic Microbiology-Acharya Charaka, Susrutha and Vaghbhata.	2hrs
Pioneers of Microbiology- Anton Van Leeuwenhoek, Louis Pasteur, Robert Koch, Edward Jenner, Winogradsky, Biejerinck, Alexander Flemming and Selman Walsmann.	3hrs
Microscopy- Principles, working and applications of bright field microscope, fluorescent microscope, Phase contrast microscope, electron microscope.	3hrs
Microbial Cell Structure: Prokaryotic cell, Eukaryotic cell. Organization and function of cellular organelles.	3hrs
Bacterial endospore structure. biochemistry and genetics of sporulation.	2hr
Biomechanics and Mechanobiology to understand bacterial physiology.	1hr
Proteins FtsZ. MreB, crescentin. Mechanosensors and motility appendages.	1hr

CHAIRPERSON
BOS in Microbiology
Bhavan's Vivekananda College
Sainikpuri

Dr. Hameeda Bee
Professor
Department of Microbiology
Osmania University, Hyd-07

UNIT 2 **15Hrs**

Methods of sterilization: Physical methods- Autoclave, Hot air oven, Laminar air flow and Filter sterilization. Radiation methods - U.V rays, Gamma rays, Ultrasonic methods. 3hrs

Chemical methods - Alcohols, Aldehydes, Phenol, Halogens and Hypo chlorides. 2hrs

The concept of prototrophs and auxotroph. 1hr

Microbiological media - Autotrophic media, synthetic media, heterotrophic media, Minimal media, defined media, complex media. 2hrs

Cultivation of Bacteria, Fungi and Algae: Routine and special culture methods (agar slant, agar stab, agar plate, roll tube, shake flask, aerobic and anaerobic culturing). 3hrs

Isolation of pure cultures. 2hrs

Preservation and Maintenance of Microbial Cultures: Routine methods and Liquid nitrogen preservation, freeze-drying (lyophilization). 2hrs

UNIT 3 **15Hrs**

Microbial identification: staining methods and microscopic. 3hrs

Ecological, Nutritional (cultural) biochemical methods, immunological characteristics, Molecular and genetic characteristics (16s rRNA and ITS). 2hrs

Principles of bacterial taxonomy and classification: - Numerical taxonomy. Bergey's manual and its importance. 4hrs

Microbial nutrition and metabolism: autotrophy - Photoautotrophy and bacterial photosynthesis, Chemoautotrophy and heterotrophic metabolism. 6hrs

UNIT 4 **15Hrs**

Microbial growth: The concept of growth and definition. 2hrs

Cell cycle in microbes and generation time. 2hrs

Growth phases of bacteria and importance of each growth phase. 2hrs

Synchronous cultures - methods of synchronous culturing. Continuous culturing methods, biphasic growth factors (pH, temperature, drought, salinity) affecting growth. 3hrs

Methods of microbial growth measurement. 3hrs

Microbial stress response- Oxidative stress, Thermal stress, Starvation stress, Aerobic to Anaerobic transition. 3hrs

Course Outcomes:

By the end of the course, the students will be able to

PMB 101.CO1: Recall and describe contributions of Vedic and modern microbiologists and foundational concepts in microbiology.

PMB 101.CO2: Explain microscopy techniques, microbial cell structures, and mechanisms like sporulation and cytoskeletal proteins.

PMB 101.CO3: Demonstrate sterilization, culturing, isolation, and preservation techniques

CHAIRPERSON
BOS in Microbiology
Bhavan's Vivekananda College
Sainikpuri

Dr. Hameeda Bee
Professor
Department of Microbiology
Osmania University, Hyd-07

for microorganisms.

PMB 101.CO4: Differentiate and analyze microbial identification methods including staining, biochemical, and molecular techniques.

PMB 101.CO5: Classify and evaluate microorganisms based on taxonomy, nutritional types, and metabolic pathways.

PMB 101.CO6: Interpret microbial growth curves, environmental influences, and stress adaptation mechanisms.

(PAPER I) I Semester PMB 151 General Microbiology and Microbial Physiology Practicals

4HPW - Credits-2

Course Objectives:

The objectives of this course are

1. Apply laboratory safety rules, microscopy techniques, staining methods, and sterilization procedures in microbiology experiments.
2. Perform preparation of various culture media and cultivation techniques for bacteria, fungi, and algae under different conditions.
3. Analyze microbial identification methods, including biochemical and molecular approaches, and anaerobic culturing techniques.
4. Evaluate microbial growth patterns and the effects of environmental factors such as temperature, pH, and salinity.

1. General instructions, Microbiology laboratory and its discipline.
2. Handling of microscopes, Calibration and measurement of microscopic objects.
3. Staining techniques for bacteria - simple, differential and special staining.
4. Sterilization procedures/methods.
5. Preparation of microbiological media. Autotrophic media, minimal media, basic media. enriched media, enrichment media, differential media.
6. Isolation and cultivation of pure cultures.
7. Identification methods of bacteria: Biochemical and molecular (demonstration).
8. Isolation and culturing of fungi (yeasts and molds) and algae.
9. Culturing methods of microbes - slant and stab cultures, tube culture, flask cultures, shake flask cultures.
10. Anaerobic culturing methods - anaerobic jar, pyrogallol method, thioglycolate media culturing, anaerobic glove box.
11. Microbial growth experiments - Viable count and calculation of generation time of bacteria.
12. Study of bacterial growth curve.
13. Effect of temperature and pH on microbial growth.
14. Microbial stress response in salinity conditions.

CHAIRPERSON
BOS in Microbiology
Bhavan's Vivekananda College
Sainikpuri

Dr. Hameeda Bee
Professor
Department of Microbiology
Osmania University, Hyd-07

Recommended books

1. Pelczar's A Textbook of Microbiology, 7th Edition (2025) by Michael J. Pelczar Jr
2. Brock Biology of Microorganisms 16th Edition (2023) by Michael T. Madigan, Kelly S. Bender, Daniel H. Buckley, W. Matthew Sattley, David A. Stahl
3. Prescott's Microbiology 11th Edition (2020) by Joanne Willey, Kathleen Sandman, Chris Woolverton.
4. Bergey's Manual of Systematic Bacteriology Vol. 1-5; 2nd Edition.
5. Microbiology: An Introduction 14th Edition (2021) by Gerard J. Tortora, Berdell R. Funke, Christine L. Case.
6. Microbial Physiology 4th Edition by Albert G. Moat, John W. Foster, Michael P. Spector.
7. A Textbook of Microbiology 10th Edition (2024) by Ananthanarayan and Panikar.
8. Microbiology Practical Manual 3rd Edition (2024) by Shukla Das.
9. Practical Handbook of Microbiology 4th Edition (2020) by Lorrence H. Green (Editor).
10. Microbiology Laboratory Theory and Application 5th Edition (2023) by Michael J. Pelczar Jr. et al.
11. Alfred Brown and Heidi Smith, 2017, Bensons Microbiological application: A laboratory manual in General Microbiology, Indian Edition, Mc.Graw Hill (13e).
12. Laboratory manual of Microbiology and Biotechnology by K.R. Aneja. 2014.

Course outcomes:

By the end of the course, the students will be able to

PMB 151.CO1: Demonstrate essential microbiological skills including microscopy, staining, sterilization, and aseptic techniques.

PMB 151.CO2: Prepare and maintain different types of culture media and successfully isolate and cultivate pure microbial cultures.

PMB 151.CO3: Analyze and interpret microbial identification results using biochemical and basic molecular methods.

PMB 151.CO4: Assess microbial growth dynamics, including growth curve, generation time, and stress responses under varying environmental conditions.

.

CHAIRPERSON
BOS in Microbiology
Bhavan's Vivekananda College
Sainikpuri

Dr. Hameeda Bee
Professor
Department of Microbiology
Osmania University, Hyd-07

Bharatiya Vidya Bhavan
BHAVAN'S VIVEKANANDA COLLEGE
of Science, Humanities and Commerce
Sainikpuri Secunderabad- 500094
Reaccredited with 'A' Grade by NAAC
Autonomous College, Affiliated to O. U

Syllabus - M.Sc Microbiology Previous
(w.e.f academic year: 2026-27)
Semester I

Course: Virology
Course Code:PMB 102 (60 Hours)

Hours/Week:4
Credits:4

Course Objectives:

1. To describe the history of virology, viral classification systems (Baltimore, ICTV hierarchy), and basic viral structure and morphology.
2. To explain viral diversity including emerging viruses, sub-viral particles, cyanophages, actinophages, and viral metagenomics (virome).
3. To demonstrate principles of virus detection, cultivation, and quantification using physical, biological, serological, and molecular methods.
4. To analyze viral replication strategies, host-virus interactions, cytopathic effects, and immune responses.
5. To evaluate pathogenicity, transmission, diagnosis, prevention, and control of plant, animal, and human viral diseases.
6. To design and interpret applications of viruses in biotechnology including vaccines, antiviral agents, and viral vectors.

Contents of the course

Unit-1 **15 Hrs**

History of virology (latest Scientific investigations), Viral classification: Baltimore. Recent changes to virus taxonomy, ICTV-Virosphere and Hierarchical ranks	2
Viral metadata resource, viral metagenomics -Virome	1
Virus structure and morphology	1
Detection of viruses: physical, biological, serological and molecular methods. Cultivation and quantification of bacteriophages, plant and animal viruses	3
Significance of emerging viruses: Ebola, Nipah, Hantavirus, Zika virus.	3
General idea about cyanophages, actinophages and mycophages	3
Sub-viral particles: structure, replication and diseases caused by satellites virus, viroids and prions	2

CHAIRPERSON
BOS In Microbiology
Bhavan's Vivekananda College
Sainikpuri

Dr. Hameeda Bee
Professor
Department of Microbiology
Osmania University, Hyd-07

Unit-2 **15 Hrs**

Viral replication Strategies: Cellular interactions---Clatherin coated pits, Lipid rafts, Endocytosis and virus uncoating mechanisms	2
Host response to viral infection-apoptosis, necrosis, stress response. Cellular basis of transformation, Types of cytopathic effects.	1
Structure, characteristics and replication strategies of Bacteriophages: T4 and Lambda	3
Structure, characteristics and replication strategies of ds/ss DNA viruses- Pleolipoviridae- Archaeal virus; ds DNA viruses: Adenoviridae - Adenovirus; ss DNA: Nanoviridae - BBTV	3
ds RNA viruses: Reoviridae - Rota virus; (+) ssRNA virus: Coronaviridae - SARS-CoV2; Virgaviridae: Tobacco Mosaic Virus (TMV); (-) ssRNA virus: Paramyxoviridae - Measles virus	4
ssRNA-RT virus: Retroviridae- HIV; dsDNA-RT virus: Hepadnaviridae - Hepatitis B virus.	2

Unit-3 **15 Hrs**

Introduction to traditional medicine; role of spices used in Indian foods for prevention and treatment of Viral Infections.	1
Pathogenicity, Lab Diagnostics, Prevention and Control of Plant viruses: Cauliflower Mosaic Virus, Gemini viruses.	2
Pathogenicity, Lab Diagnostics, Prevention and Control of Animal viruses: Air borne viral infections: Influenza, Rubella, Mumps	4
Water borne viral infections - Hepatitis (HAV). Polio myelitis	2
Zoonotic viral infections - Rabies, Dengue.	2
Sexually transmitted viral diseases - Herpes (Herpes Simplex Virus) Hepatitis B viruses, HIV-acquired immunodeficiency syndrome (AIDS)	4

Unit-4 **15 Hrs**

Recombination in phages, multiplicity reactivation and phenotypic mixing	4
General account of Tumor virus (RNA and DNA)	2
Viral Interference and Interferons. Classification of Interferons. Antiviral agents (chemical) and their mode of actions	3
Different types of viral vaccines	2
Viral vectors used for cloning and sequencing: Lambda phage, M 13, Retro viruses. Use of Baculoviruses and CaMV 35S promoter and its application.	4

CHAIRPERSON
BOS in Microbiology
Bhavan's Vivekananda College
Sainikpuri

Dr. Hameeda Bee
Professor
Department of Microbiology
Osmania University, Hyd-07

Course Outcomes:

By the end of the course, the students will be able to

PMB 102 CO1 : Outline and classify viruses based on structure, genome organization, and ICTV taxonomy, including recent updates in virosphere Classification.

PMB 102 CO2: Explain and apply techniques for viral detection, cultivation, and quantification in laboratory settings.

PMB 102 CO3: Illustrate and compare replication strategies of different virus groups (DNA, RNA, retroviruses, bacteriophages).

PMB 102 CO4: Examine host-virus interactions, immune responses, and mechanisms such as apoptosis, transformation, and cytopathic effects.

PMB 102 CO5: Assess the epidemiology, pathogenicity, diagnosis, and control measures of major viral diseases including zoonotic, airborne, waterborne, and sexually transmitted infections.

PMB 102 CO6: Develop and justify the use of antiviral strategies, vaccines, interferons, and viral vectors in research, medicine, and biotechnology.

I Semester Practical Paper II
PMB 152 Virology (4 HPW-2 Credits)

Course Objectives

1. To demonstrate techniques for isolation, cultivation, preservation, and quantification of bacteriophages from diverse environmental samples.
2. To perform experimental procedures related to phage biology such as growth curve analysis, burst size determination, and phage induction.
3. To examine and interpret viral infections in plants and animals through symptomatic observations, cytopathological changes, and lesion studies.
4. To assess and utilize applications of viruses in food preservation, biopesticides (NPV), and public health initiatives like vaccination programs

Practical Syllabus

1. Isolation of E.coli phage from soil
2. Isolation of E.coli phage from sewage
3. Isolation of phages from contaminated food samples
4. Application of bacteriophages as food preservatives
5. Quantification of phages
6. Cultivation and preservation of phages
7. Growth phages of phage and burst size (Demonstration)
8. Phage induction demonstration
9. Cultivation of animal viruses in egg allantoic, amniotic and CAM

CHAIRPERSON
BOS In Microbiology
Bhavan's Vivekananda College
Sainikpuri

Dr. Hameeda Bee
Professor
Department of Microbiology
Osmania University, Hyd-07

10. Symptomatic observations of plant viral infections
11. Demonstration of cytopathological changes of animal virus
12. Study of pathogenic lesions of animal virus diseases through slides.
13. Application of NPV and its role as biopesticide.
14. Visit to lab for NPV production
15. Awareness and participation in vaccination programs (extension activity).

Course Outcomes:

By the end of the course, the students will be able to

PMB 152 CO1:Isolate, cultivate, and quantify bacteriophages from soil, sewage, and food samples using standard microbiological techniques.

PMB 152 CO2: Analyze phage growth parameters (growth curve, burst size) and interpret experimental outcomes from phage induction studies.

PMB 152 CO3: Identify and evaluate plant and animal viral infections through symptoms, cytopathology, and lesion observations.

PMB 152 CO4: Demonstrate and justify the application of viruses in food safety (biopreservation), agriculture (NPV as biopesticide), and public health (vaccination awareness).

Recommended Books

1. Recent publications: Research papers and review articles from Google search engine
2. General Virology by Luria and Damel .
3. Basic Virology. E.K. Wagner .
4. Virology and Immunology by Jokli .
5. Laboratory manual of Microbiology and Biotechnology by Aneja, I(R . Text book of Virology by Rhodes and Van Royen
6. Plant Virology by Smith
7. Genetics of bacteria and their viruses by W. Hayes
8. Molecular Biology of the gene by Watson, Roberts, Staitz and Weiner . A laboratory guide in virology by Chjarles H. Lunningham
9. Basic lab procedures in diagnostic virology by Marty Christensen
10. Review of medical microbiology by Jawitz et al
11. Medical laboratory manual for tropical countries Vol I & II by Monica Cheesbrough .
12. Text Book of Microbiology by Ananthanarayanan and Jayaram Paniker
13. Text book of Virology by Rhodes and Van Royan
14. Principles of Virology: Molecular Biology, pathogenesis and control of animal viruses

CHAIRPERSON
BOS in Microbiology
Bhavan's Vivekananda College
Sainikpuri

Dr. Hameeda Bee
Professor
Department of Microbiology
Osmania University, Hyd-07

Bharatiya Vidya Bhavan

Bhavan's Vivekananda College

of Science, Humanities & Commerce
Sainikpuri, Secunderabad
Autonomous College - Affiliated to Osmania University
Accredited with 'A' grade by NAAC

Syllabus - M Sc I Year Microbiology
(W.e.f academic year: 2026-27)
Semester I

Course: Molecular Biology & Microbial Genetics
Course Code: PMB 103(60 Hours)

Hour/week: 4
Credits: 4

Course objectives

1. To understand the organization and structure of genomes in prokaryotic and eukaryotic systems, including different forms of DNA and RNA.
2. To explain the mechanisms of DNA replication, transcription, and translation, along with the role of enzymes and regulatory elements.
3. To analyze the structure, function, and processing of RNA molecules (mRNA, tRNA, rRNA) and post-translational modifications.
4. To study the concept of genes, gene regulation, and operon models, along with mutation types and DNA repair mechanisms.
5. To understand genetic recombination processes in bacteria, including transformation, conjugation, transduction, and transposable elements.
6. To introduce the principles and techniques of genetic engineering, including cloning, PCR, vectors, and gene library construction.

Contents of the course

Unit-1: 15Hrs

Genome organization in prokaryotes and eukaryotes.
Detailed structure of DNA, Z-DNA, A & B DNA, Denaturation and melting curves. 2hrs
DNA replication – Meselson and Stahl Experiment. Enzymology of DNA replication.
Mechanism of Semi conservative replication.
Rolling circle model, theta model, etc. 4hrs
Eukaryotic telomere and its replication. Prokaryotic and eukaryotic transcription. 4hrs
Structure and processing of m-RNA, r-RNA, t-RNA. Ribozyme, Genetic code and Wobble hypothesis, Translation in prokaryotes and eukaryotes.
Post translational modifications. 5hrs

CHAIRPERSON
BOS in Microbiology
Bhavan's Vivekananda College
Sainikpuri

Dr. Hameeda Bee
Professor
Department of Microbiology
Osmania University, Hyd-07

Unit-2: **15Hrs**

Concept of gene, Benzer's fine structure of gene – muton, cistron, recon. Types of genes – structural, constitutive, regulatory (split genes, overlapping genes, pseudogenes and oncogenes). 2hrs
Gene regulation and expression – Lac operon, arabinose and tryptophan operons. 3hrs
Gene regulation in eukaryotic systems, repetitive DNA, gene rearrangement, promoters, enhancer elements. Introduction to Short hairpin RNA (shRNA) and MicroRNA (miRNA) 5hrs
Mutation: Molecular basis of mutations, Physical, chemical and biological mutagens. Detection and analysis of mutations (Replica plating, Antibiotic enrichment, Ames test, etc.).
DNA damage and repair mechanisms. Global response to DNA damage 5hrs

Unit-3:

15Hrs

Bacterial recombination – Discovery, gene transfer, molecular mechanism, detection, efficiency calculation and applications.
Bacterial transformation – Competency and resistance. 5hrs
Bacterial conjugation – Sex factor in bacteria, F and HFR transfer, linkage mapping 2hrs
Bacterial transduction – transduction phenomenon, methods of transduction 4hrs

Transposable elements – Definition, detection of transposition in bacteria, types of bacterial transposons (DNA transposons, Retrotransposons and mechanism).
Giant extra chromosomal element – Indole and its significance). 4hrs

Unit-4: **15Hrs**

Principles of genetic engineering 3 hrs
Genomic/cDNA library construction, screening and applications
Vectors – Plasmids, phagemids/viral vectors, cosmids, Artificial chromosomes.
Restriction enzymes, polymerases, ligases, etc. 4 hrs
Polymerase chain reaction and quantitative real-time PCR.
Promoters. Blue-white selection of recombinant colonies.
Selection, expression and detection of cloned genes 5hrs
Cloning in *E. coli*, Cloning in *Bacillus subtilis*, cloning in yeast. 3hrs

Course outcomes: By the end of the course, the students will be able to,

PMB 103.CO1: Describe the structural organization of DNA and genomes and distinguish between prokaryotic and eukaryotic systems.
PMB 103.CO2: Explain the molecular mechanisms of replication, transcription, and translation, including enzymatic processes and regulation.
PMB 103.CO3: Interpret the structure and processing of different RNA types and evaluate their roles in protein synthesis.
PMB 103.CO4: Analyze gene structure, gene expression, operon systems, and the molecular basis

CHAIRPERSON
BOS in Microbiology
Bhavan's Vivekananda College
Sainikpuri

Dr. Hameeda Bee
Professor
Department of Microbiology
Osmania University, Hyd-07

of mutations and DNA repair.

PMB 103.CO5: Understanding of bacterial recombination and gene transfer mechanism and their applications

PMB 103.CO6: Apply knowledge of genetic engineering techniques, including cloning strategies, PCR, and vector-based gene manipulation.

(PAPER III) I Semester PMB 153
Molecular Biology and Microbial Genetics Practicals
4HPW - Credits-2

Course objectives:

1. To develop practical skills in isolation and purification of genomic DNA from various sources such as *E. coli* and yeast and perform quantitative estimation of biomolecules including DNA, RNA, and proteins using standard methods.
2. To study mutation induction using physical (UV) and chemical mutagens and understand their effects on microorganisms and learn techniques for screening and isolation of mutants, including replica plating.
3. To understand and perform fundamental molecular biology techniques such as restriction enzyme digestion and agarose gel electrophoresis.
4. To gain hands-on experience in gene expression and genetic engineering methods such as Lac operon induction and bacterial transformation.

1. Isolation of genomic DNA from *E. coli*
2. Isolation of genomic DNA from Yeast
3. Estimation of DNA (colorimetry)
4. Estimation of RNA
5. Estimation of protein by Folin's method
6. Induction of mutations by physical mutagens (UV)
7. Induction of mutations by chemical mutagens
8. Screening andIsolation of mutants by Replica plating technique
9. Digestion of DNA by restriction endonucleases
10. Determination of molecular weight of DNA resolved on agarose gel electrophoresis
11. Induction of Lac operon and observation of lac operon concept in *E. coli*
12. Demonstration of transformation in bacteria using $CaCl_2$ heat shock method
13. Protoplast preparation, fusion and regeneration

Course outcomes: By the end of the course, the students will be able to,

PMB 153.CO1: Isolate and analyze genomic DNA from different biological sources and quantify DNA, RNA, and proteins using standard biochemical methods

PMB 153.CO2: Induce and study mutations using physical and chemical mutagens and isolate microbial mutants using replica plating techniques

PMB 153.CO3: Perform DNA manipulation techniques including restriction digestion and electrophoresis.

CHAIRPERSON
BOS in Microbiology
Bhavan's Vivekananda College
Sainikpuri

Dr. Hameeda Bee
Professor
Department of Microbiology
Osmania University, Hyd-07

PMB 153.CO4: Demonstrate genetic engineering techniques such as transformation and operon induction.

References:

- *Principles and Techniques of Biochemistry and Molecular Biology* 8th Edition (2018) – Keith Wilson, John Walker
- *Genes XII* 12th Edition (2017) – Benjamin Lewin
- *Molecular Biology of the Cell* 6th Edition (2014) – Bruce Alberts
- *Molecular Biology of the Gene* 7th Edition (2013) – James D. Watson
- *Molecular Biology* – David Freifelder
- *MOLBIO (Fundamentals of Molecular Biology)* 2023 – Avinash Upadhyay, Kakoli Upadhyay
- *Basic Molecular Biology* (2010) – Avinash Upadhyay, Kakoli Upadhyay
- *Cytology, Genetics and Molecular Biology* – Sushil Kumar Upadhyay, Harendra Kumar Gaur
- *Molecular Biology Techniques: A Classroom Laboratory Manual* 3rd Edition (2024) – Carolyn D. Bustamante, Jan Vaughan
- *Molecular Biology: A Laboratory Manual* (2013) – S. K. Gakhar, Monika Miglani, Ashwani Kumar
- *Laboratory Manual of Microbiology, Biochemistry and Molecular Biology* (2015) – J. Saxena, M. Baunthiyal, I. Ravi

CHAIRPERSON
BOS in Microbiology
Bhavan's Vivekananda College
Sainikpuri

Dr. Hameeda Bee
Professor
Department of Microbiology
Osmania University, Hyd-07

Bharatiya Vidya Bhavan

BHAVAN'S VIVEKANANDA COLLEGE

of Science, Humanities and Commerce

Sainikpuri Secunderabad- 500094
Reaccredited with 'A' Grade by NAAC
Autonomous College, Affiliated to O. U

Syllabus - MSc I Year Microbiology
(W.e.f academic year: 2026-27)
Semester I

Course:	Microbial Biochemistry	**Hour/week:**	4
Course Code:	PMB 104 (60 Hrs.)	**Credits:**	4

Course Objectives: The objectives of this course are,

1. To understand the biological significance of pH, buffer systems, and their role in maintaining cellular homeostasis.
2. To explain the principles of bioenergetics, including thermodynamics, redox reactions, and ATP generation mechanisms.
3. To describe the classification, structure, and properties of biomolecules such as carbohydrates and lipids.
4. To understand the structure, metabolism, and functions of nucleic acids, proteins, and amino acids.
5. To explain enzyme structure, classification, kinetics, and factors affecting enzyme activity.
6. To evaluate enzyme regulation, inhibition mechanisms, and apply concepts in enzyme engineering and biotechnology applications.

Contents of Course

Unit I	**15Hrs**
Prominent Biochemists and their contributions – Emil Bloch, Dorothy Hodgkin, Carl Neugerg, Paul Boyer, John Walker, Kamala Sohonie	2Hrs
pH and its biological relevance.	2Hrs
Determination of pH. Preparation of Buffer and maintenance of pH.	2Hrs
Concept of entropy, free-energy, free energy changes, high energy compounds. Equilibrium constants.	2Hrs
Redox potentials, Biological Redox systems, Biological oxidation,	2Hrs
Biological membranes, Electron transport	2Hrs
Oxidative phosphorylation and mechanism.	3Hrs

CHAIRPERSON
BOS in Microbiology
Bhavan's Vivekananda College
Sainikpuri

Dr. Hameeda Bee
Professor
Department of Microbiology
Osmania University, Hyd-07

Unit II	**15Hrs**
Carbohydrates: Classification, basic chemical structure, monosaccharides, aldoses, and ketoses.	3Hrs
Cyclic structure of monosaccharides, stereoisomerism, anomers and epimers.	2Hrs
Sugar derivatives, deoxy sugars, amino sugars, and sugar acids	2Hrs
Nucleic acids: Structure and properties of Purines, Pyrimidines, nucleosides and nucleotides.	3Hrs
Metabolism of Purines and Pyrimidines - Biosynthesis and degradation-	5Hrs

Unit III	**15Hrs**
Proteins and amino acids: Properties of amino acids	2Hrs
Structure, confirmation and properties of proteins	3Hrs
Metabolism of amino acids. Biosynthesis and degradation — an overview	5Hrs
Lipids classification: Bacterial lipids,	3 Hrs
Prostaglandins- structure and function, Major steroids of biological importance.	2 Hrs

Unit IV	**15Hrs**
Enzymes nomenclature and classification	1Hr
Methods for determination of enzyme activity	1Hr
Isolation and purification of enzymes.	1Hr
Enzyme kinetics: Effect of pH, substrate concentration, temperature and inhibitors.	2Hrs
Control of enzymes. Mechanism of enzyme action – Action of Hydrolases (RNase), Oxidases (Cytochrome Oxidase) and reductases (Ribonucleotide reductase).	3Hrs
Coenzyme catalysis (Pyridoxal phosphate and TPP).	1Hr
Isoenzymes.	1Hr
Competitive and non-competitive inhibition.	
Methods for increased microbial enzymes production and activity. Enzyme engineering.	1Hr
Control of enzymes. Regulation of enzyme activity: Allosteric enzymes and feedback mechanisms	2Hrs
Metabolic compartmentalization in relation to enzyme,	1Hr
Enzymes and secondary metabolites	1Hr

Course Outcomes: By the end of the course, the students will be able to,

PMB 104 CO1	Prepare buffers and accurately determine pH for biochemical experiments.
PMB 104 CO2	Explain and apply concepts of bioenergetics and metabolic pathways in microbial systems.
PMB 104 CO3	Identify and analyze biomolecules using qualitative and quantitative biochemical techniques.
PMB 104 CO4	Describe and interpret the structure and metabolism of proteins, nucleic acids, and amino acids.

CHAIRPERSON
BOS in Microbiology
Bhavan's Vivekananda College
Sainikpuri

Dr. Hameeda Bee
Professor
Department of Microbiology
Osmania University, Hyd-07

PMB 104 CO5 Perform enzyme assays, calculate enzyme activity, and analyze enzyme kinetics (Km, Vmax).

PMB 104 CO6 Evaluate enzyme regulation, inhibition mechanisms, and apply concepts in enzyme engineering and biotechnology applications.

I Semester M.Sc Microbiology Practical
PMB 154 Microbial Biochemistry
(4 HPW-2Credits)

Course Objectives:

1. To impart fundamental knowledge of biochemical techniques, including qualitative analysis of biomolecules.
2. To develop hands-on skills in quantitative analysis of biomolecules and enzyme characterization.
3. To build competence in experimental design and data analysis in biochemical studies.
4. To enable interpretation of biochemical processes such as enzyme kinetics, inhibition, and metabolic reactions.

Practical Syllabus

1. Safety and good lab practices, Biochemical calculations
2. Preparation of buffers and adjustment of pH
3. Qualitative tests for carbohydrates and analysis of unknowns
4. Qualitative tests for amino acids and analysis of unknowns
5. Tests for lipids (qualitative)
6. Quantitative estimation of glucose and fructose
7. Determination of Saponification value of fats
8. Partial purification of enzymes (β-amylase, urease and Catalase)
9. Effect of substrate concentration, pH, time and temperature on enzyme activity
10. Calculation of Km for partially purified enzyme
11. Study for inhibition of enzyme activity

Course Outcomes: By the end of the course, the students will be able to,

PMB154CO1 Students will be able to perform basic biochemical assays and accurately prepare laboratory reagents.

PMB154CO2 Students will demonstrate the ability to analyze biomolecules while adhering to laboratory safety and good practices.

PMB154CO3 Students will be able to evaluate enzyme activity and understand enzyme kinetics and inhibition mechanisms.

PMB154CO4 Students will gain the ability to interpret experimental data for applications in biological and clinical research.

CHAIRPERSON
BOS in Microbiology
Bhavan's Vivekananda College
Sainikpuri

Dr. Hameeda Bee
Professor
Department of Microbiology
Osmania University, Hyd-07

Recommended Books

1. Biochemistry by Lehninger
2. Outlines of Biochemistry by Cohn and Stumph
3. Biochemistry of Nucleic acids by Davidson
4. Biological Chemistry by Mullar and Cards
5. Biochemistry by White, Handler and Smith
6. Methods in Enzymology series
7. The Cell – Bratch and Mirsky series
8. Biochemistry lab manual by Jayaraman

CHAIRPERSON
BOS in Microbiology
Bhavan's Vivekananda College
Sainikpuri

Dr. Hameeda Bee
Professor
Department of Microbiology
Osmania University, Hyd-07

Bharatiya Vidya Bhavan

BHAVAN'S VIVEKANANDA COLLEGE OF SCIENCE, HUMANITIES AND COMMERCE, SAINIKPURI, SECUNDERABAD.

Autonomous College

Affiliated to Osmania University, Hyderabad.

(Accredited with 'A' grade by NAAC)

Department of Microbiology

Effective for 2026-28

M.Sc. Microbiology Semester II

SEMESTER – II						
Syllabus Ref No	**Subject**	**Credits**	**Teaching Hours**	**Marks**		
				Internal Assessment	**Semester Exam**	**Total**
THEORY						
PMB 201	Artificial Intelligence and Computational Microbiology (Core)	4	4	30	70	100
PMB 202	Immunology (Core)	4	4	30	70	100
PMB 203	Industrial Microbiology (Core)	4	4	30	70	100
PMB 204	Pharmaceutical Microbiology (Core)	4	4	30	70	100
PRACTICALS						
PMB 251	Molecular Biology and Microbial Genetics	2	4	--	50	50
PMB 252	Immunology	2	4	--	50	50
PMB 253	Industrial Microbiology	2	4	--	50	50
PMB 254	Pharmaceutical Microbiology	2	4	--	50	50
	Total	**24**	**32**	**120**	**480**	**600**

CHAIRPERSON
BOS in Microbiology
Bhavan's Vivekananda College
Sainikpuri

Dr. Hameeda Bee
Professor
Department of Microbiology
Osmania University, Hyd-07

Bharatiya Vidya Bhavan
BHAVAN'S VIVEKANANDA COLLEGE
of Science, Humanities and Commerce
Sainikpuri Secunderabad- 500094
Reaccredited with 'A' Grade by NAAC
Autonomous College, Affiliated to O. U

MSc Microbiology Previous (2026-28)
(w.e.f academic year: 2026-27)
Semester II

Course:	Artificial Intelligence and Computational Biology	**Hour/week:**	4
Course Code:	PMB 201(60 Hours)	**Credits:**	4

Course Objectives: The Objectives of this course are

1	To introduce the fundamental concepts of Artificial Intelligence, Machine Learning, Deep Learning, and complementary technologies such as IoT and Cloud Computing in Microbial Sciences.
2	To develop understanding of AI applications in microbial data analysis, metagenomics, clinical microbiology, and antimicrobial resistance prediction.
3	To provide knowledge of bioinformatics tools, biological databases, and computational approaches used in microbial research and diagnostics.
4	To train students in programming skills using Python and R for handling microbiological data, genome analysis, and data visualization.
5	To familiarize students with sequence analysis, phylogenetics, primer design, and AI-based drug discovery and microbial genome interpretation.
6	To promote ethical and responsible use of AI in microbiology, including data privacy, research integrity, and real-world applications in healthcare and biotechnology.

Contents of the course

UNIT I	**15Hrs**
Introduction to Artificial Intelligence (AI). Basics of complementary technologies: Internet of Things (IoT), Cloud computing in Microbial Sciences.	2Hrs
AI models: Logic-based, rule-based, probabilistic, machine learning models; Foundations of Machine Learning (ML), Deep Learning (DL).	2Hrs
Understanding basics of Data Science for Big Data management in Microbial Sciences.	2Hrs
Evolution of AI in Microbiology: Key breakthroughs, and future potential.	2Hrs
AI tools used for Gram stain interpretation, bacterial colony count and culture plate analysis.	2Hrs
AI-assisted Whole Genome Sequencing (WGS) interpretation and classification.	3Hrs
Ethical use of AI in microbiology and data privacy.	2Hrs

CHAIRPERSON
BOS in Microbiology
Bhavan's Vivekananda College
Sainikpuri

Dr. Hameeda Bee
Professor
Department of Microbiology
Osmania University, Hyd-07

UNIT II **15Hrs**

Integrating ML/DL to analyze complex data sets and its applications.	2Hrs
Basics of metagenomics: Using AI and Principal Component Analysis (PCA) to compare microbial community compositions.	2Hrs
AI to understand Microbial Pathogenesis: Pathogenicity predictions using sequence or phenotype data.	2Hrs
AI for epidemiological surveillance of pathogens.	1Hrs
Use of AI for Antimicrobial Resistance (AMR) and Predicting Antibiotic Resistance Genes using AI and MALDI-TOF MS analysis	2Hrs
Applications of AI in Clinical Microbiology and Diagnostics.	2Hrs
AI for drug discovery and antibiotics: Halicin, Abaucin.	2Hrs
AI in bioprocess optimization and microbial fermentation systems.	2Hrs

UNIT III **15Hrs**

Bioinformatics Basics: Use of computational tools in biology and diagnostic studies.	1Hrs
Introduction to Unix and Linux systems and basic commands.	1Hrs
DNA sequence studies. Database concepts.	1Hr
Proteins and nucleic acid databases	1Hr
Structural databases, Biological XML DTDs, Pattern matching algorithm basics.	2Hrs
Python for Microbiology: Basics of Python: Syntax, variables, loops, functions.	2Hrs
Handling biological data using Biopython, Pandas, NumPy, Matplotlib.	2Hrs
Simple data visualizations: bar plots, heatmaps, scatter plots.	1Hrs
Reading FASTA/GenBank files, parsing microbial genomes.	1Hrs
Sequence analysis. Microbial growth curve modelling.	1Hrs
R for Microbiology: Introduction to R environment and RStudio,	1Hrs
Importing and cleaning microbiological datasets (CSV, TXT), Data visualization using ggplot2, dplyr, tidyr, Microbiome data analysis, Creating boxplots, volcano plots, diversity plots. Statistical tests (ANOVA, t-test) in R.	1Hrs

UNIT IV **15Hrs**

Biological databases for microbiologists: NCBI, EMBL, DDBJ, UniProt, KEGG.	2Hrs
Sequence-based microbial identification: NCBI BLAST, genome annotation tools.	2Hrs
Introduction to multiple sequence alignment: CLUSTALW, MAFFT.	1Hrs
Primer design using AI tools (Primer3, NCBI tools).	1Hrs
Phylogenetic tree construction using Distance Matrix, UPGMA, Neighbor-Joining (via MEGA or R).	3Hrs

CHAIR
BOS in Micro...
Bhavan's Vivekananda College
Sainikpuri

Dr. Hameeda Bee
Professor
Department of Microbiology
Osmania University, Hyd-07

Structure-based drug discovery: Docking tools: AutoDock, GOLD, AI in drug screening and scoring.	3Hrs
In silico ADME and toxicity prediction for antimicrobials.	2Hrs
Case Studies: AI in COVID-19 genome tracking; AI-based pipeline for gut microbiome analysis.	1Hrs

Course Outcomes:

Students will be able to

PMB 201 CO1	Explain the principles of Artificial Intelligence, Machine Learning, and Big Data analytics in the context of microbiology.
PMB 201 CO2	Apply AI tools and computational techniques for microbial identification, pathogen prediction, and antimicrobial resistance analysis.
PMB 201 CO3	Use bioinformatics databases and tools for sequence analysis, genome annotation, and microbial data interpretation.
PMB 201 CO4	Perform basic programming in Python and R for microbiological data analysis, visualization, and statistical testing.
PMB 201 CO5	Construct phylogenetic trees, design primers, and utilize AI-based tools for drug discovery and microbial genome studies.
PMB 201 CO6	Evaluate ethical issues and apply AI responsibly in clinical microbiology, epidemiology, and microbial research.

II Semester Practical
PMB 251Artificial Intelligence and Computational Biology
(4 HPW- 2Credits)

Objectives:

1	To provide hands-on exposure to computational and bioinformatics tools for analyzing microbiological data.
2	To develop skills in AI-based techniques such as artificial neural networks (ANNs), convolutional neural networks (CNNs), and image processing
3	To enable the use of sequence analysis tools and microbial databases for data interpretation.
4	To integrate experimental microbiology with digital technologies for applications in clinical diagnostics, antimicrobial resistance prediction, vaccine design, and microbiome analysis.

1. Demonstration of Artificial Neural Networks (ANNs) and Convolutional Neural Networks (CNNs) for their use in microbial sciences
2. Colony Count using CNN and digital image processing tools

CHAIR
BOS in Microbiology
Bhavan's Vivekananda College
Sainikpuri

Dr. Hameeda Bee
Professor
Department of Microbiology
Osmania University, Hyd-07

3. Growth Analysis of Clinically important bacteria and yeast using Digital Image Processing
4. Demonstration of Clinical Trial Data Interpretation using Publicly Available Microbial Datasets
5. Integration of Bacterial Culture Images with MALDI-TOF MS Profiles for Clinical Pathogen Identification
6. Prediction of Antimicrobial Resistance Genes (ARGs) from Clinical Isolates using Online Tools (CARD or ResFinder)
7. Demonstration of Neoantigen Prediction Workflow for Microbial Vaccine Design
8. Demonstration of microbiome data analysis using gut microbiome to understand healthy and diseased individuals
9. Protein modelling (Swiss model)
10. Demonstration of BLAST and sequence alignment (multiple and pair-wise) and phylogenetic tree construction by MEGA software

Students will be able to

PMB 251CO1	Students will be able to apply bioinformatics tools for solving real-world problems in microbial sciences, including pathogen identification.
PMB 251CO2	Students will demonstrate the use of machine learning and image analysis techniques for microbial growth analysis and related applications.
PMB 251CO3	Students will develop skills to interpret complex biological datasets in microbiology.
PMB 251CO4	Students will be able to generate meaningful insights for clinical, research, and translational applications.

Reference Material

1. Open-source tools for AI and ML
2. Artificial Intelligence in Microbiology: Scope and Challenges, 1st Edition (2024) – Akanksha Srivastava, Vaibhav Mishra
3. Bioinformatics and Beyond: AI Applications in Healthcare, 1st Edition (2025) – Moolchand Sharma, Deepak Kumar Sharma, Deevyankar Agarwal, Khoula Al Harthy
4. Artificial Intelligence in Bioinformatics and Chemoinformatics (2023) – Yashwant Pathak, Surovi Saikia, Sarvadaman Pathak, Jayvadankumar Patel, Bhupendra Gopalbhai Prajapati

CHAIRPERSON
BOS in Microbiology
Bhavan's Vivekananda College
Sainikpuri

Dr. Hameeda Bee
Professor
Department of Microbiology
Osmania University, Hyd-07

5. Implementation of Convolutional Neural Networks for Microbial Colony Recognition (2025) – Fanhui Kong, Mingkuan Su, Jingli Guo, Jiafu Li, Jiancheng Huang (Microbiology Spectrum)

6. Artificial Intelligence Applications in Diagnosis and Treatment of Bacterial Infections (2024) – Xiaohui Zhang et al.

7. Artificial Intelligence for Microbiology and Microbiome (2024) – Yang-Yu Liu et al.

8. The Impact of Artificial Intelligence on Microbial Diagnosis (2024) – A. Alsulimani et al.

9. Qu K., Guo F., Liu X., Lin Y., Zou Q. (2019) Application of Machine Learning in Microbiology. *Frontiers in Microbiology* 10:827. DOI: 10.3389/fmicb.2019.00827

10. Computational Genomics and Structural Bioinformatics in Microbial Science, Vol. 2, 1st Edition (2025) – Javed Ahmad Parray, Niraj Singh, Wen-Jun Li

11. Paul P. Bourbeau, Nathan A. Ledeboer – Automation in Clinical Microbiology, *Journal of Clinical Microbiology*, May 2013, 51(6):1658–1665; DOI: 10.1128/JCM.00301-13

12. LeCun Y., Bengio Y., Hinton G. (2015) Deep Learning. *Nature* 521: 436–444. DOI: https://doi.org/10.1038/nature14539

13. Kenneth P. Smith, Anthony D. Kang, James E. Kirby – Automated Interpretation of Blood Culture Gram Stains Using Deep CNN, *Journal of Clinical Microbiology*, Feb 2018, 56(3): e01521-17; DOI: 10.1128/JCM.01521-17

Dr. Hameeda Bee
Professor
Department of Microbiology
Osmania University, Hyd-07

CHAIRPERSON
BOS in Microbiology
Bhavan's Vivekananda College
Sainikpuri

Bharatiya Vidya Bhavan

Bhavan's Vivekananda College

of Science, Humanities & Commerce
Sainikpuri, Secunderabad
Autonomous College - Affiliated to Osmania University
Accredited with 'A' grade by NAAC

Syllabus - M.Sc Microbiology Previous(2026-28)
(W.e.f academic year: 2026-27)
Semester II

Course: Immunology
Course Code:PMB 202 (60 Hours)

Hours/Week:4
Credits:4

Objectives:

1. To describe the fundamental concepts of immunology including history, hematopoiesis, immune cell lineages, antigens, antibodies, and immune system organization.
2. To explain the molecular basis of immune recognition including immunoglobulin genes, antibody diversity, and T-cell receptor generation.
3. To demonstrate mechanisms of innate and adaptive immunity, antigen processing and presentation, and immune responses to infections.
4. To analyze immunological disorders such as hypersensitivity, autoimmunity, immunodeficiency, and transplant rejection.
5. To evaluate diagnostic immunological techniques and antigen–antibody interactions used in research and clinical applications.
6. To design and assess immunological interventions including vaccines, monoclonal antibodies, immunotherapy, and immunosuppressive strategies.

Unit 1	**15 Hrs**
History of immunology. Haematopoeisis, Cell lineage, components of immune system, cells and organs of immune system	3
Antigens –Nature, properties and types. Haptens	2
Antibody -Structure, functions and classification. Isotypes, allotypes and idiotypes	2
Immunoglobulin genes. Generation of antibody diversity. Clonal nature of the immune response - Clonal selection theory.	4
Generation of T cell receptor diversity by genomic rearrangement	3
Structure of B and T cell receptors	1

CHAIRPERSON
BOS in Microbiology
Bhavan's Vivekananda College
Sainikpuri

Dr. Hameeda Bee
Professor
Department of Microbiology
Osmania University, Hyd-07

Unit 2	15 Hrs
Overview of Innate and adaptive immunity	1
Toll-like receptors, cell-mediated and humoral immune responses, inflammation	2
Major Histocompatability Complex (MHC).Human Leucocyte Antigen(HLA) restriction process and presentation of antigen by MHC. Transplantation immunity	3
Immune response during bacterial (tuberculosis), parasitic (malaria) and viral (HIV) infections.	2
Congenital and acquired immunodeficiencies. Immunodeficiency disorders: Animal models of primary immunodeficiency(SCID mouse)Specific impaired functions in lymphoid lineage(SCID.Digeorge syndrome),myeloid lineage (CGD and Chediak Higashi syndrome)	5
Immunological tolerance-central and peripheral	2

Unit 3	15 Hrs
Autoimmunity – systemic and localized autoimmune disorders	2
Hypersensitivity - immediate and delayed type hypersensitivity reactions	3
Classical, Alternate and Lectin mediated Complement pathways	2
Introduction to inflammasome pathway and its components	2
Antigen and antibody reactions–Agglutination, Precipitation, neutralization, and function. Labeled antigen-antibody reactions- ELISA, RIA, immune blotting, CFT, immunofluorescence. Flow cytometry (Fluorescence activated cell sorter) and its applications in Immunology. Development Of immuno diagnostic kits	6

Unit 4	15 Hrs
Types of conventional vaccines and principles of Immunization	2
Modern vaccines; peptide, DNA, recombinant / vector, and anti-idiotypic vaccines	2
Schedules of common vaccination, Benefits and adverse consequences of vaccination	2
Production of polyclonal antibodies; Animals models for production of antibodies	2
Hybridoma techniques and monoclonal antibody production. Applications of monoclonal antibodies in biomedical research, clinical diagnosis and treatment. Chimeric Antibodies	2
Immuno suppression and its mechanism of action	2
Immune evasion by bacteria and viruses	1
Tumor immunology. Immuno diagnosis and immune therapy of cancer	2

CHAIRPERSON
BOS in Microbiology
Bhavan's Vivekananda College
Sainikpuri

Dr. Hameeda Bee
Professor
Department of Microbiology
Osmania University

Outcomes:

Students will be able to

PMB 202 CO1: Outline and explain the structure and function of immune system components, antigens, antibodies, and immune cell receptors.

PMB 202 CO2: Explain and apply concepts of immune responses, antigen presentation (MHC/HLA), and host defense mechanisms against pathogens.

PMB 202 CO3: Illustrate and compare immune responses in infectious diseases and interpret mechanisms underlying immunodeficiency disorders.

PMB 202 CO4: Examine hypersensitivity reactions, autoimmune disorders, and complement pathways in disease pathogenesis.

PMB 202 CO5: Assess immunological techniques such as ELISA, immunoblotting, flow cytometry, and their applications in diagnostics.

PMB 202 CO6: Develop and justify strategies for vaccination, monoclonal antibody production, immunotherapy, and cancer immunodiagnostics.

II Semester PMB 252 Immunology Practicals (CBCS) - Paper II
(4 HPW- 2Credits)

Course Objectives

1. To demonstrate basic immunological techniques such as blood grouping, agglutination, flocculation, and immunodiffusion assays.
2. To perform hematological and immunological procedures including RBC/WBC counting, differential leukocyte count, and lymphocyte culture.
3. To analyze and interpret antigen–antibody reactions and diagnostic tests such as Widal, VDRL, ELISA, and indirect agglutination.
4. To evaluate protein separation and detection techniques and develop skills in immunodiagnostic applications and data interpretation.

Practical Syllabus

1. Demonstrating identification of Blood groups
2. Agglutination reactions – WIDAL test- slide and tube agglutination method
3. Diagnosis of syphilis by VDRL (Flocculation test)
4. Single Radial Immunodiffusion and Ouchterlony double diffusion test
5. Rocket Immunoelectrophoresis
6. WBC count and RBC count
7. Differential Leukocyte Count
8. Separation of serum and plasma proteins
9. Blot transfer and detection of protein on blot by staining (Demonstration by kit or tutorial mode)
10. Demonstration of ELISA technique
11. Lymphocyte culture, staining and Heamocytometer count.

CHAIRPERSON
BOS in Microbiology
Bhavan's Vivekananda College
Sainikpuri

Dr. Hameeda Bee
Professor
Department of Microbiology
Osmania University, Hyd-07

12. Indirect agglutination (Pregnancy hCG Ag)

Course Outcomes

Students will be able to:

PMB 252 CO1: Perform blood grouping, agglutination, immunodiffusion, and immunoelectrophoresis techniques using standard protocols.

PMB 252 CO2: Interpret results of diagnostic tests such as Widal, VDRL, ELISA, and pregnancy tests based on antigen–antibody interactions.

PMB 252 CO3: Examine and evaluate hematological parameters including RBC/WBC counts, differential leukocyte counts, and lymphocyte cultures.

PMB 252 CO4: Demonstrate and justify the use of protein separation, blotting techniques, and immunoassays in clinical diagnostics and research applications.

Recommended Books

1. Immunology by Janice Kuby
2. Cellular and molecular immunology by Abul K. Abbas et al
3. Test book of Immunology by Barrett
4. Immunology – The science of self-non self-discrimination by Jan Klein
5. Essential Immunology by Roitt, IM
6. Immunology by Tizard
7. Medical Microbiology by Ananthanarayan and Jayaram Panicker
8. The elements of Immunology by Fahim Halim Khan

CHAIRPERSON
BOS in Microbiology
Bhavan's Vivekananda College
Sainikpuri

Dr. Hameeda Bee
Professor
Department of Microbiology
Osmania University, Hyd-07

Bharatiya Vidya Bhavan

BHAVAN'S VIVEKANANDA COLLEGE

of Science, Humanities and Commerce

Sainikpuri Secunderabad- 500094
Reaccredited with 'A' Grade by NAAC
Autonomous College, Affiliated to O. U

Syllabus –M.Sc I Year Microbiology
(w.e.f academic year: 2026-27)
Semester II

Course: IndustrialMicrobiology
Course Code: PMB 203(60 Hours)

Hour/week: 4
Credits: 4

Course Objectives: The objectives of this course are

1. Remember the fundamentals of industrial microbiology, including its role in economy, environment, employment, and entrepreneurship.
2. Understand the principles of screening, selection, and strain improvement of microorganisms for industrial product formation.
3. Apply knowledge of fermentation media, inoculum preparation, and upstream processing strategies in industrial processes.
4. Analyze different types of fermenters, fermentation processes, and production techniques for products like beer, wine, antibiotics, and biofuels.
5. Evaluate industrial production processes for bioproducts such as alcohol, antibiotics, monoclonal antibodies, and nanoparticles.
6. Apply and assess downstream processing, product recovery, immobilization techniques, and analytical methods for product detection and quality control.

Contents of the course

UNIT 1 15Hrs

Introduction to industrial microbiology and Biotechnology for Economy, Environment,

Employment and/or Entrepreneurship. 2hrs

Screening and selection of microorganisms for industrially important products like amylase, organic acid, antibiotic, amino acid and vitamins. 3hrs

Concept of life cycle assessment and sustainable production of bio-based products using microorganisms. 2hrs

CHAIRPERSON
BOS in Microbiology
Bhavan's Vivekananda College
Sainikpuri

Dr. Hameeda Bee
Professor
Department of Microbiology
Osmania University, Hyd-07

Strain improvement strategies. Environmental and genetic factors for strain improvement. 2hrs

Inoculum media, inoculum preparation- seed culture preparation and frozen stocks. 1hr

Fermentation media and sterilization. Upstream strategies and raw materials for fermentation process. 3hrs

Cost economics and use of low-cost agro-industrial wastes as carbon, nitrogen sources for production media. 2hrs

UNIT 2 15Hrs

Design of fermenter, type of fermenter, agitation, aeration, antifoam, pH and temperature control. 3hrs

Types of fermentations processes - Solid state, surface and submerged fermentations. Batch, fed batch and continuous fermentations. Direct, dual or multiple fermentations. 4hrs

Fermentative production of beer - Media components, malt, malt adjuncts, hops. water.

Preparation of wort, mashing, wort boiling, microorganism, inoculum preparation, fermentation. cold storage maturation, carbonation, packing and preservation. 4hrs

Principles of wine making - Fruit selection, picking, crushing, sulphite addition. processing. fermentation, aging and bottling. 4hrs

UNIT 3 15Hrs

Fermentative production of industrial alcohol, uses, raw materials, microorganisms, inoculum preparation, preparation of wort, fermentation and recovery. 3hrs

Designing microbial cell factories for production of different bioproducts and Biofuels. 2hrs

Fermentation and recovery process of Antibiotics - Commercial production of benzyl penicillin, and semi-synthetic penicillin. 3hrs

Fermentative production oftetracyclines - uses, chlortetracycline, oxy-tetracycline, tetracycline and semisynthetic tetracyclines. 2hrs

Production of monoclonal antibodies and antimicrobial peptides at industrial level. 3hrs

Microbial nanotechnology-Bio-fabrication of nanoparticles, characterization and optimization studies. 2hrs

CHAIRPERSON
BOS in Microbiology
Bhavan's Vivekananda College
Sainikpuri

Dr. Hameeda Bee
Professor
Department of Microbiology
Osmania University, Hyd-07

UNIT 4 15Hrs

Microbial products: Qualitative and quantitative assays for detection of enzymes, amino acids, organic acids, vitamin B12, steroids. 4hrs

Bio-transformations used in microbial process. 3hrs

Downstream strategies for product recovery.

Detection and assay of fermentation products. Physico-chemical methods and biological assays. 4hrs

Immobilization methods used in industries - Absorption, covalent linkage, entrapment and cross linkage, types of carriers, advantage and disadvantages. 4hrs

Course outcomes: By the end of the course, the students will be able to,

PMB203.CO1: Students will be able to recall and explain key concepts of industrial microbiology and its applications in various sectors.

PMB 203.CO2: Students will describe and interpret methods for screening, strain improvement, and media formulation for industrial microorganisms.

PMB 203.CO3: Students will demonstrate understanding of fermentation technology, including fermenter design, process control, and types of fermentation.

PMB 203.CO4: Students will analyze production processes of industrially important products such as alcohol, antibiotics, and fermented beverages.

PMB 203.CO5: Students will evaluate modern approaches like microbial cell factories, nanotechnology, and bioproduct synthesis.

PMB 203.CO6:Students will apply and interpret downstream processing techniques, immobilization methods, and assay procedures for industrial products.

CHAIRPERSON
BOS in Microbiology
Bhavan's Vivekananda College
Sainikpuri

Dr. Hameeda Bee
Professor
Department of Microbiology
Osmania University, Hyd-07

(PAPER III)II Semester PMB 253 Industrial Microbiology Practical

4HPW - Credits-2

Course Objectives: The objectives of this course are

1. Apply microbiological and biochemical techniques for isolation, screening, and characterization of industrially important microorganisms.
2. Perform fermentation processes for the production of bio-products such as ethanol, wine, antibiotics, and nanoparticles.
3. Analyze biochemical parameters including estimation of sugars, ethanol, and fermentation efficiency using standard methods.
4. Evaluate industrial techniques such as microbial immobilization and product recovery for enhanced productivity.

1. Isolation and screening for amylase producing microorganisms.
2. Isolation and screening for lipolytic microorganisms.
3. Isolation of antibiotic producing microorganisms by crowded plate technique.
4. Estimation of maltose
5. Production of ethanol by flask fermentation, recovery of ethanol by distillation
6. Estimation of ethanol by dichromate method.
7. Estimation of glucoseand calculation of fermentation efficiency.
8. Preparation of wine from grapes/fruits by fermentation.
9. Isolation of *Penicillium spp*. from different source samples.
10. Production of Penicillin by fermentation process and its characterization.
11. Biosynthesis of nanoparticles using microorganisms.
12. Immobilization of microbial cells by entrapment method.

Recommended Books

1. Industrial Microbiology: An Introduction (2001)by Michael J. Waites, Neil L. Morgan, John S. Rockey, Gary Higton.
2. Industrial Microbiology: Fundamentals and Applications (2017) Agrawal, Parihar.
3. Industrial Microbiology 3rd Edition (1986) by L. E. Casida J.R
4. Industrial Microbiology 4th Edition (1959) Samuel Cate Prescott, Cecil Gordon Dunn.

CHAIRPERSON
BOS In Microbiology
Bhavan's Vivekananda College
Sainikpuri

Dr. Hameeda Bee
Professor
Department of Microbiology
Osmania University, Hyd-07

5. Microbial Technology: Fermentation Technology (1979) by H.J Peppler, D. Perlman.
6. Biochemistry of Industrial Microorganisms (1963) by C. Rainbow, A.H.Rose.
7. Comprehensive Biotechnology 3rd Edition (2019) by Murray Moo-Young.
8. Industrial Microbiology: A Laboratory Manual (2010) by N. Mathur.
9. Alfred Brown and Heidi Smith, 2017, Bensons Microbiological application: A laboratory manual in General Microbiology, Indian Edition, Mc.Graw Hill (13e).

Course outcomes: By the end of the course, the students will be able to,

PMB253.CO1: Students will be able to demonstrate skills in isolation and screening of enzyme- and antibiotic-producing microorganisms.

PMB 253.CO2: Students will carry out and interpret fermentation processes and product recovery methods such as distillation.

PMB 253.CO3: Students will analyze and calculate biochemical parameters like glucose, maltose, ethanol concentration, and fermentation efficiency.

PMB 253.CO4: Students will apply advanced concepts including nanoparticle biosynthesis and immobilization techniques in industrial microbiology.

CHAIRPERSON
BOS in Microbiology
Bhavan's Vivekananda College
Sainikpuri

Dr. Hameeda Bee
Professor
Department of Microbiology
Osmania University, Hyd-07

Bharatiya Vidya Bhavan
BHAVAN'S VIVEKANANDA COLLEGE
of Science, Humanities and Commerce
Sainikpuri Secunderabad- 500094
Reaccredited with 'A' Grade by NAAC
Autonomous College, Affiliated to O. U

MSc Microbiology Previous (2026-28)
(w.e.f academic year: 2026-27)
Semester II

Course:	Pharmaceutical Microbiology	**Hour/week:**	4
Course Code:	PMB 204(60 Hours)	**Credits:**	4

Objectives:

1. To understand the principles of microbial contamination, spoilage, and preservation of pharmaceutical and cosmetic products
2. To explain Good Manufacturing Practices (GMP), GxP guidelines, regulatory standards, and quality assurance in pharmaceutical industries.
3. To describe the design, monitoring, and sterilization processes involved in pharmaceutical production systems.
4. To understand the principles of chemotherapy, antimicrobial agents, drug metabolism (ADME), and pharmacodynamics.
5. To analyze the mechanisms of antimicrobial resistance (AMR) and emerging drug resistance challenges.
6. To develop knowledge of microbiological assays, antimicrobial testing methods, and quality control techniques used in pharmaceutical and cosmetic industries

Contents of the course

Unit I	**15 Hrs**
Pharmaceutical industry. Importance of various pharmacopeias with special reference to Indian pharmacopeia, British pharmacopeia, United States pharmacopeia and international pharmacopeia	2Hrs
Design and layout of sterile product manufacturing unit	2Hrs
Microbiological issues for inspection of pharmaceutical facilities: Sterilization (D value, z value, F value, F_0 value, survival curve),	3Hrs
Depyrogenation, Environmental monitoring	2 Hrs
Room design and Equipment,	2 Hrs
Water purification and Delivery system, Personnel, Product sampling, Method suitability test, Sample analysis (Bioburden analysis, Sterility testing,). Concept of GxP and Quality Assurance in pharmaceuticals.	4Hrs

CHAIRPERSON
BOS in Microbiology
Bhavan's Vivekananda College
Sainikpuri

Dr. Hameeda Bee
Professor
Department of Microbiology
Osmania University, Hyd-07

Unit II	**15Hrs**
Introduction to FDA's CAPA (Corrective and Preventive action) steps requirements and regulations, OOPs, SOPs. ISO, WHO and US certification	**4Hrs**
Understanding the changing dynamics of pharma ecosystem.	**2 Hrs**
Digitization of equipment, instrument, air and water systems.	**2 Hrs**
Adherence to guidelines like GAMP (Good automated manufacturing practice and 21 CFR (Code of federal regulations).	**2 Hrs**
Drug metabolism and Response; Pharmacokinetics (ADME), Pharmacodynamics, Pharmacogenomics	**3 hrs**
Emergence and mechanisms of antimicrobial resistance (AMR) and antimicrobial resistance genes (ARG) in different environments. Concepts of MDR, XDR and PDR	**2 Hrs**

Unit III	**15Hrs**
History of chemotherapy –Paul Ehrlich and his contributions. Arsenicals as therapeutics.	2Hrs
Research on Indian medicinal plants derived natural products and their applications	1Hr
Classification of antimicrobial agents. Drugs, Semi-synthetic drugs and Antibiotics, Topical agents. Choice of drug, dosage, route of administration, combined multi drug therapy.	3Hrs
Selective toxicity, molecular principles of drug targeting	2 Hrs
Development of synthetic antibiotic/ drugs: Sulphanamides, Chloramphenicol, Antitubercular compounds, Quinolinones, Metronidazole, Anti-tumor drugs.	2Hrs
Mode of action of important drugs – Cell wall inhibitors (Betalactam – e.g. Penicillin), membrane inhibitors (Polymyxins),macromolecular synthesis inhibitors (streptomycin). Macrolides (Nafithromycin) . Recently developed antibiotics (Enmetazobactam, Zaynich) and antifungal medications. (Nystatin).	5 Hrs

Unit IV	**15Hrs**
Antimicrobial Effectiveness Testing (AET): Microbial contamination and spoilage of certain pharmaceutical products sterile injectable, non-injectable, ophthalmic preparations, implants, Cosmetic products and Preservatives (PET).	5Hrs
Bacterial endotoxin testing.	2 Hrs
Non antibiotic antimicrobial compounds: Metals and Biocides (Phenol coefficient/RWC).	3Hrs
Drug Sensitivity methods and their importance. Antibiotic potency test/Microbial Assays for antibiotics-Determination of MIC, the Liquid Tube Assay, Solid Agar Tube assay, Agar plate assay (Disc diffusion, Agar well and Cylindrical Cup Method)	5Hrs

CHAIRPERSON
BOS in Microbiology
Bhavan's Vivekananda College
Sainikpuri

Dr. Hameeda Bee
Professor
Department of Microbiology
Osmania University, Hyd-07

Course Outcomes:

Students will be able to

PMB 204CO1	Analyze microbial spoilage, contamination risks, and preservation strategies in pharmaceutical and cosmetic products.
PMB 204CO2	Apply GMP, GxP, and regulatory guidelines in pharmaceutical microbiology and quality assurance processes.
PMB 204CO3	Evaluate sterilization methods, environmental monitoring, and validation techniques in pharmaceutical production.
PMB 204CO4	Evaluate sterilization methods, environmental monitoring, and validation techniques in pharmaceutical production.
PMB 204CO5	Assess antimicrobial resistance mechanisms and interpret drug susceptibility data (AST, MIC).
PMB 204CO6	Perform and interpret microbiological assays, antibiotic potency tests, and antimicrobial effectiveness testing in industrial settings.

II Semester Practical
PMB 254 Pharmaceutical Microbiology Practical
(4 HPW- 2Credits

Objectives:

1	To provide comprehensive training in microbiological techniques for evaluating microbial contamination.
2	To develop skills in assessing sterilization efficiency in pharmaceutical and related products.
3	To build practical competence in performing bioassays and drug sensitivity testing.
4	To enable assessment of disinfectants and antimicrobial agents under standardized laboratory conditions.

1. Bioburden testing methods for pharmaceutical and cosmetic products
2. Sterility testing by *Bacillus stearothermophilus* or any other method
3. Sampling of pharmaceuticals for microbial contamination and load (syrups, suspensions, creams and ointments, ophthalmic preparations).
4. Determination of D value, Z value for heat sterilization in pharmaceuticals.
5. Determination of antibacterial spectrum of drugs/antibiotics
6. Testing for antibiotic/drug sensitivity/resistance
7. Determination of MIC, LD 50 of antimicrobial chemicals
8. Microbiological assays for antibiotics (Liquid tube, agar tube, agar plate assays)
9. Antimicrobial effectiveness testing
10. Bioassay with Griseofulvin / chloramphenicol
11. Bacterial endotoxin test (BET): Demonstration through kit or tutorial mode

CHAIRPERSON
BOS in Microbiology
Bhavan's Vivekananda College
Sainikpuri

Dr. Hameeda Bee
Professor
Department of Microbiology
Osmania University, Hyd-07

12. Bioassays with any plant / microbial secondary metabolites against Gram positive and Gram-negative bacteria
13. Tests for disinfectants (Phenol coefficient/RWC)
14. Determination of antimicrobial activity of a formaldehyde to that of phenol under standardized experimental conditions
15. Treatment of bacterial cells with cetrimide, phenol and detection of leaky substances.

Students will be able to

PMB 254CO1	Students will be able to perform microbiological testing methods for evaluating bioburden, sterility, and microbial contamination in pharmaceutical and cosmetic products.
PMB 254CO2	Students will demonstrate skills in assessing sterilization parameters (D value, Z value) and conducting antimicrobial effectiveness and disinfectant testing.
PMB 254CO3	Students will be able to evaluate antimicrobial activity through techniques such as antibiotic sensitivity testing, MIC determination, and microbiological assays.
PMB 254CO4	Students will gain the ability to conduct bioassays, interpret endotoxin testing, and analyze the effects of antimicrobial agents on microbial cells under standardized laboratory conditions.

Recommended Books

1. Disinfection, sterilization and preservation. Block, S.S. (ed). Lea and Febigor, Baltimore
2. Pharmaceutical Microbiology. Huge, W.B. and Russel, AD.Blackwell Scientific, Oxford
3. Principles and methods of sterilization in health sciences. Perkins, JK. Pub: Charles C. Thomos, Springfield.
4. Compendium of methods for the microbiological examination of foods. Vanderzant, C. and Splittstoesser, D. Pub: American Public Health Association, Washington, D.C.
5. Disinfectants: Their use and evaluation of effectiveness. Collins, CH., Allwood, MC., Bloomfield, SF. And Fox, A. (eds). Pub: Academic Press, New York
6. Inhibition and destruction of microbial cell by Hugo, WB. (ed). Pub: Academic Press,NY
7. Manual of Clinical Microbiology. Lennette, EH. (ed).Pub: American Society for Microbiology, Washington.
8. Principles and Practices of disinfection. Russell, AP.,Hugo,WB., and Ayliffe, GAJ.(eds). Publ. Blackwell Sci.
9. Biochemistry of antimicrobial action. Franklin, DJ and Snow, GA.Pub:Chapman& Hall.
10. Antibiotics and Chemotherapy. Garrod, L.P., Lambert, HP. And C'Grady, F. (eds). Publ: Churchill Livingstone.
11. Antibiotics. Lancini, G. and Parenti, F. publ: Springer-Verlag.
12. The Molecular Basis of antibiotic action. Gae, EF. Et al. Publ: Wiley, New York.
13. Antimicrobial Drug action. Williams, RAD., Lambart, PA. & Singleton, P. Pub:Bios Sci.
14. Microbiological Assays. Hewitt.
15. Indian Pharmacopea; United States Pharmacopea; British Pharmacopea

CHAIRPERSON
BOS in Microbiology
Bhavan's Vivekananda College
Sainikpuri

Dr. Hameeda Bee
Professor
Department of Microbiology
Osmania University, Hyd-07