

**MAHAKAUSHAL UNIVERSITY,
JABALPUR M.P.**

**Approved by Higher Education
And the Governor of M.P.**



**Faculty of Science
Scheme & Syllabus
For
Subject –Microbiology
M.Sc. Programme
(1 Year PG Diploma/ 1 Year PG/ 2Year PG)
Programme
I to IV Semester
2025-26**

For 2- Year PG Programme

Part A: Introduction				
Program-	Class: M.Sc.	Year: I	Semester: Ist	Session: 2025-2026
Subject: Microbiology				
1	Course Code	MMCB0101-T		
2	Course Title	Principles of Microbiology		
3	Course Type	Core Course		
4	Pre-requisite (If any)	To study this course a student must have had the subject B.Sc. with Biology.		
5	Course Learning outcomes (CLO)	<p>The objectives of this course are to introduce the field of microbiology with special emphasis on microbial (Bacteria, Fungi and virus) diversity, morphology, growth and nutrition; methods for control of microbes and viruses.</p> <p>CLO-</p> <p>The students should be able to: -</p> <ol style="list-style-type: none"> 1. Understand the general features and characteristics of microbes. 2. Know about the history of microbiology and microorganisms. 3. Identify major categories of microorganisms and analyze their classification, diversity, and ubiquity; 4. Learn about general methods and techniques to isolate and culture of microorganisms. 		
6	Credit Value	6		
7	Total Marks	Max. Marks: 40+60	Min. Passing Marks : 40	

Part B : Content of the Course

Total numbers of Lectures (in hours per week) : 6 hours per week/credit

Total Lectures : 90 hours

Unit	Topics	Number of Lectures
I	<p>Ancient History of Microbiology from Atharva Veda, Contribution of Risi Karva, Atri, Jamdagni and Agastya, origin and Prevalence of germs. Nomenclature of germs in Vedas, their classification based on Caraka,</p> <p>Historical development and scope of Microbiology-Contribution of scientists and spontaneous generation and germ theory, Classification and identification of microorganisms, polyphasic taxonomy. Bergey's Manual of determinative Bacteriology.</p> <p>Activity</p> <ol style="list-style-type: none"> 1. Discussion on ancient origin of Life in Vedas. 2. Slide preparation of microorganism from different environment. 3. Chart preparation on Biodiversity of pathogenic and non-pathogenic microorganism. 4. Demonstration of Bergey's, Manual of determinative Bacteriology. 	18
II	<p>Techniques in Microbiology- Isolation, pure and enrichment culture, staining procedure, physical & chemical sterilization methods, physical and chemical agents- Antiseptics and disinfectants, Control of Microorganisms by Narrow and broad-spectrum antibiotics, Antifungal antibiotics, Preservation of bacterial cultures. Cultivation of bacteria-aerobic, anaerobic, types of culture media.</p> <p>Activity:</p> <ol style="list-style-type: none"> 1. Demonstration of pasteurization by visit to dairy industry. 2. Survey of antiseptics and disinfectants available in local market. 3. Preparation of chart of antifungal antibiotics with their biochemical activity. 	18
III	<p>Morphology and ultrastructure of bacteria size, shape and arrangement, structure and chemical composition and function of cell walls of Gram positive and Gram negative bacteria; Structure, composition and function of cell membrane, capsule; flagella, pilli, gas vesicles, cytoplasmic matrix, reserve food materials; chromosomes, carboxysomes. magnetosomes and phycobilisomes; nucleoid. Reproduction and Recombination in bacteria. Nature and properties of spores: Bacterial exo and endospores, Germination of spores. Antibiotic resistance mechanisms and multiple drug resistance. Diversity of Microbes-archaea, Photosynthetic bacteria and Cyanobacteria</p>	18

	<p>Activity:</p> <ol style="list-style-type: none"> 1. Preparation of model of Gram positive and Gram negative cell wall. 2. Comparative chart preparation of prokaryotic & Eukaryotic cells 3. Quiz of diversity of cyanobacteria and Photosynthetic activity. 	
IV	<p>Current status of fungi; their classification with reference to Ainsworth; General characters, somatic structure, asexual and sexual reproduction of microbiologically important genera of Myxomycota, Mastigomycotina. Zygomycotina, Ascomycotina, Basidiomycotina and Deuteromycotina; Heterothallism; sex hormones in fungi; physiological specialization and phylogeny of fungi. Parasexual life cycle; Symbiotic associations of fungi with algae; Economic importance of fungi.</p> <p>General characters of algae; classification of algae; Somatic structure, asexual and sexual reproduction of Chlorophyceae, Phaeophyceae, Bacillariophyceae and Rhodophyceae. Microbial ecology</p> <p>General characteristics, structure, nomenclature and classification of microbial, animal and plant viruses.</p> <p>Disease symptomatology, transmission and diagnostic techniques of animal and plant viruses. Bacteriophages: structural organization, lytic and lysogenic cycle. Viroids, and virusoids. Prions and its diseases.</p> <p>General characters of protozoans; Structure and reproduction in protozoans: Entamoeba, Giardia, Trichomonas, Leishmania, Trypanosoma and Plasmodium, Paragonimus, <i>Fasciola hepatica</i>, Schistosoma.</p> <p>Activity-</p> <ol style="list-style-type: none"> 1. Make tree chart of imported gene of fungi. 2. Collection of Symbiotic associations of fungi with algae from forest. 3. Chart preparation of fresh water algae from marshy water bodies. 	18
V	<p>The definition of microbial growth, Growth in batch culture, Mathematical representation of bacterial growth, Bacterial generation time, Specific growth rate, Monoauxic, Diauxic and synchronized growth curves, Measurement of microbial growth, Factors affecting microbial growth. Brief account of growth in fungi, Culture collection and maintenance of microbial cultures, Principles of microbial nutrition- Chemoautotrophs, chemoheterotrophs, photoautotrophs and photo heterotrophs.</p> <p>Activity-</p> <ol style="list-style-type: none"> 1. Chart making on Monoauxic, Diauxic and synchronized growth curves, 2. Demonstrate of various methods of microbial growth measurement. 	18

3. Visit to different microbial culture collection centre.	
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Part C : Learning Resources

Text Books, Reference Books, Other resources

Suggested Readings:

1. Tortora, Funke & Case. Microbiology: An Introduction 7th Edition. 2001
2. M.J. Pelczar, E.C.S. Chan, N.R. Krieg. Microbiology VI Edition: New York: McGraw-Hill. 2001.
3. R. Y. Stainier, J. L. Ingraham, M. L. Wheelis and P.R. General Microbiology: Painter. Publisher: Macmillan.
4. Matthai, W., Berg, C.Y. & Black, J.G. Boston, MA: Microbiology, Principles and Explorations: John Wiley & Son. 2005.
5. Willey, J.M., Sherwood, L., Woolverton, C.J., Prescott, L.M. & Willey, J.M., Prescott's . Microbiology: New York: McGraw-Hill. 2011.
6. Pommerville, J.C., Alcamo's Jones and Bartlett Fundamentals of Microbiology (10th Ed.): Learning. 2013.
7. Madigan, MT, Bender, K.S., Buckley, D.H., Sattley, W.M. & Stahl, D.A., Biology of Microorganisms (15th Ed.): Brock Pearson/ Benjamin Cummings. 2018.
8. Sequeira, M., Kapoor, K.K., Yadav, K.S. & Tauro, P., An Introduction to Microbiology (3rd Ed.): New Age International Publishers. 2019.
9. Relevant book published in Hindi Granth Academy.
10. Dubey R.C. & Maheshwari D.K., A Textbook of Microbiology, 5th edition S. Chand Publishing, 2023.
11. H. D. Kumar, Daya Agricultural Biotechnology Publishing House, 2006
12. P.S. Bisen and Kavita Verma, Handbook of Microbiology, CBS publishers and distributors Pvt Ltd 2021
13. B. D. Singh, Biotechnology, 4th Edition Kalyani Publishers, 2010.
14. Books published by M.P. Hindi Granth Academy, Bhopal

Suggested equivalent online courses:

SWAYAM CENTRAL For All Courses

<https://swayamopenid.b2clogin.com/>

1. <https://archive.nptel.ac.in/courses/102/103/102103015/>
2. https://sirsyedcollege.ac.in/crm/public/uploads/download_image/btKWFkbwIXh58dyzfdvqwoyegD9XbO.pdf
3. <https://microbenotes.com/bacterial-sizes-shapes-arrangement/>
4. <https://rnlkwc.ac.in/pdf/study-material/physiology/BacterialCellWall.pdf>
5. <https://journals.asm.org/doi/pdf/10.1128/microbiolspec.vmbf-0016-2015>
6. <https://lecture-notes.tiu.edu.iq/wp-content/uploads/2021/04/Lec-7-Antimicrob->

[drug-resist.pdf](#)

7. https://ocm.govtsciencecollegedurg.ac.in/Document/858_070732.pdf
8. [uou.ac.in/lecturenotes/science/MSCBOT-17/Viruses \(BOT-501\) by Dr. Kirtika Padalia.pdf](http://uou.ac.in/lecturenotes/science/MSCBOT-17/Viruses%20(BOT-501)%20by%20Dr.%20Kirtika%20Padalia.pdf)
9. <https://dspmuranchi.ac.in/pdf/Blog/Bacteriophages.pdf>
10. https://vikramuniv.ac.in/files/wp-content/uploads/M_Sc_II_Sem-Viroids_Virusides_and_Prions-Dr_S_K_Jain.pdf
11. https://mlsu.ac.in/econtents/4136_Unit%20%20Viroids,%20Prions.pdf
12. <http://www.mphindigranthacademy.org>

Part-D Assessment and Evaluation

Pattern of Marks Distribution THEORY PAPER for NEP PG courses

<p>Recommended Continuous Assessment Methods-: (It may vary for respective course subject but TOTAL marks distribution will remain same)</p> <p>Maximum Marks: 100</p> <p>Continuous Comprehensive Evaluation (CCE): 40 Marks</p> <p>University Examination: 60 Marks</p>		
<p>Internal Assessment: Continuous Comprehensive Evaluation (CCE):</p>	<p>Class Test Assignment/Presentation</p>	<p>20 Marks 20 Marks Total Marks = 40</p>
<p>External Assessment: University Examination: Time: 3 Hours</p>	<p>Section (A)- Five very short answer question (20 words each) Section (B)- Five short answer question (200 words each) Section (C)- Two long answer question (500 words each)</p>	<p>02 Marks x 05 Questions = 10 Marks <i>(All 5 Questions to be attempted)</i> 06 Marks x 05 Questions = 30 Marks <i>(5 Questions to be attempted out of total 8 Questions)</i> 10 Marks x 02 Questions = 20 Marks <i>(2 Questions with each having internal choice)</i> Total Marks = 60</p>

Part A: Introduction				
Program-	Class: M.Sc.	Year: I	Semester: I	Session: 2025-2026
Subject: Microbiology				
1	Course Code	MMCB0101-P		
2	Course Title	Lab work for Principles of Microbiology (Practical-I)		
3	Course Type	Core Course		
4	Pre-requisite (If any)	To study this course a student must have had the subject B.Sc. with Biology.		
5	Course Learning outcomes (CLO)	<p>The objectives of this course are to introduce the field of microbiology with special emphasis on microbial (Bacteria, Fungi and virus) diversity, morphology, growth and nutrition; methods for control of microbes and viruses.</p> <p>CLO</p> <p>The students should be able to: -</p> <ol style="list-style-type: none"> 1. Understand the general features and characteristics of microbes. 2. Know about the history of microbiology and microorganisms. 3. Identify major categories of microorganisms and analyze their classification, diversity, and ubiquity; 4. Learn about general methods and techniques to isolate and culture of microorganisms. 		
6	Credit Value	4		
7	Total Marks	Max. Marks: 40+60	Min. Passing Marks : 40	

Part B: Content of the Practical Course

Total numbers of Lectures (in hours per week): 8 hours per week

Total Lectures: 120 hours

List of Practicals

1. Sterilization, disinfection and safety in microbiological laboratory.
2. Media Preparation for Cultivation of Microorganisms.
3. Isolation of bacteria in pure culture by streak plate method.
4. Study of colony and growth characteristics of some common bacteria.
5. Preparation of bacterial smear and Gram's staining.
6. Enumeration of bacteria: standard plate count.
7. Growth–Factors affecting growth. Sporulation, Growth curve of bacteria in batch culture.
8. Antimicrobial sensitivity test and demonstration of drug resistance.
9. Maintenance of stock cultures: slants, stabs and glycerol stock cultures
10. Determination of phenol coefficient of antimicrobial agents.
11. Determination of Minimum Inhibitory Concentration(MIC)
12. Methods of isolation, purification and maintenance of microorganisms from different environments (air, water, soil, milk and food).
13. Enrichment culture technique–isolation of asymbiotic, symbiotic nitrogen fixing bacteria.
14. Determination of viable and total number of cells.
15. Measurement of cell size. and spore germination in bacteria.
16. Protoplasts formation.
17. Inactivation of microorganisms by different mutagens. Production, isolation and characterization of mutants. Determination of mutation rate.
18. Determination of soil microbial population; Soil microbial biomass; Decomposition studies in soil, Soil enzymes; Study of rhizosphere effect.

Part C: Learning Resources

Text Books, Reference Books, Other resources

Suggested Readings:

1. Cappuccino, J.G., & Welsh, C., Microbiology: a Laboratory Manual. Benjamin-Cummings Publishing Company. 2016.
2. Collins,C.H.,Lyne,P.M.,Grange,J.M.,&FalkinhamIII,J.CollinsandLyne'sMicrobiological Methods (8th Ed.). Arnolds. 2004.
3. Tille,P.M.,Bailey&Scott'sDiagnosticMicrobiology(14thEd.).Elsevier.2017.
4. Kapoor,K.K.&Paroda,S.,ExperimentalSoilMicrobiology.CBSPublishers.2007. Garg,F.C.,ExperimentalMicrobiology.CBSPublishers&Distributors.2005.
5. Tortora, Funke & Case. Microbiology: An Introduction 7th Edition. 2001
6. M.J.Pelczar, E.C.S. Chan, N.R. Krieg. Microbiology VI Edition: New York: McGraw-Hill. 2001.
7. R. Y. Stainier, J. L. Ingraham, M. L. Wheelis and P.R. General Microbiology: Painter. Publisher: Macmillan.

8. Matthai, W., Berg, C.Y. & Black, J.G. Boston, MA: Microbiology, Principles and Explorations: John Wiley & Son. 2005.
9. Willey, J.M., Sherwood, L., Woolverton, C.J., Prescott, L.M. & Willey, J.M., Prescott's . Microbiology: New York: McGraw-Hill. 2011.
10. Pommerville, J.C., Alcamo's Jones and Bartlett Fundamentals of Microbiology (10th Ed.): Learning. 2013.
11. Madigan, MT, Bender, K.S., Buckley, D.H., Sattley, W.M. & Stahl, D.A., Biology of Microorganisms (15th Ed.): Brock Pearson/ Benjamin Cummings. 2018.
12. Sequeira, M., Kapoor, K.K., Yadav, K.S. & Tauro, P., An Introduction to Microbiology (3rd Ed.): New Age International Publishers. 2019.
13. Relevant book published in Hindi Granth Academy.
14. Dubey R.C. & Maheshwari D.K., A Textbook of Microbiology, 5th edition S. Chand Publishing, 2023.
15. H. D. Kumar, Daya Agricultural Biotechnology Publishing House, 2006
16. P.S. Bisen and Kavita Verma, Handbook of Microbiology, CBS publishers and distributors Pvt Ltd 2021
17. B. D. Singh, Biotechnology, 4th Edition Kalyani Publishers, 2010.
18. Books published by M.P. Hindi Granth Academy, Bhopal

Suggested equivalent online courses:

SWAYAM CENTRAL For All Courses

<https://swayamopenid.b2clogin.com/>

1. <https://archive.nptel.ac.in/courses/102/103/102103015/>
2. https://sirsyedcollege.ac.in/crm/public/uploads/download_image/btKWFkbwIXh58dyzfdvqwoyegD9XbO.pdf
3. <https://microbenotes.com/bacterial-sizes-shapes-arrangement/>
4. <https://mlkwc.ac.in/pdf/study-material/physiology/BacterialCellWall.pdf>
5. <https://journals.asm.org/doi/pdf/10.1128/microbiolspec.vmbf-0016-2015>
6. <https://lecture-notes.tiu.edu.iq/wp-content/uploads/2021/04/Lec-7-Antimicrob-drug-resist.pdf>
7. https://ocm.govtsciencecollegedurg.ac.in/Document/858_070732.pdf
8. [uou.ac.in/lecturenotes/science/MSCBOT-17/Viruses \(BOT-501\) by Dr. Kirtika Padalia.pdf](http://uou.ac.in/lecturenotes/science/MSCBOT-17/Viruses (BOT-501) by Dr. Kirtika Padalia.pdf)
9. <https://dspmuranchi.ac.in/pdf/Blog/Bacteriophages.pdf>
10. https://vikramuniv.ac.in/files/wp-content/uploads/M_Sc_II_Sem-Viroids_Virusides_and_Prions- Dr S K Jain.pdf
11. https://mlsu.ac.in/econtents/4136_Unit%20%20Viroids,%20Prions.pdf
12. <http://www.mphindigranthacademy.org>

Part-D Assessment and Evaluation

Pattern of Marks Distribution PRACTICAL PAPER for NEP PG courses

Suggested Continuous Evaluation Methods: (It may vary for respective course subject but TOTAL marks distribution will remain same)			
Internal Assessment	Marks	External Assessment	Marks
Class Interaction /Quiz	15	Viva Voce on Practical	10
Attendance in the lab	10	Practical Record File	10
Assignments (Charts/ Model Seminar / Rural Service/ Technology Dissemination/ Report of Excursion/ Lab Visits/ Survey / Industrial visit)	15	Table work / Experiments	40
TOTAL	40		60

Part A: Introduction				
Program-	Class: M.Sc.	Year: I	Semester: I	Session: 2025-2026
Subject: Microbiology				
1	Course Code	MMCB102-T		
2	Course Title	Microbial Biochemistry and Genetics		
3	Course Type	Core Course		
4	Pre-requisite (If any)	To study this course a student must have had the subject B.Sc. with Biology.		
5	Course Learning outcomes (CLO)	<p>Course Outcomes (Cos): Objectives of this course are to build the knowledge of biochemical principles with a specific emphasis on different metabolic pathways and microbial genetics. Course content highlights the Biochemistry, metabolism and genetics of microbes. Understand basic aspects of Bioenergetics and metabolism of microbes. The content of this course, students should be able to: -</p> <ol style="list-style-type: none"> 1. Gain fundamental knowledge on structure, functions and metabolism of biomolecules. 2. To understand the microbial genetics of microbes. Learn about gene expression. 		
6	Credit Value	6		
7	Total Marks	Max. Marks: 40+60	Min. Passing Marks: 40	

Part B: Content of the Course

Total numbers of Lectures (in hours per week) : 6 hours per week/ credit

Total Lectures : 90 hours

Unit	Topics	Number of Lectures
I	<p>Origin of Universe-Cosmogony, God particle, Big Bang theory, Atoms and Molecules in Vedic period. An introduction, General structure and important features of carbohydrates, glycoproteins & glycolipids. Metabolism of Carbohydrates-Glycolysis, Feeder pathways, Citric acid cycle, Gluconeogenesis and their regulations, Glycogen metabolism, reciprocal control of glycogen synthesis and breakdown, Roles of epinephrine and glucagon and insulin in glycogen metabolism; Starvation responses and insulin signalling. Glyoxylate and Pentose phosphate pathways.</p> <p>Activity</p> <ol style="list-style-type: none"> 1. Discussion on chronological order of creation. 2. Chart formation on Glucose metabolism or Pentose Phosphate pathways. 3. Model preparation of the DNA double helix structure 	18
II	<p>Definition and classification of lipids. Structure and functions of major lipid subclasses- Acylglycerols, Phospholipids, Glycolipids, Sphingolipids, Waxes, Terpenes and Sterols.</p> <p>Fatty acids biosynthesis, degradation and their regulations, Hormone trigger mobilization of stored triacylglycerol, Oxidation of fatty acids-saturated (odd and even carbon) and unsaturated, Ketone bodies synthesis. Biosynthesis of TAG, Phospholipids and Glycolipids. Mevalonate pathway.</p> <p>Activity</p> <ol style="list-style-type: none"> 1. Chart preparation on major lipid subclasses. 2. Flow chart format of fatty acids degradation. 3. Demonstration and application of Mevalonate pathway. 	18
III	<p>Amino Acids- structure, classification and properties. Handerson and Hasselbach equation for ionization of amino acids, Reverse turns and Ramachandran plot.</p> <p>Structure- function relationships in model proteins like, myoglobin, hemoglobin, chymotrypsin etc.</p> <p>A brief account of amino acid biosynthesis and degradation, Urea cycle and its regulation. Chemical synthesis of peptides and small proteins. Protein sequencing.</p> <p>Activity-</p> <ol style="list-style-type: none"> 1. Demonstration of Handerson and Hasselbach equation. 2. Computation and Chart preparation of myoglobin, hemoglobin, chymotrypsin etc. 	18

	3. Quiz on protein sequencing.	
IV	<p>Enzymes as biocatalysts- Enzyme classification. Mechanism of enzyme action- specificity, active site, activity unit and isozymes. Factors affecting enzyme efficiency, enzyme activators, coenzymes and cofactors. Enzyme kinetics - Michaelis - Menton equation for simple enzymes, determination of kinetic parameters, multi-step reactions and rate limiting steps. Enzyme inhibition- reversible, irreversible, competitive and noncompetitive. Allostercim- kinetic analysis of allosteric enzymes, Principles of allosteric regulation.</p> <p>Activity-</p> <ol style="list-style-type: none"> 1. Discuss on enzyme, coenzymes and cofactors. 2. Demonstration of allosteric regulation by model. 3. Online visualization of enzyme inhibition. 	18
V	<p>Fine structure of nucleic acid, DNA replication, DNA damage and Repair pathways, Transcription-General Principles, basic apparatus and types of RNA polymerases. Initiation, elongation and termination steps, Maturation and processing of RNA: Methylation, cutting and trimming of rRNA; capping, polyadenylation and splicing of mRNA, Basic features of the genetic code, Wobble hypothesis, protein, synthesis; steps, details of initiation, elongation and termination, Regulation of gene expression: Operon concept, positive and negative regulation of lac operon; catabolite repression, inducers and co-repressors, arabinose and tryptophan operon. Biosynthesis and degradation of purines and pyrimidines, Salvage pathway.</p> <p>Activity-</p> <ol style="list-style-type: none"> 1. Chart making on type of RNA polymerases. 2. Quiz on DNA damage and repair pathway. 3. Discussion of Salvage pathway. 	18

Part C: Learning Resources

Text Books, Reference Books, Other resources

Suggested Readings:

1. Stryer, L., Biochemistry. (8th Ed.): New York: Freeman. 2015.
2. Nelson, D.L. & Cox, M.M. Lehninger, A.L. Principles of Biochemistry (7th Ed.): Lehninger New York, NY: Worth. 2017.
3. Voet, D. & Voet, J.G., Hoboken, NJ: J. Biochemistry (5th Ed.): Wiley & Sons.
4. Martin. P. A and Rodwell. V. M.D.W, Mayes. Harper's review of Biochemistry
5. B. Lewin. Gene VII.
6. P. K. Gupta. Genetics
7. B.D. Singh. Genetics
8. H.D. Kumar. Microbial Genetics
9. Books published by M.P. Hindi Granth Academy, Bhopal

Suggested equivalent online courses:

1. https://onlinecourses.nptel.ac.in/noc25_bt33/preview
2. https://www.coledavid.com/downloads/datadownloads/chapter_1_biomolecules.pdf
3. https://epgp.inflibnet.ac.in/epgpdata/uploads/epgp_content/S001174BS/P001202/M010962/ET/1526556203Module_23_ET.pdf
4. <https://uw.pressbooks.pub/fmrbiochemistry/chapter/main-body-3/>
5. <https://ebooks.inflibnet.ac.in/biocp04/chapter/glycolysis/>
6. <https://egyankosh.ac.in/bitstream/123456789/75923/1/Unit-13.pdf>
7. <https://www.medschool.lsuhs.edu/biochemistry/Courses/Biochemistry201/Desai/Amino%20Acid%20Metabolism%20I%2010-14-08.pdf>
8. <https://basu.org.in/wp-content/uploads/2020/06/Enzymes.pdf>
9. <https://biochem.du.ac.in/userfiles/downloads/Enzyme%20Kinetics.pdf>
10. <https://ugcmoocs.inflibnet.ac.in/assets/uploads/1/223/6898/et/15200319060603031212.pdf>
11. <https://rwu.pressbooks.pub/bio103/chapter/regulation-of-gene-expression/>
12. <http://www.mphindigranthacademy.org>

Part-D Assessment and Evaluation

Pattern of Marks Distribution THEORY PAPER for NEP PG courses

<p>Recommended Continuous Assessment Methods:- (It may vary for respective course subject but TOTAL marks distribution will remain same)</p> <p>Maximum Marks: 100</p> <p>Continuous Comprehensive Evaluation (CCE): 40 Marks</p> <p>University Examination: 60 Marks</p>		
<p>Internal Assessment: Continuous Comprehensive Evaluation (CCE):</p>	<p>Class Test Assignment/Presentation</p>	<p>20 Marks</p> <p>20 Marks</p> <p>Total Marks = 40</p>
<p>External Assessment: University Examination: Time: 3 Hours</p>	<p>Section (A)- Five very short answer question (20 words each) Section (B)- Five short answer question (200 words each) Section (C)- Two long answer question (500 words each)</p>	<p>02 Marks x 05 Questions = 10 Marks <i>(All 5 Questions to be attempted)</i></p> <p>06 Marks x 05 Questions = 30 Marks <i>(5 Questions to be attempted out of total 8 Questions)</i></p> <p>10 Marks x 02 Questions = 20 Marks <i>(2 Questions with each having internal choice)</i></p> <p>Total Marks = 60</p>

Part A: Introduction				
Program-	Class: M.Sc.	Year: I	Semester: I	Session: 2025-2026
Subject: Microbiology				
1	Course Code	MMCB0102-P		
2	Course Title	Lab work for Microbial Biochemistry and Genetics (Practical-II)		
3	Course Type	Core Course		
4	Pre-requisite (If any)	To study this course a student must have had the subject B.Sc. with Biology.		
5	Course Learning outcomes (CLO)	<p>Course Outcomes (Cos): Objectives of this course are to build the knowledge of biochemical principles with a specific emphasis on different metabolic pathways and microbial genetics. Course content highlights the Biochemistry, metabolism and genetics of microbes. Understand basic aspects of Bioenergetics and metabolism of microbes. The content of this course, students should be able to: -</p> <ol style="list-style-type: none"> 1. Gain fundamental knowledge on structure, functions and metabolism of biomolecules. 2. To understand the microbial genetics of microbes. Learn about gene expression. 		
6	Credit Value	4		
7	Total Marks	Max. Marks: 40+60	Max. Marks: 40+60	

Part B: Content of the Practical Course

Total numbers of Lectures (in hours per week): 8 hours per week/credit

Total Lectures: 120 hours

List of Practical

1. Preparing various stock solutions and working solutions that will be needed for the course.
2. To prepare an Acetic-Na Acetate Buffer and validate the Henderson-Hasselbach equation.
3. To determine an unknown protein concentration by plotting a standard graph of BSA using UV-Vis Spectrophotometer and validating Beer-Lambert's Law.
4. Separation of aliphatic, aromatic and polar amino acids by paper chromatography.
5. Separation of lipids by thin-layer chromatography.
6. Purification and characterization of an enzyme from a natural/recombinant source
(such as Alkaline Phosphatase or Lactate Dehydrogenase or any enzyme of choice).
7. Preparation of cell-free lysates
8. Ammonium Sulfate precipitation
9. Ion-exchange Chromatography
10. Gel Filtration Chromatography
11. Affinity Chromatography
12. Dialysis of the purified protein solution against 60% glycerol as a demonstration of storage method.
13. Assessing the purity of samples from each step of purification by SDS-PAGE/ Gel Electrophoresis\
14. Enzyme Kinetic Parameters: K_m , V_{max} and K_{cat} .
15. Experimental verification that absorption at OD 260 is more for denatured DNA as compared to native double stranded DNA. Reversal of the same following DNA renaturation. Kinetics of DNA renaturation as a function of DNA size.
16. Identification of an unknown sample as DNA, RNA or protein using available laboratory tools.

Part C: Learning Resources

Text Books, Reference Books, Other resources

Suggested Readings:

1. Stryer, L., Biochemistry. (8th Ed.): New York: Freeman. 2015.
2. Nelson, D.L. & Cox, M.M. Lehninger, A.L. Principles of Biochemistry (7th Ed.): Lehninger New York, NY: Worth. 2017.
3. Voet, D. & Voet, J.G., Hoboken, NJ: J. Biochemistry (5th Ed.): Wiley & Sons.
4. Martin. P. A and Rodwell. V. M.D.W, Mayes. Harper's review of Biochemistry
5. B. Lewin. Gene VII.
6. P. K. Gupta. Genetics
7. B.D. Singh. Genetics
8. H.D. Kumar. Microbial Genetics
9. Sawhney, S.K. & Singh, R., Introductory Practical Biochemistry, Narosa Publishing House. 2009.
10. Plummer, D., An Introduction to Practical Biochemistry (3rd Ed.). McGraw Hill Education. 2017.
11. Sadasivam, S., Biochemical Method (3rd Ed.). New Age International Pvt Ltd Publishers. 2018.
12. Jayaraman, J., Laboratory Manual in Biochemistry. New Age International Private Limited. 2011.
13. Books published by M.P. Hindi Granth Academy, Bhopal

Suggested equivalent online courses:

1. https://onlinecourses.nptel.ac.in/noc25_bt33/preview
2. https://www.coledavid.com/downloads/datadownloads/chapter_1_biomolecules.pdf
3. https://epgp.inflibnet.ac.in/epgpdata/uploads/epgp_content/S001174BS/P001202/M010962/ET/1526556203Module_23_ET.pdf
4. <https://uw.pressbooks.pub/fmrbiochemistry/chapter/main-body-3/>
5. <https://ebooks.inflibnet.ac.in/biopc04/chapter/glycolysis/>
6. <https://egyankosh.ac.in/bitstream/123456789/75923/1/Unit-13.pdf>
7. <https://www.medschool.lsuhs.edu/biochemistry/Courses/Biochemistry201/Desai/Amino%20Acid%20Metabolism%20I%2010-14-08.pdf>
8. <https://basu.org.in/wp-content/uploads/2020/06/Enzymes.pdf>
9. <https://biochem.du.ac.in/userfiles/downloads/Enzyme%20Kinetics.pdf>
10. <https://ugcmoocs.inflibnet.ac.in/assets/uploads/1/223/6898/et/15200319060603031212.pdf>
11. <https://rwu.pressbooks.pub/bio103/chapter/regulation-of-gene-expression/>
12. <http://www.mphindigranthacademy.org>

Part-D Assessment and Evaluation

Pattern of Marks Distribution PRACTICAL PAPER for NEP PG courses

Suggested Continuous Evaluation Methods: (It may vary for respective course subject but TOTAL marks distribution will remain same)			
Internal Assessment	Marks	External Assessment	Marks
Class Interaction /Quiz	15	Viva Voce on Practical	10
Attendance in the lab	10	Practical Record File	10
Assignments (Charts/ Model Seminar / Rural Service/ Technology Dissemination/ Report of Excursion/ Lab Visits/ Survey / Industrial visit)	15	Table work / Experiments	40
TOTAL	40		60

Part A: Introduction				
Program-	Class: M.Sc.	Year: I	Semester: II	Session: 2025-2026
Subject: Microbiology				
1	Course Code	MMCB0201-T		
2	Course Title	BIOINSTRUMENTATION		
3	Course Type	Core Course		
4	Pre-requisite (If any)	To study this course a student must have had the subject B.Sc. with Biology.		
5	Course Learning outcomes (CLO)	<p>The objectives of this course are to teach basics of the new principles to students so as to appreciate current-day research tool-kit better. This course is broad-based in nature encompassing several new technologies that current experimental researchers are employing to probe complex system biology questions in life-sciences.</p> <p>CLO-</p> <p>The course contents of the course students should be able to: -</p> <ol style="list-style-type: none"> 1. To learn history, theoretical basis and applications of latest technologies in the advanced area of microbiology. 2. To gain fundamental knowledge about the light spectrum, absorption, fluorescence, NMR, mass spectroscopy 3. To acquire knowledge on the different. Chromatographic methods for the separation of biological products. 		
6	Credit Value	6		
7	Total Marks	Max. Marks: 40+60	Min. Passing Marks : 40	

Part B : Content of the Course

Total numbers of Lectures (in hours per week) : 6 hours per week/credit

Total Lectures : 90 hours

Unit	Topics	Number of Lectures
I	<p>Principles & applications of microscopy: light microscopy: bright field, dark field, phase contrast, fluorescent microscopy, Flowcytometry, Electron microscopy: transmission & Scanning, Confocal microscopy, atomic force microscopy.</p> <p>Activity-</p> <ol style="list-style-type: none"> 1. Comparative Chart making on different types of microscope & their application. 2. Lab visit for demonstration of Electron microscopy, Atomic force microscopy and flow cytometry. 3. Discussion about the biosafety regulation of the laboratory. 	18
II	<p>Macromolecular structure determination- Basics of X-ray Crystallography: symmetry, space groups, unit cells, structure factors, reciprocal lattice, Fourier transform, electron density, phase problems and it's solutions, biological application and interpretations of Nuclear Magnetic Resonance (NMR) & Electron Spin Resonance (ESR).</p> <p>Activiy-</p> <ol style="list-style-type: none"> 1. Lab visit for demonstration of FTIR and X-ray Crystallography. 2. Comparative Chart preparation on Principal Nuclear Magnetic Resonance (NMR) & Electron Spin Resonance (ESR). 3. Quiz of biological application of ESR. 	18
III	<p>Centrifugation: basic principles, types: differential, zonal, density gradient & Ultracentrifugation- basic instrument design & application.</p> <p>Chromatography: basic principle, types: partition, absorption, paper, thin layer, gas, ion exchange, gel filtration, Affinity chromatography, HPLC.</p> <p>Basics principles and applications of various chromatography methods: Theory and biological applications of GC and FPLC.</p> <p>Activity-</p> <ol style="list-style-type: none"> 1. Chart preparation on types of centrifuge. 2. Visit for understanding principles of Ultracentrifugation to scientific labs. 3. Demonstration of GC and application. 	18
IV	<p>Immunological technique: immunoelectrophoresis, immunodiffusion, immunofluorescence: radioimmunoassay, enzyme linked immunosorbant assay. Autoradiography: principles, methods of processing and application.</p>	18

	<p>Electrophoresis: basic principles, types: moving boundary & zonal electrophoresis; paper & gel techniques, (Polyacrylamide and agarose gel electrophoresis) its application & 2-D electrophoresis, isoelectric focusing.</p> <p>Activity-</p> <ol style="list-style-type: none"> 1. Demonstration of different type of ELISA through teaching kits. 2. Visit to medical labs for immuno Electrophoresis 3. Model making on 2-D electrophoresis. 	
V	<p>Basics of radioactive isotopes and radioactive decay, sample preparation, counting, Safety precautions during handling, biological applications, Liquid Scintillation counter, HPGe.</p> <p>Introduction to nanobodies, nanobody as a tool for protein structure-function studies, use of nanobodies for molecular imaging. Microarray, Theory, principle and applications of PSA cum Zeta sizer, CRISPR-CAS, DSC-TGA etc.</p> <p>Activity-</p> <ol style="list-style-type: none"> 1. Scientific lab visit for observation Liquid Scintillation counter. 2. Demonstration of Microarray. 3. Online awareness study on CRISPR-CAS mechanism. 	18

Part C: Learning Resources

Text Books, Reference Books, Other resources

Suggested Readings:

1. Banwell, C., Fundamentals of Molecular Spectroscopy (4th Ed.): McGraw Hill. 2017.
2. Lakowicz, J. & Joseph, R., Principles of Fluorescence Spectroscopy (3rd Ed.): Springer. 2006.
3. Valeur, B.,Molecular Fluorescence: Principles and Applications (2nd Ed.): Wiley. 2013.
4. Rupp, B., Biomolecular Crystallography: Principles, Practice and Application to Structural Biology (1st Ed.): Garland Science. 2009.
5. Wilson, K. & Walker, L., Principles and Techniques in Practical Biochemistry (5th Ed.): Cambridge University Press. 2000.
6. Dash, U.N., Textbook of Biophysical Chemistry: Macmillan Publishers India. 2006.
7. Cantor, C.R. Schimmel, P.R., W.H Freeman and Co.Biophysical Chemistry: Part 2: Techniques (1st Ed.): 2008.
8. Campbell, I.D., Biophysical Techniques: Oxford: Oxford University Press. 2012.
9. Serdyuk, I.N., Zaccai, N.R., & Zaccai, G.,. Methods in Molecular Biophysics: Structure, Dynamics, Function: Cambridge: Cambridge University Press. 2007.
10. Chakravarty, R., Goel, S. & Cai, W., Nanobody: The “Magic Bullet” for Molecular Imaging? Theranostics, 4(4), 386-398. doi:10.7150/thno.8006. 2014.
11. Books published by M.P. Hindi Granth Academy, Bhopal

Suggested equivalent online courses:

1. <https://archive.nptel.ac.in/content/storage2/courses/102103047/PDF/mod6.pdf>
2. <https://cattheni.edu.in/wp-content/uploads/2018/09/2.Microscopy-Principles-and-Types.pdf>
3. <https://archive.nptel.ac.in/noc/courses/noc16/SEM1/noc16-mm03/>
4. <https://jiwaji.edu/pdf/ecourse/chemistry/Lecture%203%20Crystal%20system%20etc..pdf>
5. https://onlinecourses.nptel.ac.in/noc20_bt18/preview
6. <https://egyankosh.ac.in/bitstream/123456789/87970/1/Unit-6.pdf>
7. <https://uou.ac.in/sites/default/files/slm/MSCCH-509.pdf>
8. https://ddugu.ac.in/ePathshala_Attachments/E_PS337351@10170be2i.pdf
9. https://bly.covenantuniversity.edu.ng/ebooks/Environmental_Microbiology/Chapter-12---Immunological-Methods_2015_Environmental-Microbiology.pdf
10. <https://archive.nptel.ac.in/content/storage2/courses/102103047/PDF/mod3.pdf>
11. [Thermogravimetric Analysis \(TGA\) & Differential Scanning Calorimetry \(DSC\)](#)
12. <https://www.nobelprize.org/uploads/2024/03/doudna-lecture.pdf>
13. <http://www.mphindigranthacademy.org>

Part-D Assessment and Evaluation

Pattern of Marks Distribution THEORY PAPER for NEP PG courses

<p>Recommended Continuous Assessment Methods-: (It may vary for respective course subject but TOTAL marks distribution will remain same)</p> <p>Maximum Marks: 100</p> <p>Continuous Comprehensive Evaluation (CCE): 40 Marks</p> <p>University Examination: 60 Marks</p>		
<p>Internal Assessment: Continuous Comprehensive Evaluation (CCE):</p>	<p>Class Test Assignment/Presentation</p>	<p>20 Marks 20 Marks Total Marks = 40</p>
<p>External Assessment: University Examination: Time: 3 Hours</p>	<p>Section (A)- Five very short answer question (20 words each) Section (B)- Five short answer question (200 words each) Section (C)- Two long answer question (500 words each)</p>	<p>02 Marks x 05 Questions = 10 Marks <i>(All 5 Questions to be attempted)</i> 06 Marks x 05 Questions = 30 Marks <i>(5 Questions to be attempted out of total 8 Questions)</i> 10 Marks x 02 Questions = 20 Marks <i>(2 Questions with each having internal choice)</i> Total Marks = 60</p>

Part A: Introduction				
Program-	Class: M.Sc.	Year: I	Semester: II	Session: 2025-2026
Subject: Microbiology				
1	Course Code	MMCB0201-P		
2	Course Title	Lab work for Bioinstrumentation (Practical-I)		
3	Course Type	Core Course		
4	Pre-requisite (If any)	To study this course a student must have had the subject B.Sc. with Biology.		
5	Course Learning outcomes (CLO)	<p>The objectives of this course are to teach basics of the new principles to students so as to appreciate current-day research tool-kit better. This course is broad-based in nature encompassing several new technologies that current experimental researchers are employing to probe complex system biology questions in life- sciences.</p> <p>CLO-</p> <p>The course contents of the course students should be able to: -</p> <ol style="list-style-type: none"> 1. To learn history, theoretical basis and applications of latest technologies in the advanced area of microbiology. 2. To gain fundamental knowledge about the light spectrum, absorption, fluorescence, NMR, mass spectroscopy 3. To acquire knowledge on the different. Chromatographic methods for the separation of biological products. 		
6	Credit Value	4		
7	Total Marks	Max. Marks: 40+60	Min. Passing Marks : 40	

Part B: Content of the Practical Course

Total numbers of Lectures (in hours per week): 8 hours per week/credit

Total Lectures: 120 hours

List of Practicals

1. Study of different morphological and surface features using atomic force microscopy
2. Study of the crystalline information of the sample (either solid or thin film) using X-ray diffraction.
3. Quantification of the metal ion concentrations in aqueous samples using atomic absorption spectroscopy (AAS)/inductively coupled plasma mass spectrometry (ICP-MS).
4. Study of the spectrum of pure and complex samples using mass spectroscopy.
5. Study of the variation of properties of substance with heat using differential scanning calorimetry (DSC) and thermogravimetric analysis (TGA).

Part C: Learning Resources

Text Books, Reference Books, Other resources

Suggested Readings:

1. Banwell, C., Fundamentals of Molecular Spectroscopy (4th Ed.): McGraw Hill. 2017.
2. Lakowicz, J. & Joseph, R., Principles of Fluorescence Spectroscopy (3rd Ed.): Springer. 2006.
3. Valeur, B.,Molecular Fluorescence: Principles and Applications (2nd Ed.): Wiley. 2013.
4. Rupp, B., Biomolecular Crystallography: Principles, Practice and Application to Structural Biology (1st Ed.): Garland Science. 2009.
5. Wilson, K. & Walker, L., Principles and Techniques in Practical Biochemistry (5th Ed.): Cambridge University Press. 2000.
6. Dash, U.N., Textbook of Biophysical Chemistry: Macmillan Publishers India. 2006.
7. Cantor, C.R. Schimmel, P.R., W.H Freeman and Co.Biophysical Chemistry: Part 2: Techniques (1st Ed.): 2008.
8. Campbell, I.D., Biophysical Techniques: Oxford: Oxford University Press. 2012.
9. Serdyuk, I.N., Zaccai, N.R., & Zaccai, G.,. Methods in Molecular Biophysics: Structure, Dynamics, Function: Cambridge: Cambridge University Press. 2007.
10. Chakravarty, R., Goel, S. & Cai, W., Nanobody: The “Magic Bullet” for Molecular Imaging? Theranostics, 4(4), 386-398. doi:10.7150/thno.8006. 2014
11. Punt, J., Stranford, S., Jones, P. & Owen, J.A., Kuby Immunology (8th Ed.). Macmillan International Higher Education. 2018.
12. Delves, P.J., Martin, S.J., Burton, D.R. &Roitt, I.M., Roitt's Essential Immunology (13th Ed.). Wiley- Blackwell. 2017.

13. Kenneth, M. & Weaver, C., Janeway's Immunobiology (9th Ed.). Garland Science. 2016.
14. Green, M.R. & Sambrook, J., Molecular Cloning: A Laboratory Manual. Cold Spring Harbor, NY: Cold Spring Harbor Laboratory Press. 2012.
15. Wilson, K. & Walker, L., Principles and Techniques in Practical Biochemistry (5th Ed.). Cambridge University Press. 2000.
16. Banwell, C., Fundamentals of Molecular Spectroscopy (4th Ed.) McGraw Hill. 2017.
17. Lakowicz, J. & Joseph, R., Principles of Fluorescence Spectroscopy (3rd Ed.) Springer. 2006.
18. Valeur, B., Molecular Fluorescence: Principles and Applications (2nd Ed.) Wiley. 2013.
19. Serdyuk, I.N., Zaccai, N.R., & Zaccai, G., Methods in Molecular Biophysics: Structure, Dynamics, Function. Cambridge: Cambridge University Press. 2007.
20. Books published by M.P. Hindi Granth Academy, Bhopal.

Suggested equivalent online courses:

1. <https://archive.nptel.ac.in/content/storage2/courses/102103047/PDF/mod6.pdf>
2. <https://cattheni.edu.in/wp-content/uploads/2018/09/2.Microscopy-Principles-and-Types.pdf>
3. <https://archive.nptel.ac.in/noc/courses/noc16/SEM1/noc16-mm03/>
4. <https://jiwaji.edu/pdf/ecourse/chemistry/Lecture%203%20Crystal%20system%20etc..pdf>
5. https://onlinecourses.nptel.ac.in/noc20_bt18/preview
6. <https://egyankosh.ac.in/bitstream/123456789/87970/1/Unit-6.pdf>
7. <https://uou.ac.in/sites/default/files/slm/MSCCH-509.pdf>
8. https://ddugu.ac.in/ePathshala_Attachments/E_PS337351@10170be2i.pdf
9. https://bly.covenantuniversity.edu.ng/ebooks/Environmental_Microbiology/Chapter-12---Immunological-Methods_2015_Environmental-Microbiology.pdf
10. <https://archive.nptel.ac.in/content/storage2/courses/102103047/PDF/mod3.pdf>
11. [Thermogravimetric Analysis \(TGA\) & Differential Scanning Calorimetry \(DSC\)](#)
12. <https://www.nobelprize.org/uploads/2024/03/doudna-lecture.pdf>
13. <http://www.mphindigranthacademy.org>

Part-D Assessment and Evaluation

Pattern of Marks Distribution PRACTICAL PAPER for NEP PG courses

Suggested Continuous Evaluation Methods: (It may vary for respective course subject but TOTAL marks distribution will remain same)			
Internal Assessment	Marks	External Assessment	Marks
Class Interaction /Quiz	15	Viva Voce on Practical	10
Attendance in the lab	10	Practical Record File	10
Assignments (Charts/ Model Seminar / Rural Service/ Technology Dissemination/ Report of Excursion/ Lab Visits/ Survey / Industrial visit)	15	Table work / Experiments	40
TOTAL	40		60

Part A: Introduction				
Program-	Class: M.Sc.	Year: I	Semester: II	Session: 2025-2026
Subject: Microbiology				
1	Course Code	MMCB0202-T		
2	Course Title	Biostatistics and Bioinformatics		
3	Course Type	Core Course		
4	Pre-requisite (If any)	To study this course a student must have had the subject B.Sc. with Biology.		
5	Course Learning outcomes (CLO)	<p>The objectives of this course are to provide basic knowledge about biostatistics and bioinformatics.</p> <p>CLO-</p> <p>The students should be able to: -</p> <ol style="list-style-type: none"> 1. Develop an understanding of the basics of biostatistics, data analysis tools and bioinformatics tools; 2. Gain working knowledge of these bioinformatics tools and methods. 3. Appreciate their relevance for investigating specific contemporary biological questions. 4. Critically analyze and interpret results of their study. 		
6	Credit Value	6		
7	Total Marks	Max. Marks: 40+60	Min. Passing Marks: 40	

Part B: Content of the Course

Total numbers of Lectures (in hours per week) : 6 hours per week/credit

Total Lectures : 90 hours

Unit	Topics	Number of Lectures
I	<p>Introduction Concept of variables in biological systems. Collection, classification, tabulation graphical and diagrammatic representation of numerical data. Measures of central tendency: mean, median and mode and their relationship, measures of dispersion: Range, quartile deviation, mean deviation, standard deviation. Coefficient of variation, skewness and kurtosis. Probability: Random experiment, events, sample space, mutually exclusive events, independent and dependent events. Various definitions of probability, addition and multiplication theorems of probability (only statement), Random variables (discrete and continuous). Probability density functions and its properties.</p> <p>Activity-</p> <ol style="list-style-type: none"> 1. Group discussion on importance of Biostatistics with reference to research data. 2. Flow chart on sampling methods and /or Chi-square test and student's 't' test 3. Quiz on databases related to Bioinformatics. 	18
II	<p>Sample Some probability distributions such as binomial, Poisson and normal (Basic idea about these distributions) and their applications. Concept of populations and sample. Simple random sampling without replacement. Definition of simple random sample. Chi-square (X^2), student's t and f-distributions (derivations not required) their properties and uses. Concept of standard error. Correlation and Regression, linear and quadratic regression Analysis of variance: One-way and two-way classifications with single observation per cell.</p> <p>Activity-</p> <ol style="list-style-type: none"> 1. Exercise on probability distributions and Analysis of variance. 2. Field Survey of different types of sampling methods. 	18
III	<p>Introduction to Bioinformatics</p> <p>Definition, role, scope and limitation of Bioinformatics. Different branches of Bioinformatics. Terminologies: Internet Browser, Software, hardware, database, Network NicNet, Infnlibnet, EMBnet, Operating System, algorithm. Biological data & databases: Biological data type, Classification of biological database, sequence database: GenBank, EMBL DDBJ, PIR, SWISS-PROT. Secondary nucleotide and protein sequence databases: ExInt, TIGR, EPD, CUTG, GOBASE, PROSITE, PRINTS, BLOCKS, Pfam, PRODOME. Structure database: PDB, CSD, CATH, SCOP, FSSP, Specialized Database: KEGG, ENZYME, REBASE. Study of data entry formats: GenBank, EMBL, DDBJ, Swiss-Port, PIR, PDB, FASTA, MSA, PHYLIP</p> <p>Activity-</p> <ol style="list-style-type: none"> 1. Chart preparation of Software and hardware used in 	18

	<p>bioinformatics.</p> <ol style="list-style-type: none"> 2. Online exercise on protein sequencing PROSITE, Pfam, PRODOM database. 3. Model preparation on classification sequence database. 	
IV	<p>Sequence Analysis Introduction, methods (HMM & ANN) and significance. Nucleic acid sequence analysis: Principle and software tools. Protein Sequence Analysis: Principle and software tools. Sequence Comparison: Pair wise algorithms-Introduction and significance. Methods of alignment: Dot matrix, Dynamic Programming, Heuristic algorithm (FASTA & BLAST). Scoring matrix: PAM and BLOSUM, Concept of Gap penalty. Multiple Sequence Alignment Introduction, Significance and various algorithms. Phylogenetic Analysis: Introduction & Importance, Phylogenetic tree, methods of Phylogenetic analysis.</p> <p>Activity-</p> <ol style="list-style-type: none"> 1. Discussion on Nucleic acid sequence analysis and software tools used. 2. Comparative Chart Preparation on methods of alignment: Dot matrix and Scoring matrix. 3. Quiz on multiple sequence Alignment/ methods of Phylogenetic analysis. 	18
V	<p>Structural Bioinformatics Introduction & Importance. Experimental Structure determination: X-ray, NMR and electron microscopy. Coordinate systems. Visualization & presentation of structure. Geometric Analysis of structure. Structure comparison. Protein structure prediction: secondary structure prediction, tertiary structure prediction. Protein folding. Nucleic acid structure: RNA structure prediction: principle and tools: DNA structural polymorphism. Molecular modeling and dynamics, computer aided drug designing</p> <p>Activity-</p> <ol style="list-style-type: none"> 1. Questionnaire preparation Geometric Analysis of structure. 2. Online exercise of protein folding. 3. Discussion on computer aided drug designing. 	18

Part C: Learning Resources

Text Books, Reference Books, Other resources

Suggested Readings:

Statistics:

1. An Introduction Biostatistics Glover
2. Mishra & Mishra An Introduction Biostatistics- , Kalyani Publication .
3. Bajpai P.K. S Chand Biological Instrumentation and Methodology & Company, 2010.
4. K.N. Scott and A.K. Mathur Textbook of Biomedical Instrumentation, , CBS Publishers and Distributors Pvt Ltd; 1st Edition, 2013.
5. Khan & Khanum Shiba Khan, Fundamentals of Biostatistics Ukaaz Publications,
6. Jayaram Reddy. Bioinformatics and Biostatistics, Jayaram Reddy, Geetha Book House, Bengaluru, 2017
7. Books published by M.P. Hindi Granth Academy, Bhopal.

Suggested equivalent online courses:

1. https://www.lkouniv.ac.in/site/writereaddata/siteContent/202004241216240370priyamka_SDS_COLLECTION_OF_DATA.pdf
2. <https://ebooks.inflibnet.ac.in/hsp16/chapter/and-tabulation-of-data/>
3. <https://egyankosh.ac.in/bitstream/123456789/65182/3/Unit-3.pdf>
4. https://digital.nios.ac.in/content/311en/311_Maths_Eng_Lesson18.pdf
5. https://math.ucr.edu/~jbritton/Normal_Binomial_Poisson_Distributions.pdf
6. <https://uw.pressbooks.pub/quantbusiness/chapter/simple-linear-regression-and-correlation/>
7. https://www.lkouniv.ac.in/site/writereaddata/siteContent/202003291612341467kuaum_yadav_Bioinformatics.pdf
8. https://epgp.inflibnet.ac.in/epgpdata/uploads/epgp_content/S001174BS/P001209/M014178/ET/1526979884P14_M2_ET.pdf
9. <https://www.ebi.ac.uk/training/online/courses/bioinformatics-terrified/what-makes-a-good-bioinformatics-database/primary-and-secondary-databases/>
10. <http://www.binf.gmu.edu/jafri/binf630/Lecture7.pdf>
11. <https://www.biogem.org/downloads/notes/kau/PAM%20and%20BLOSUM%20Matrices.pdf>
12. https://onlinecourses.nptel.ac.in/noc21_bt29/preview
13. https://liacs.leidenuniv.nl/~bakkerem2/cmb2015/CMB2015_lecture10.pdf
14. <http://www.mphindigranthacademy.org>

Part-D Assessment and Evaluation

Pattern of Marks Distribution THEORY PAPER for NEP PG courses

<p>Recommended Continuous Assessment Methods-: (It may vary for respective course subject but TOTAL marks distribution will remain same)</p> <p>Maximum Marks: 100</p> <p>Continuous Comprehensive Evaluation (CCE): 40 Marks</p> <p>University Examination: 60 Marks</p>		
<p>Internal Assessment: Continuous Comprehensive Evaluation (CCE):</p>	<p>Class Test Assignment/Presentation</p>	<p>20 Marks 20 Marks Total Marks = 40</p>
<p>External Assessment: University Examination: Time: 3 Hours</p>	<p>Section (A)- Five very short answer question (20 words each) Section (B)- Five short answer question (200 words each) Section (C)- Two long answer question (500 words each)</p>	<p>02 Marks x 05 Questions = 10 Marks <i>(All 5 Questions to be attempted)</i> 06 Marks x 05 Questions = 30 Marks <i>(5 Questions to be attempted out of total 8 Questions)</i> 10 Marks x 02 Questions = 20 Marks <i>(2 Questions with each having internal choice)</i> Total Marks = 60</p>

Part A: Introduction				
Program-	Class: M.Sc.	Year: I	Semester: II	Session: 2025-2026
Subject: Microbiology				
1	Course Code	MMCB0202- P		
2	Course Title	Lab work for Biostatistics and Bioinformatics (Practical-II)		
3	Course Type	Core Course		
4	Pre-requisite (If any)	To study this course a student must have had the subject B.Sc. with Biology.		
5	Course Learning outcomes (CLO)	<p>The objectives of this course are to provide basic knowledge about biostatistics and bioinformatics.</p> <p>CLO-</p> <p>The students should be able to: -</p> <ol style="list-style-type: none"> 1. Develop an understanding of the basics of biostatistics, data analysis tools and bioinformatics tools; 2. Gain working knowledge of these bioinformatics tools and methods. 3. Appreciate their relevance for investigating specific contemporary biological questions. 4. Critically analyze and interpret results of their study. 		
6	Credit Value	4		
7	Total Marks	Max. Marks: 40+60	Max. Marks: 40+60	

Part B: Content of the Practical Course

Total numbers of Lectures (in hours per week): 8 hours per week/credit

Total Lectures: 120 hours

List of Practical

1. Using NCBI and Uniprot web resources.
2. Introduction and use of various genome databases.
3. Sequence information resource: Using NCBI, EMBL, Genbank, Entrez, Swissprot/ TrEMBL, UniProt.
4. Similarity searches using tools like BLAST and interpretation of results.
5. Multiple sequence alignment using Clustal W.
6. Phylogenetic analysis of protein and nucleotide sequences.
7. Use of gene prediction methods (GRAIL, Gen scan, Glimmer).
8. Using RNA structure prediction tools.
9. Use of various primer designing and restriction site prediction tools.
10. Use of different protein structure prediction databases (PDB, SCOP, CATH).
11. Construction and study of protein structures using Deep view/Py Mol.

Part C: Learning Resources

Text Books, Reference Books, Other resources

Suggested Readings:

1. An Introduction Biostatistics Glover
2. Mishra & Mishra An Introduction Biostatistics- , Kalyani Publication .
3. Bajpai P.K. S Chand Biological Instrumentation and Methodology & Company, 2010.
4. K.N. Scott and A.K. Mathur Textbook of Biomedical Instrumentation, , CBS Publishers and Distributors Pvt Ltd; 1st Edition, 2013.
5. Khan & Khanum Shiba Khan, Fundamentals of Biostatistics Ukaaz Publications,
6. Jayaram Reddy. Bioinformatics and Biostatistics, Jayaram Reddy, Geetha Book House, Bengaluru, 2017.
7. Green, M.R., & Sambrook, J., Molecular Cloning: A Laboratory Manual. Cold Spring Harbor, NY: Cold Spring Harbor Laboratory Press. 2012.
8. Mount, D.W., Bioinformatics: Sequence and Genome Analysis. Cold Spring Harbor, NY: Cold Spring Harbor Laboratory Press. 2001.
9. Baxevanis, A.D., & Ouellette, B.F., Bioinformatics: a Practical Guide to the Analysis of Genes and Proteins. New York: Wiley-Interscience. 2001.
10. Pevsner, J., Bioinformatics and Functional Genomics. Hoboken, NJ: Wiley-Blackwell. 2015.
11. Bourne, P.E., & Gu, J. Structural Bioinformatics. Hoboken, NJ: Wiley-Liss. 2009.
12. Lesk, A.M., Introduction to Protein Science: Architecture, Function, and Genomics. Oxford: Oxford University Press. 2004.
13. Books published by M.P. Hindi Granth Academy, Bhopal.

Suggested equivalent online courses:

1. https://www.lkouniv.ac.in/site/writereaddata/siteContent/202004241216240370priyamka_SDS_COLLECTION_OF_DATA.pdf
2. <https://ebooks.inflibnet.ac.in/hsp16/chapter/and-tabulation-of-data/>
3. <https://egyankosh.ac.in/bitstream/123456789/65182/3/Unit-3.pdf>
4. https://digital.nios.ac.in/content/311en/311_Maths_Eng_Lesson18.pdf
5. https://math.ucr.edu/~jbritton/Normal_Binomial_Poisson_Distributions.pdf
6. <https://uw.pressbooks.pub/quantbusiness/chapter/simple-linear-regression-and-correlation/>
7. https://www.lkouniv.ac.in/site/writereaddata/siteContent/202003291612341467kuaum_yadav_Bioinformatics.pdf
8. https://epgp.inflibnet.ac.in/epgpdata/uploads/epgp_content/S001174BS/P001209/M014178/ET/1526979884P14_M2_ET.pdf
9. <https://www.ebi.ac.uk/training/online/courses/bioinformatics-terrified/what-makes-a-good-bioinformatics-database/primary-and-secondary-databases/>
10. <http://www.binf.gmu.edu/jafri/binf630/Lecture7.pdf>
11. <https://www.biogem.org/downloads/notes/kau/PAM%20and%20BLOSUM%20Matrices.pdf>
12. https://onlinecourses.nptel.ac.in/noc21_bt29/preview
13. https://liacs.leidenuniv.nl/~bakkerem2/cmb2015/CMB2015_lecture10.pdf
14. <http://www.mphindigranthacademy.org>

Part-D Assessment and Evaluation

Pattern of Marks Distribution PRACTICAL PAPER for NEP PG courses

Suggested Continuous Evaluation Methods: (It may vary for respective course subject but TOTAL marks distribution will remain same)			
Internal Assessment	Marks	External Assessment	Marks
Class Interaction /Quiz	15	Viva Voce on Practical	10
Attendance in the lab	10	Practical Record File	10
Assignments (Charts/ Model Seminar / Rural Service/ Technology Dissemination/ Report of Excursion/ Lab Visits/ Survey / Industrial visit)	15	Table work / Experiments	40
TOTAL	40		60

Part A: Introduction				
Program-	Class: M.Sc.	Year: II	Semester: III	Session: 2025-2026
Subject: Microbiology				
1	Course Code	MMCB0301-T		
2	Course Title	Immunology & Immunodiagnostics		
3	Course Type	Core Course		
4	Pre-requisite (If any)	To study this course a student must have had the subject B.Sc. with Biology.		
5	Course Learning outcomes (CLO)	<p>The objectives of this course are to acquaint students to understand about the infection, immune system, immune response, antigen, antibody, hypersensitivity, Transplantation immunology and autoimmunity its mechanisms and related immunodeficiency disorders and diseases.</p> <p>CLO- Students should understand Immunology and immunodiagnostics.</p> <ol style="list-style-type: none"> 1. Learn about infection, Antigen, Antibody, MHC and Immune response 2. Understand transplantation immunology, Tumour immunology and Immuno deficiency diseases. 		
6	Credit Value	6		
7	Total Marks	Max. Marks: 40+60	Min. Passing Marks : 40	

Part B: Content of the Course

Total numbers of Lectures (in hours per week): 8 hours per week/credit

Total Lectures: 90 hours

Unit	Topics	Number of Lectures
I	<p>Defense from the germs, elimination of germs by Sunrays. contribution of Dhanvantri. Immunology Components of innate and acquired immunity; Important organs and cells of immune responses, complement and inflammatory responses; Pathogen recognition receptors (PRR) and pathogen associated molecular pattern (PAMP); Interferon, Inflammation, ADCC, Acute Phase protein, Innate immune response; Mucosal immunity; Immune dysfunction and its consequences; Antigens - immunogens, Haptens, adjuvant; Antigenic determinants.</p> <p>Immunoglobulins: Structure of IgG (b) , various classes of antibodies, theories of generation of antibodies, Diversity, molecular mechanisms of antibody diversity, monoclonal antibodies (hybridoma technology) , recombinant antibodies, antigen- antibody interaction, class-switching.</p> <p>Activity-</p> <ol style="list-style-type: none"> 1. Flow chart on monoclonal antibodies. 2. Chart making on Immunodiagnostic based on antigen-antibody interaction. 3. Quiz on antibody diversity and recombinant antibodies. 	18
II	<p>Complement System Classical and alternate pathways, Role of Complement in immune response-Immunity to bacteria, fungi, protozoa & worms. complement deficiencies</p> <p>Major Histo-compatibility Complex, recognition of antigens by T & B cells, T – cell receptor complex, B – cells receptor complex. Dendritic cells and N cells.</p> <p>Immunological Responses: Cell mediated immune response, cellular interactions in the immune response – antigen recognition and presentation, cytokines, immunological tolerance, hypersensitivity, anti-immune diseases & AIDS.</p> <p>Activity-</p> <ol style="list-style-type: none"> 1. Chart preparation on role Complement in immune response. 2. Discussion on awareness programmes run by government on AIDS and other out auto immune diseases. 3. Model making of Major Histo-compatibility Complex. 	18
III	<p>Autoimmunity and Vaccines</p> <p>Mechanism and therapeutic approaches, immunodeficiency syndrome and their diagnosis,</p> <p>vaccines-active and passive immunization, whole organism vaccines, macromolecules as vaccines, recombinant vector vaccines, synthetic peptide vaccines and subunit vaccines, DNA vaccines, Immunodiagnostic: precipitation techniques, agglutination, fluorescence Molecular mechanism of antibody diversity, Antibody Engineering, Monoclonal antibodies: Production, characterization and application in</p>	18

	<p>diagnosis therapy and basic research.</p> <p>Activity-</p> <ol style="list-style-type: none"> 1. Discussion on diagnosis methods of immunodeficiency syndrome. 2. Quiz on various programme run by Govt. on Vaccination for various diseases. 3. Chart making on antibody engineering. 	
IV	<p>Immunodiagnosics for detection of infectious agents: fungi, bacteria, viruses and protozoan, cancer (malignant and non malignant) and autoimmune diseases; Immunosensors.</p> <p>Activity-</p> <ol style="list-style-type: none"> 1. pathology lab visit for demonstration of Immunodiagnosics. 2. Chart Preparation on Immunosensors/ difference between malignant and non malignant tumor. 	18
V	<p>Immuno fluorescence microscopy; Immuno electronmicroscopy; principle and application. Immunohistochemistry, Immunoblotting technique; principle and applications.</p> <p>Therapeutic monoclonal antibodies: principle and applications, Biological response modifiers (immunostimulators and immunosuppressant), Recombinant vaccines-vector, DNA, synthetic peptide.</p> <p>Activity-</p> <ol style="list-style-type: none"> 1. Scientific lab visit for demonstration of Immunoblotting technique. 2. Quiz on Therapeutic monoclonal antibodies. 3. Chart preparation on principle of Immunohistochemistry. 	18

Part C : Learning Resources

Text Books, Reference Books, Other resources

Suggested Readings:

1. Biochemistry (7th edition) JM Berg, JLT Tymoczko and L. Stryer, 2012, WH Freeman and Co., New York.
2. Biochemistry (4th edition): D Voet and JE Voet, 2011 John Wiley and Sons. Principles of Biochemistry (Lehninger) (5th edition), MM Cox and DL Nelson, CBS Publishers.
3. Scientific Foundations of Clinical Biochemistry: Ed, D.L. Williams, R.F. Nun, V. Marks; William Heinemann Medical Books Ltd.
4. Harper's Review of Biochemistry (29th edition) RK Murray, DA Benderer, PJ Kennelly, VW Rodwell and PA Weil. 2012, McGraw Hill Co.
5. Textbook of Biochemistry for Medical Students (6th edition) DM Vasudevan, S Sreekumari and K Vaidyanathan 2011, Jaypee Medical Publishers, New Delhi.
6. Practical Biochemistry, Principles and Techniques (4th edition) edited by Keith Wilson and John Walker, 1994, Cambridge University Press.
7. Biochemistry "Lippincott's Illustrated Reviews" (5th edition) RA Harvey (series editor), 2011, Lippincott Williams & Wilkins, Wolters Kluwer.
8. Genomes (3rd edition) TA Brown, Wiley-Liss Publications.
9. Cell and Molecular Biology (5th edition) Gerald Karp, John Wiley and Sons Ltd.
10. Molecular Biology of the Cell (5th edition) Bruce Alberts, Alexander Johnson, Julian Lewis, Martin Raff, Keith Roberts, Peter Walter. Garland Science Publications
11. Molecular Cell Biology, (6th edition) Harvey Lodish, Arnold Berk, Paul Matsudaira, Chris A. Kaiser, Monty Krieger, Matthew P. Scott, Lawrence Zipursky, and James Darnell. WH Freeman Publications
12. Lydyard, P. M., Whelan, A., Fanger, M.W. Immunology: , 1st Ed., Viva Books.
13. Roitt, I.M., Essential Immunology, 9th Ed. (1997), Blackwell Scientific, Oxford, UK.
14. Kubly, J. Immunology, 3rd Ed. (1997), Freeman, W. H., Oxford.
15. Punt, J., Stranford, S., Jones, P. & Owen, J.A., Kubly Immunology (8th Ed.). Macmillan International Higher Education. 2018
16. Kenneth, M. & Weaver, C., Janeway's Immunobiology (9th Ed.). Garland Science. 2016.
17. Dubey, R.C. -Vedic Microbiology- A Scientific Approach Motilal Banarsidass-. International Publishers Delhi 2022.
18. Books published by M.P. Hindi Granth Academy, Bhopal.

Suggested equivalent online courses:

1. <https://ebooks.inflibnet.ac.in/biocp16/chapter/types-of-immunity-innate-and-acquired/>
2. <https://www.jsscacs.edu.in/sites/default/files/Department%20Files/3.%20Immunoglobulins.pdf>
3. <https://mlkwc.ac.in/pdf/study-material/zoology/Hybridoma%20Technology%20&%20Monoclonal%20Antibody.pdf>
4. <https://archive.nptel.ac.in/content/storage2/courses/102103038/download/module2.pdf>
5. https://www.researchgate.net/publication/316209197_Monoclonal_antibodies_A_review_of_therapeutic_applications_and_future_prospects

6. https://www.pvpsiddhartha.ac.in/dep_it/lecture%20notes/LSFE/Unit-V%20Recombinant%20DNA%20technology.pdf
7. <http://www.mphindigranthacademy.org>

Part-D Assessment and Evaluation

Pattern of Marks Distribution THEORY PAPER for NEP PG courses

<p>Recommended Continuous Assessment Methods-: (It may vary for respective course subject but TOTAL marks distribution will remain same)</p> <p>Maximum Marks: 100</p> <p>Continuous Comprehensive Evaluation (CCE): 40 Marks</p> <p>University Examination: 60 Marks</p>		
<p>Internal Assessment: Continuous Comprehensive Evaluation (CCE):</p>	<p>Class Test Assignment/Presentation</p>	<p>20 Marks 20 Marks Total Marks = 40</p>
<p>External Assessment: University Examination: Time: 3 Hours</p>	<p>Section (A)- Five very short answer question (20 words each) Section (B)- Five short answer question (200 words each) Section (C)- Two long answer question (500 words each)</p>	<p>02 Marks x 05 Questions = 10 Marks <i>(All 5 Questions to be attempted)</i> 06 Marks x 05 Questions = 30 Marks <i>(5 Questions to be attempted out of total 8 Questions)</i> 10 Marks x 02 Questions = 20 Marks <i>(2 Questions with each having internal choice)</i> Total Marks = 60</p>

Part A: Introduction				
Program-	Class: M.Sc.	Year: II	Semester: III	Session: 2025-2026
Subject: Microbiology				
1	Course Code	MMCB0301-P		
2	Course Title	Lab Work for Immunology & Immunodiagnostics (Practical-I)		
3	Course Type	Core Course		
4	Pre-requisite (If any)	To study this course a student must have had the subject B.Sc. with Biology.		
5	Course Learning outcomes (CLO)	<p>The objectives of this course are to acquaint students to understand about the infection, immune system, immune response, antigen, antibody, hypersensitivity, Transplantation immunology and autoimmunity its mechanisms and related immunodeficiency disorders and diseases.</p> <p>CLO- Students should understand Immunology and immunodiagnostics.</p> <ol style="list-style-type: none"> 1. Learn about infection, Antigen, Antibody, MHC and Immune response 2. Understand transplantation immunology, Tumour immunology and Immuno deficiency diseases. 		
6	Credit Value	4		
7	Total Marks	Max. Marks: 40+60	Min. Passing Marks : 40	

Part B: Content of the Practical Course

Total numbers of Lectures (in hours per week): 8 hours per week/credit

Total Lectures: 120 hours

List of Practicals

1. Selection of animals, preparation of antigens, immunization and methods of blood collection, serum separation and storage.
2. Antibody titre by ELISA method.
3. Double diffusion, Immuno-electrophoresis and Radial Immuno diffusion.
4. Complement fixation test.
5. Isolation and purification of IgG from serum or IgY from chicken egg.
6. Immunoblotting, Dotblot assays.
7. Blood smear identification of leucocytes by Giemsa stain.
8. Separation of leucocytes by the dextran method.
9. Demonstration of Phagocytosis of latex beads and their cryopreservation.
10. Separation of mononuclear cells by Ficoll-Hypaque and their cryopreservation.
11. Demonstration of ELISPOT.
12. Demonstration of FACS.

Part C: Learning Resources

Text Books, Reference Books, Other resources

Suggested Readings:

1. Biochemistry (7th edition) JM Berg, JLT Tymoczko and L. Stryer, 2012, WH Freeman and Co., New York.
2. Biochemistry (4th edition): D Voet and JE Voet, 2011 John Wiley and Sons. Principles of Biochemistry (Lehninger) (5th edition), MM Cox and DL Nelson, CBS Publishers.
3. Scientific Foundations of Clinical Biochemistry: Ed, D.L. Williams, R.F. Nun, V. Marks; William Heinemann Medical Books Ltd.
4. Harper's Review of Biochemistry (29th edition) RK Murray, DA Benderer, PJ Kennelly, VW Rodwell and PA Weil. 2012, McGraw Hill Co.
5. Textbook of Biochemistry for Medical Students (6th edition) DM Vasudevan, S Sreekumari and K Vaidyanathan 2011, Jaypee Medical Publishers, New Delhi.
6. Practical Biochemistry, Principles and Techniques (4th edition) edited by Keith Wilson and John Walker, 1994, Cambridge University Press.
7. Biochemistry "Lippincott's Illustrated Reviews" (5th edition) RA Harvey (series editor), 2011, Lippincott Williams & Wilkins, Wolters Kluwer.
8. Genomes (3rd edition) TA Brown, Wiley-Liss Publications.
9. Cell and Molecular Biology (5th edition) Gerald Karp, John Wiley and Sons Ltd.
10. Molecular Biology of the Cell (5th edition) Bruce Alberts, Alexander Johnson, Julian Lewis, Martin Raff, Keith Roberts, Peter Walter. Garland Science Publications
11. Molecular Cell Biology, (6th edition) Harvey Lodish, Arnold Berk, Paul Matsudaira, Chris A. Kaiser, Monty Krieger, Matthew P. Scott, Lawrence Zipursky, and James

Darnell. WH Freeman Publications

12. Lydyard, P. M., Whelan, A., Fanger, M.W. Immunology: , 1st Ed., Viva Books.
13. Roitt, I.M., Essential Immunology, 9th Ed. (1997), Blackwell Scientific, Oxford, UK.
14. Kuby, J. Immunology, 3rd Ed. (1997), Freeman, W. H., Oxford.
15. Punt, J., Stranford, S., Jones, P. & Owen, J.A., Kuby Immunology (8th Ed.). Macmillan International Higher Education. 2018
16. Kenneth, M. & Weaver, C., Janeway's Immunobiology (9th Ed.). Garland Science. 2016
17. Books published by M.P. Hindi Granth Academy, Bhopal

Suggested equivalent online courses:

1. <https://ebooks.inflibnet.ac.in/bioci16/chapter/types-of-immunity-innate-and-acquired/>
2. <https://www.jsscacs.edu.in/sites/default/files/Department%20Files/3.%20Immunoglobulins.pdf>
3. <https://rnlkwc.ac.in/pdf/study-material/zoology/Hybridoma%20Technology%20&%20Monoclonal%20Antibody.pdf>
4. <https://archive.nptel.ac.in/content/storage2/courses/102103038/download/module2.pdf>
5. https://www.researchgate.net/publication/316209197_Monoclonal_antibodies_A_review_of_therapeutic_applications_and_future_prospects
6. https://www.pvpsiddhartha.ac.in/dep_it/lecture%20notes/LSFE/Unit-V%20Recombinant%20DNA%20technology.pdf
7. <http://www.mphindigranthacademy.org>

Part-D Assessment and Evaluation

Pattern of Marks Distribution PRACTICAL PAPER for NEP PG courses

Suggested Continuous Evaluation Methods: (It may vary for respective course subject but TOTAL marks distribution will remain same)			
Internal Assessment	Marks	External Assessment	Marks
Class Interaction /Quiz	15	Viva Voce on Practical	10
Attendance in the lab	10	Practical Record File	10
Assignments (Charts/ Model Seminar / Rural Service/ Technology Dissemination/ Report of Excursion/ Lab Visits/ Survey / Industrial visit)	15	Table work / Experiments	40
TOTAL	40		60

Part A: Introduction				
Program-	Class: M.Sc.	Year: II	Semester: III	Session: 2025-2026
Subject: Microbiology				
1	Course Code	MMCB0302-T		
2	Course Title	Molecular Biology and Recombinant DNA Technology		
3	Course Type	Core Course		
4	Pre-requisite (If any)	To study this course a student must have had the subject B.Sc. with Biology.		
5	Course Learning outcomes (CLO)	<p>The objectives of this course are to acquaint students with various approaches of molecular biology and recombinant DNA technology and their applications in biological research / industries.</p> <p>CLO-</p> <p>Upon completion of this course, students should be:</p> <ol style="list-style-type: none"> 1. Understand core techniques and essential enzyme used in molecular biology & recombinant DNA Technology (rDNA Technology). 2. Understanding and learn cloning strategies. 3. Learn about DNA sequencing methods for DNA. 4. Learn about application of r-DNA Technology. 5. Endowed with strong theoretical knowledge of molecular biology & recombinant DNA technology and its applications in the genetic manipulation of organisms for the agriculture, industrial, and pharmaceutical industries. 6. In conjunction with the practical in molecular biology & genetic engineering, the students should be able to take up biological research as well as placement in the relevant biotech industry. 		
6	Credit Value	6		
7	Total Marks	Max. Marks: 40+60	Min. Passing Marks: 40	

Part B: Content of the Course

Total numbers of Lectures (in hours per week) : 6 hours per week/credit

Total Lectures : 90 hours

Unit	Topics	Number of Lectures
I	<p>Origin of Molecules and Atoms in Vedas. The Nature of Genetic Material: DNA as genetic material, Chemical structure and base composition of nucleic acids, Double helical structures, Different forms of DNA, Forces stabilizing nucleic acid structure, Super coiled DNA, Properties of DNA, Renaturation and denaturation of DNA. T_m and Cot curves, Structure of RNA.</p> <p>Organization of prokaryotic and eukaryotic genomes, chromatin arrangement, nucleosome formation, satellite DNA.</p> <p>DNA Replication: General features of DNA replication, Enzymes and proteins of DNA replication, Models of replication, Prokaryotic and eukaryotic replication mechanism, relationship between DNA replication and cell cycle, DNA copy number maintenance. Replication in phages, Reverse transcription.</p> <p>Activity-</p> <ol style="list-style-type: none"> 1. Model making on DNA structure, Double helix/super coiled DNA. 2. Chart making on types of RNA. 3. Discussion on Prokaryotic and eukaryotic DNA replication. 4. Visualization and demonstration of DNA from plants & animals. 	18
II	<p>Transcription: Mechanism of transcription in prokaryotes and eukaryotes, Structure and assembly of prokaryotic and eukaryotic RNA polymerases, promoters and enhancers, Transcription factors as activators and repressor, Transcription- Initiation, Elongation and Termination, Effect of chromatin structure, Regulation of transcription.</p> <p>Post-transcriptional Processes: Co- and post-transcriptional modifications, Post-transcriptional processing of tRNA, rRNA and mRNA (5' capping, 3' polyadenylation and splicing), mRNA flow through nuclear envelop into cytoplasm, RNA Editing; RNAi and miRNAs, Antisense RNA, Posttranscriptional gene regulation, RNA as an enzyme- Ribozyme.</p> <p>Activity-</p> <ol style="list-style-type: none"> 1. Chart making on Mechanism of transcription in prokaryotes and eukaryotes. 2. Quiz on RNA Editing and post-transcriptional Processes. 	18
III	<p>Genetic code: Genetic code, General features, Deciphering of genetic code, Wobble hypothesis, Mitochondrial genetic code.</p> <p>Translation: Translational mechanism in prokaryotes and eukaryotes. Ribosome composition and assembly, Regulation of translation, RNA</p>	18

	<p>instability, Antibiotic inhibitors and translation, stringent response in bacteria, Non ribosomal polypeptide synthesis.</p> <p>Post-translational Processes: Post translational modification, transport, folding, chaperones. Protein targeting, The Signal Hypothesis.</p> <p>DNA Binding Protein Motifs: Zinc finger, leucine zipper, helix-turn-helix and other motifs.</p> <p>Activity-</p> <ol style="list-style-type: none"> 1. Discussion on wobble hypotheses. 2. Chart on protein targeting of DNA Binding Protein Motifs. 3. Quiz on Translational mechanism in prokaryotes. 	
IV	<p>Introduction and Tools of Recombinant DNA Technology (RDT) : Impact of RDT in modern society; General requirements for performing a genetic engineering experiment; restriction endonucleases and methylases; DNA ligase, Klenow enzyme, T4 DNA polymerase, polynucleotide kinase, alkaline phosphatase; cohesive and blunt end ligation; linkers; adaptors; homopolymeric tailing; labeling of DNA: nick translation, random priming, radioactive and non-radioactive probes, hybridization techniques: northern, southern, south- western and far-western and colony hybridization, fluorescence in situ hybridization.</p> <p>Cloning and Expression Vectors: Vehicles for gene cloning, Plasmids, Bacteriophages, Cosmids and Phagemids as vectors, P1 vectors, F- factor based vectors, Plant and animal viruses as vector, Artificial chromosomes as vectors (YAC, BAC, PAC and MAC vectors), Expression vectors- use of promoters and expression cassettes, Baculovirus and Pichia vectors system, plant-based vectors, Ti and Ri as vectors, yeast vectors, Binary and shuttle vectors.</p> <p>Activity-</p> <ol style="list-style-type: none"> 1. Model Preparation on the tools of Recombinant DNA Technology (RDT). 2. Chart preparation on hybridization techniques. 3. Quiz on Cloning and Expression Vectors. 	18
V	<p>PCR Techniques: Principles of PCR: primer design; fidelity of thermostable enzymes; DNA polymerases; types of PCR, cloning of PCR products; T- vectors; proof reading enzymes; PCR based site specific mutagenesis; PCR in molecular diagnostics; viral and bacterial detection; Sequencing Techniques: Sequencing methods; Enzymatic DNA sequencing; Chemical sequencing of DNA; automated DNA sequencing; RNA sequencing; chemical synthesis of oligonucleotides; mutation detection: SSCP, DGGE, RFLP, Next Generation sequencing methods: 454 FLX Roche genome analyzer platform, Illumina Solexagenome analyzer platform. Whole genome sequencing and functional genomics (a brief account), Applications of genomics and Proteomics with special reference to <i>E.coli</i>, Phage lambda and SV40.</p> <p>Gene Silencing and Genome Editing Technologies: principle and application of gene silencing; Gene silencing techniques; introduction to siRNA; siRNA technology; Micro RNA; construction of siRNA vectors; gene knockouts and gene therapy.</p>	18

Transgenics - gene replacement; gene targeting; creation of transgenic and knock-out mice; disease model; Genome editing by CRISPR-Cas with specific emphasis on Chinese and American clinical trials.

Activity-

1. Demonstration on different types of PCR by visiting different labs.
2. Quiz on application on genomics protein/ gene editing.

Part C: Learning Resources

Text Books, Reference Books, Other resources

Suggested Readings:

1. Clark DP and Pazdernik NJ. (2009). Biotechnology-Appling the Genetic Revolution. Elsevier Academic Press, USA.
2. Brown T.A., Gene Cloning & DNA Analysis (6th Ed.) Wiley-Blackwell, New York. 2010.
3. Watson J.D., A Passion for DNA: Genes, Genomes & Society, Cold Spring Harbor Laboratory press (CSHL). 2009.
4. Primrose, S.B. & Twyman, R.M. Principles of Gene Manipulation and Genomics (7th Ed.). Malden, MA: Blackwell Publisher. 2006.
5. Green, M.R. & Sambrook, J., Molecular Cloning: a Laboratory Manual. Cold Spring Harbor, NY: Cold Spring Harbor Laboratory Press. 2012.
6. Alcamo, I.E., DNA Technology: The Awesome Skill. Harcourt Academic Press. 2001.
7. Books published by M.P. Hindi Granth Academy, Bhopal

Suggested equivalent online courses:

1. <https://archive.nptel.ac.in/courses/102/103/102103013/>
2. <https://www.ekac.in/online/attendance/classnotes/files/1719553816.pdf>
3. <https://www.gacbe.ac.in/pdf/ematerial/18MZO23C-U5.pdf>
4. https://www.lachoomemorial.org/pdf/study_material/course/BSBT212%20PTM%2020.03.2020%20DV.pdf
5. <https://jiwaji.edu/pdf/ecourse/biochemistry/Genetic%20Code%20-%20Evidence%20&%20Properties.pdf>
6. https://www.purdue.edu/postlab/wpcontent/uploads/PHRM836/108_transcription-factors.pdf
7. https://epgp.inflibnet.ac.in/epgpdata/uploads/epgp_content/S001174BS/P001199/M010865/ET/1479285858P4M30eTextSept21.pdf
8. <https://facultystaff.richmond.edu/~lrunyaen/bio554/lectnotes/chapter14.pdf>
9. https://mlsu.ac.in/econtents/150_Vectors%20NPETL%20Notes.pdf
10. https://www.lucy.cam.ac.uk/sites/default/files/inline-files/Presentation_slides_CRISPR.pdf
11. <http://www.mphindigranthacademy.org>

Part-D Assessment and Evaluation

Pattern of Marks Distribution THEORY PAPER for NEP PG courses

<p>Recommended Continuous Assessment Methods-: (It may vary for respective course subject but TOTAL marks distribution will remain same)</p> <p>Maximum Marks: 100</p> <p>Continuous Comprehensive Evaluation (CCE): 40 Marks</p> <p>University Examination: 60 Marks</p>		
<p>Internal Assessment: Continuous Comprehensive Evaluation (CCE):</p>	<p>Class Test Assignment/Presentation</p>	<p>20 Marks 20 Marks Total Marks = 40</p>
<p>External Assessment: University Examination: Time: 3 Hours</p>	<p>Section (A)- Five very short answer question (20 words each) Section (B)- Five short answer question (200 words each) Section (C)- Two long answer question (500 words each)</p>	<p>02 Marks x 05 Questions = 10 Marks <i>(All 5 Questions to be attempted)</i> 06 Marks x 05 Questions = 30 Marks <i>(5 Questions to be attempted out of total 8 Questions)</i> 10 Marks x 02 Questions = 20 Marks <i>(2 Questions with each having internal choice)</i> Total Marks = 60</p>

Part A: Introduction				
Program-	Class: M.Sc.	Year: II	Semester: III	Session: 2025-2026
Subject: Microbiology				
1	Course Code	MMCB0302-P		
2	Course Title	Lab work for Molecular Biology and Recombinant DNA Technology (Practical-II)		
3	Course Type	Core Course		
4	Pre-requisite (If any)	To study this course a student must have had the subject B.Sc. with Biology.		
5	Course Learning outcomes (CLO)	<p>The objectives of this course are to acquaint students with various approaches of molecular biology and recombinant DNA technology and their applications in biological research / industries.</p> <p>CLO-</p> <p>Upon completion of this course, students should be:</p> <ol style="list-style-type: none"> 1. Understand core techniques and essential enzyme used in molecular biology & recombinant DNA Technology (rDNA Technology). 2. Understanding and learn cloning strategies. 3. Learn about DNA sequencing methods for DNA. 4. Learn about application of r-DNA Technology. 5. Endowed with strong theoretical knowledge of molecular biology & recombinant DNA technology and its applications in the genetic manipulation of organisms for the agriculture, industrial, and pharmaceutical industries. 6. In conjunction with the practical in molecular biology & genetic engineering, the students should be able to take up biological research as well as placement in the relevant biotech industry. 		
6	Credit Value	4		
7	Total Marks	Max. Marks: 40+60	Min. Passing Marks : 40	

Part B: Content of the Practical Course

Total numbers of Lectures (in hours per week): 8 hours per week

Total Lectures: 120 hours

List of Practical

1. Isolation of genomic DNA.
2. DNA fingerprinting by RAPD.
3. Restriction analysis of genomic DNA.
4. Southern blotting analysis.
5. Determination of molecular size of DNA.
6. Amplification of gene by PCR.
7. Isolation of RNA and AGE analysis.
8. cDNA synthesis by RT-PCR.
9. Isolation of plasmids and Electrophoretic analysis.
10. Ligation of DNA into plasmid vectors.
11. Transformation of plasmids.
12. Selection of recombinant clones by blue – White screening.
13. Identification of gene by Colony PCR.

Part C: Learning Resources

Text Books, Reference Books, Other resources

Suggested Readings:

1. Clark DP and Pazdernik NJ. (2009). Biotechnology-Applying the Genetic Revolution. Elsevier Academic Press, USA.
2. Brown T.A., Gene Cloning & DNA Analysis (6th Ed.) Wiley-Blackwell, New York. 2010.
3. Watson J.D., A Passion for DNA: Genes, Genomes & Society, Cold Spring Harbor Laboratory press (CSHL). 2009.
4. Primrose, S.B. & Twyman, R.M. Principles of Gene Manipulation and Genomics (7th Ed.). Malden, MA: Blackwell Publisher. 2006.
5. Green, M.R. & Sambrook, J., Molecular Cloning: a Laboratory Manual. Cold Spring Harbor, NY: Cold Spring Harbor Laboratory Press. 2012.
6. Alcamo, I.E., DNA Technology: The Awesome Skill. Harcourt Academic Press. 2001.
7. Molecular Biology Techniques: A Classroom Laboratory Manual by Sue Carson, Heather B. Miller, D. Scott Witherow, and Melissa C. Srougi (4th Edition, Academic Press, 2019; ISBN-13: 978-0128180242.
8. Gene Cloning and DNA Analysis: An Introduction by T.A. Brown (8th Edition, Wiley-Blackwell, November 2020; ISBN-13: 978-1119640783, 432 pages)
9. PCR Protocols: A Guide to Methods and Applications, edited by Michael A. Innis, David H. Gelfand, John J. Sninsky, and Thomas J. White (1st Edition, Academic Press, January 11, 1990; ISBN-13: 978-0123721808, 482 pages)

10. Molecular Biotechnology: Principles and Applications of Recombinant DNA by Bernard R. Glick, Jack J. Pasternak, and Cheryl L. Patten (4th Edition, ASM Press, 2010; ISBN-13: 978-1555814984.
11. Books published by M.P. Hindi Granth Academy, Bhopal

Suggested equivalent online courses:

1. <https://archive.nptel.ac.in/courses/102/103/102103013/>
2. <https://www.ekac.in/online/attendance/classnotes/files/1719553816.pdf>
3. <https://www.gacbe.ac.in/pdf/ematerial/18MZO23C-U5.pdf>
4. https://www.lachoomemorial.org/pdf/study_material/course/BSBT212%20PTM%2020.03.2020%20DV.pdf
5. <https://jiwaji.edu/pdf/ecourse/biochemistry/Genetic%20Code%20-%20Evidence%20&%20Properties.pdf>
6. https://www.purdue.edu/postlab/wpcontent/uploads/PHRM836/108_transcription-factors.pdf
7. https://epgp.inflibnet.ac.in/epgpdata/uploads/epgp_content/S001174BS/P001199/M010865/ET/1479285858P4M30eTextSept21.pdf
8. <https://facultystaff.richmond.edu/~lrunyenj/bio554/lectnotes/chapter14.pdf>
9. https://mlsu.ac.in/econtents/150_Vectors%20NPETL%20Notes.pdf
10. https://www.lucy.cam.ac.uk/sites/default/files/inline-files/Presentation_slides_CRISPR.pdf
11. <http://www.mphindigranthacademy.org>

Part-D Assessment and Evaluation

Pattern of Marks Distribution PRACTICAL PAPER for NEP PG courses

Suggested Continuous Evaluation Methods: (It may vary for respective course subject but TOTAL marks distribution will remain same)			
Internal Assessment	Marks	External Assessment	Marks
Class Interaction /Quiz	15	Viva Voce on Practical	10
Attendance in the lab	10	Practical Record File	10
Assignments (Charts/ Model Seminar / Rural Service/ Technology Dissemination/ Report of Excursion/ Lab Visits/ Survey / Industrial visit)	15	Table work / Experiments	40
TOTAL	40		60

Part A: Introduction				
Program-	Class: M.Sc.	Year:II	Semester: IV	Session: 2025-2026
Subject: Microbiology				
1	Course Code	MMCB0401-T		
2	Course Title	Microbial Enzymes and Fermentation Technology		
3	Course Type	Core Course		
4	Pre-requisite (If any)	To study this course a student must have had the subject B.Sc. with Biology.		
5	Course Learning outcomes (CLO)	<p>The objectives of this course are to educate students about the fundamental concepts and its related Microbial Enzymes and Fermentation Technology applications, thus preparing them to meet the challenges of the new and emerging areas of fermentation industry.</p> <p>CLO- The content of the course, students should be able to: -</p> <ol style="list-style-type: none"> 1. Understand the general features and characteristics of enzymes regulation. 2. Know about the application of industrially important enzymes. 3. Develop strong fundamental knowledge that can be applicable to fermentation industries. 4. Identify major categories of microorganisms and analyze their classification, diversity, and ubiquity; 5. Evaluate factors that contribute in enhancement of cell and product formation. 		
6	Credit Value	6		
7	Total Marks	Max. Marks: 40+60	Min. Passing Marks: 40	

Part B: Content of the Course

Total numbers of Lectures (in hours per week): 6 hours per week/credit

Total Lectures: 90 hours

Unit	Topics	Number of Lectures
I	<p>Regulatory Enzymes: Allosteric enzymes, Sequential and symmetry models, covalently regulated enzymes.</p> <p>Enzyme Technology: Large scale production of enzymes, Uses of isolated enzymes in food and chemical industries, Therapeutic & medicinal use of enzymes.</p> <p>Activity-</p> <ol style="list-style-type: none"> 1. Group Discussion on origin of enzymes/ types. 2. Survey of chemical industries where enzymes are used. 3. Application profile of microbial enzymes. 	18
II	<p>Enzymes: commercial applications; production of Amylases; Glucose Isomerase; L Asparaginase Proteases Renin; Penicillin acylases; Lactases; Pectinases; Lipases; Structure and biosynthesis Nucleosides Nucleotides and related compounds.</p> <p>Activity-</p> <ol style="list-style-type: none"> 1. The application profile of microbial enzymes is used. 2. Finding the medium components used from the isolation of enzymes and the importance of each component in the medium from the literature. 3. Survey of an enzyme-making company in M.P. 	18
III	<p>Introduction to Fermentation Technology: Fermentation- Overview, Introduction to fermentation processes, industrially important microorganisms-Isolation, screening, and preservation of industrially important microorganisms, Strain improvement for increased yield and other desirable characteristics; Principles of overproduction of primary and secondary metabolites with relevant examples, Culture collection, cataloguing of cultures.</p> <p>Fermentation Systems: Batch and Continuous system, Fed batch culture, multistage systems, Feedback systems, Solid substrate fermentation. Instrumentation and control of fermentation processes, Monod kinetics of microbial growth, growth and non-growth associated product formation, product formation kinetics.</p> <p>Activity-</p> <ol style="list-style-type: none"> 1. Searching for the names of culture collection centers in India. 2. Group discussion on locally available (M.P.) solid substrates for fermentation. 3. Chart making on secondary metabolites production. 	18

IV	<p>Fermentation Upstream Processing: Media for industrial fermentation, Criteria used in media formulation, fermentation economics; upstream processing: media formulation and optimization; sterilization; aeration, agitation and heat transfer in bioprocess; scale up and scale down; measurement and control of bioprocess parameters.</p> <p>Downstream Processing: Separation of insoluble products - filtration, centrifugation, sedimentation, flocculation; Cell disruption; separation of soluble products: Liquid-liquid extractions, precipitation, chromatographic techniques, reverse osmosis, ultra and micro filtration, electrophoresis; final purification: drying; crystallization; storage and packaging.</p> <p>Activity-</p> <ol style="list-style-type: none"> 1. Group discussion on the economics of fermentation processes. 2. Interactive seminar for students regarding the upstream and downstream processing in fermentation. 3. Chart making on chromatographic techniques used in downstream processing. 	18
V	<p>Hygiene and safety in fermentation industries. Microbial production of vaccines. Microbial production of polymers: Dextran and xanthan. Microbial transformation: steroid and biotransformation,</p> <p>Waste Treatment: Waste Treatment systems, Aerobic and anaerobic waste treatment systems for waste treatment in fermentation industry, Treatment of sewage (primary, secondary and tertiary treatments), treatment of industrial effluents (distillery, textile, pulp and paper), methods to detect various pollutants (metals, sediments, toxin and organic matters).</p> <p>Activity-</p> <ol style="list-style-type: none"> 1. Field visit to wastewater treatment plant. 2. Group discussion on the wastewater pollutants and how to overcome these problems. 3. Application profile for microbial transformation. 	18

Part C : Learning Resources

Text Books, Reference Books, Other resources

Suggested Readings:

1. Cruger, W. & Kruger, A., Biotechnology -A Textbook of Industrial Microbiology (2nd Ed.). Panima Publishing Corporation, New Delhi. 2002.
2. Clarke, W., Industrial Microbiology. CBS Publisher and Distributors PVT. LTD New Delhi. 2016.

3. Book published by Hindi Granth Aakadmi.
4. Stanbury, P.F., Hall, S., Whitaker, A., Principles of Fermentation Technology (3rd Ed.). ButterworthHeinemann Ltd., Elsevier. 2016.
5. Ward, O.P., Fermentation Biotechnology - Principles, Process and Products. Prentice Hall Publishing, New Jersey. 1999.
6. Rehm,H.J.,Reed,G.B.,Puehler,A.&Stadler,Biotechnology,Vol.1-8,VCHPublication.1993.
7. Prescott, S.C. & Dunn, G.C., Prescott and Dunn's Industrial Microbiology (4th Ed.). CBS Publication, New Delhi. 1992
8. Demain, A.I. & Davies, J. E., Manual of Industrial Microbiology and Biotechnology (2nd Ed.), ASM Press, Washington D.C. 1999.
9. Glazer, A.N. & Nikaido, H., Microbial Biotechnology: Fundamentals of Applied Microbiology. WHFreeman & Company, New York. 1998.
10. Cruger, W.&Kruger,A.,Biotechnology-ATextbookofIndustrialMicrobiology(2nd Ed.).Panima Publishing Corporation, New Delhi. 2002.
11. Clarke, W.,IndustrialMicrobiology.CBSPublisherandDistributorsPVT.LTDNewDelhi.2016.
12. Books published by M.P. Hindi Granth Academy, Bhopal

Suggested equivalent online courses:

1. <https://archive.nptel.ac.in/courses/102/105/102105058/>
2. https://sist.sathyabama.ac.in/sist_coursematerial/uploads/SBB2204.pdf
3. https://ddugu.ac.in/ePathshala_Attachments/STUDY349@536623.pdf
4. <https://oldsite.pup.ac.in/e-content/science/botany/MScBot40.pdf>
5. https://ocm.govtsciencecollegedurg.ac.in/Document/530_040544.pdf
6. https://sist.sathyabama.ac.in/sist_coursematerial/uploads/SBT1301.pdf
7. https://ugcmoocs.inflibnet.ac.in/assets/uploads/1/69/2045/et/MOOC%20IM&I_MOD_5_Write%20up200409040404043131.pdf
8. https://www.sathyabama.ac.in/sites/default/files/course-material/2020-10/UNIT-IV_9.pdf
9. https://epgp.inflibnet.ac.in/epgpdata/uploads/epgp_content/S000014ER/P000284/M028915/ET/1522996468paper15_module_6_etext.pdf
10. https://biotech.nuph.edu.ua/wpcontent/uploads/2020/05/Lecture_6_Production-of-vaccines_serums_ect.pdf
11. https://sist.sathyabama.ac.in/sist_coursematerial/uploads/SBTA5203.pdf
12. <http://www.mphindigranthacademy.org>
13. https://onlinecourses.nptel.ac.in/noc23_bt05/preview

Part-D Assessment and Evaluation

Pattern of Marks Distribution THEORY PAPER for NEP PG courses

<p>Recommended Continuous Assessment Methods-: (It may vary for respective course subject but TOTAL marks distribution will remain same)</p> <p>Maximum Marks: 100</p> <p>Continuous Comprehensive Evaluation (CCE): 40 Marks</p> <p>University Examination: 60 Marks</p>		
<p>Internal Assessment: Continuous Comprehensive Evaluation (CCE):</p>	<p>Class Test Assignment/Presentation</p>	<p>20 Marks 20 Marks Total Marks = 40</p>
<p>External Assessment: University Examination: Time: 3 Hours</p>	<p>Section (A)- Five very short answer question (20 words each) Section (B)- Five short answer question (200 words each) Section (C)- Two long answer question (500 words each)</p>	<p>02 Marks x 05 Questions = 10 Marks <i>(All 5 Questions to be attempted)</i> 06 Marks x 05 Questions = 30 Marks <i>(5 Questions to be attempted out of total 8 Questions)</i> 10 Marks x 02 Questions = 20 Marks <i>(2 Questions with each having internal choice)</i> Total Marks = 60</p>

Part A: Introduction				
Program-	Class: M.Sc.	Year:II	Semester:IV	Session: 2025-2026
Subject: Microbiology				
1	Course Code	MMCB0401-P		
2	Course Title	Lab Work for Microbial Enzymes and Fermentation Technology (Practical-I)		
3	Course Type	Core Course		
4	Pre-requisite (If any)	To study this course a student must have had the subject B.Sc. with Biology.		
5	Course Learning outcomes (CLO)	<p>The objectives of this course are to educate students about the fundamental concepts and its related Microbial Enzymes and Fermentation Technology applications, thus preparing them to meet the challenges of the new and emerging areas of fermentation industry.</p> <p>CLO- The content of the course, students should be able to: -</p> <ol style="list-style-type: none"> 1. Understand the general features and characteristics of enzymes regulation. 2. Know about the application of industrially important enzymes. 3. Develop strong fundamental knowledge that can be applicable to fermentation industries. 4. Identify major categories of microorganisms and analyze their classification, diversity, and ubiquity; 5. Evaluate factors that contribute in enhancement of cell and product formation. 		
6	Credit Value	4		
7	Total Marks	Max. Marks: 40+60	Min. Passing Marks :40	

Part B: Content of the Practical Course

Total numbers of Lectures (in hours per week): 8 hours per week/credit

Total Lectures: 120 hours

List of Practicals

1. Introduction to Microbiology laboratory – GLP, Biosafety
2. Preparation and sterilization of culture media
3. Isolation, screening, selection of industrially important microorganisms, and their Preservation.
4. Strain improvement using different mutagenic agents.
5. Aseptic Transfer Techniques
6. Assessment of sterility of glassware and nutritional media (Hot air oven and Autoclave).
7. Sterilization by membrane filtration and sterility assessment Fermentation
8. Measurement of microbial growth
9. Turbidimetric studies for bacterial growth
10. Determination of viable count and CFU
11. Isolation of industrially important microorganisms
12. Characterization of metabolites of industrial purpose, qualitative and quantitative Assays.

Part C: Learning Resources

Text Books, Reference Books, Other resources

Suggested Readings:

1. Cruger, W. & Kruger, A., Biotechnology -A Textbook of Industrial Microbiology (2nd Ed.). Panima Publishing Corporation, New Delhi. 2002.
2. Clarke, W., Industrial Microbiology. CBS Publisher and Distributors PVT. LTD New Delhi. 2016.
3. Book published by Hindi Granth Aakadmi.
4. Stanbury, P.F., Hall, S., Whitaker, A., Principles of Fermentation Technology (3rd Ed.). ButterworthHeinemann Ltd., Elsevier. 2016.
5. Ward, O.P., Fermentation Biotechnology - Principles, Process and Products. Prentice Hall Publishing, New Jersey. 1999.
6. Rehm, H.J., Reed, G.B., Puehler, A. & Stadler, Biotechnology, Vol. 1-8, VCH Publication. 1993.
7. Prescott, S.C. & Dunn, G.C., Prescott and Dunn's Industrial Microbiology (4th Ed.). CBS Publication, New Delhi. 1992
8. Demain, A.I. & Davies, J. E., Manual of Industrial Microbiology and Biotechnology (2nd Ed.), ASM Press, Washington D.C. 1999.
9. Glazer, A.N. & Nikaido, H., Microbial Biotechnology: Fundamentals of Applied

Microbiology. WHFreeman & Company, New York. 1998.

10. Cruger, W. & Kruger, A., Biotechnology - A Textbook of Industrial Microbiology (2nd Ed.). Panima Publishing Corporation, New Delhi. 2002.

11. Clarke, W., Industrial Microbiology. CBS Publisher and Distributors PVT. LTD New Delhi. 2016.

12. Books published by M.P. Hindi Granth Academy, Bhopal.

Suggested equivalent online courses:

1. <https://archive.nptel.ac.in/courses/102/105/102105058/>
2. https://sist.sathyabama.ac.in/sist_coursematerial/uploads/SBB2204.pdf
3. https://ddugu.ac.in/ePathshala_Attachments/STUDY349@536623.pdf
4. <https://oldsite.pup.ac.in/e-content/science/botany/MScBot40.pdf>
5. https://ocm.govtsciencecollegedurg.ac.in/Document/530_040544.pdf
6. https://sist.sathyabama.ac.in/sist_coursematerial/uploads/SBT1301.pdf
7. https://ugcmoocs.inflibnet.ac.in/assets/uploads/1/69/2045/et/MOOC%20IM&I_MOD_5_Write%20up200409040404043131.pdf
8. https://www.sathyabama.ac.in/sites/default/files/course-material/2020-10/UNIT-IV_9.pdf
9. https://epgp.inflibnet.ac.in/epgpdata/uploads/epgp_content/S000014ER/P000284/M028915/ET/1522996468paper15_module_6_etext.pdf
10. https://biotech.nuph.edu.ua/wpcontent/uploads/2020/05/Lecture_6_Production-of-vaccines_serums_ect.pdf
11. https://sist.sathyabama.ac.in/sist_coursematerial/uploads/SBTA5203.pdf
12. <http://www.mphindigranthacademy.org>
13. https://onlinecourses.nptel.ac.in/noc23_bt05/preview

Part-D Assessment and Evaluation

Pattern of Marks Distribution PRACTICAL PAPER for NEP PG courses

Suggested Continuous Evaluation Methods: (It may vary for respective course subject but TOTAL marks distribution will remain same)			
Internal Assessment	Marks	External Assessment	Marks
Class Interaction /Quiz	15	Viva Voce on Practical	10
Attendance in the lab	10	Practical Record File	10
Assignments (Charts/ Model Seminar / Rural Service/ Technology Dissemination/ Report of Excursion/ Lab Visits/ Survey / Industrial visit)	15	Table work / Experiments	40
TOTAL	40		60

Part A: Introduction				
Program-	Class: M.Sc.	Year: II	Semester: IV	Session: 2025-2026
Subject: Microbiology				
1	Course Code	MMCB402-T		
2	Course Title	Applied Microbiology		
3	Course Type	Core Course		
4	Pre-requisite (If any)	To study this course a student must have had the subject B.Sc. with Biology.		
5	Course Learning outcomes (CLO)	<p>The objectives of this course are to introduce the field of food, environment medical microbiology with special emphasis on applied importance microbes in this field.</p> <p>CLO- After successful completion of this course, students will be able to:</p> <ol style="list-style-type: none"> 1. Comprehend knowledge regarding fermented food products, food spoilage and infection. 2. Learn about general methods and techniques of water treatment, environmental, bioremediation and medical microbiology. 		
6	Credit Value	6		
7	Total Marks	Max. Marks: 40+60	Min. Passing Marks: 40	

Part B: Content of the Course

Total numbers of Lectures (in hours per week) : 6 hours per week/credit

Total Lectures : 90 hours

Unit	Topics	Number of Lectures
I	<p>Occurrence of germs in water & soil according to Vedas. Agnihotra- on plant and microbial health. Soil and Water Microbiology: Importance of soil microorganisms, Distribution of various groups of microorganisms in soil, such as bacteria, fungi, protozoa, algae and viruses, nutrient transformation processes, plant-microbe symbiosis, microbial antagonism, biofilms and their biotechnological applications, drinking water microbiology and quality control.</p> <p>Microbial transformation, microbial interaction in soil, microbial control by bioinoculants.</p> <p>Activity-</p> <ol style="list-style-type: none"> 1. Project preparation on Biotechnological application of soil bacteria. 2. Group Discussion on Nutrient transformation processes/plant microbe interaction/ Microbial transformation. 3. Chart making on microbial Biocontrol agents. 4. Demonstration on water quality control test. 5. Visit to Water purification units. 	18
II	<p>Fermented Food Products: Microorganisms involved in food fermentations, Starter Cultures, Fermented meats and sausages; Fermented milk products- Acidophilus and Bulgarian milk, yoghurt, cheese, Kefir, Koumiss; Fermented grains and vegetable products - Sauerkraut, Soy sauce, Tempeh, Miso, Olive, and Kimchi, Nutraceuticals & Nanonutraceuticals.</p> <p>Protein Engineering: Protein engineering in food technology-objectives, methods, targets, potential applications in food industry and limitations.</p> <p>Food Safety and Quality Assurance in Foods: Microbial testing of foods-traditional methodology and new approaches: Microbiological, Physical, Chemical methods, Immunological methods, Use of gene probes and PCR, bioluminescence, BAX system, Riboprinter and Real Time PCR based approaches, Biosensors in food. Concept of HACCP for quality assurance and food safety in food industry.</p> <p>Activity-</p> <ol style="list-style-type: none"> 1. Demonstration and discussion of PCR and RT-PCR. 2. Culinary events on fermented foods and traditional foods. 3. Field visit to food industries for food safety protocols. 	18

<p>III</p>	<p>Environmental Microbiology: Development of microbial ecology and emergence of field of environmental microbiology, significant applications of microbes in solving environmental pollution problems.</p> <p>Bioremediation of Environmental Pollutants: Biological indicators of soil health. Biodegradation of pesticides & xenobiotic compounds, Heavy metals etc. Phytoremediation, Role of microorganisms in sustainable agriculture and organic farming, use of biosensors for their detection.</p> <p>Biomass Waste Management of Plant Residues: Lignocellulolytic microorganisms, enzymes and their biotechnological applications in: (i) biopulping, (ii) biobleaching, (iii) textiles (iv) biofuels, (v) animal feed production. Challenges in waste management.</p> <p>Activity-</p> <ol style="list-style-type: none"> 1. Science and art integration- Microbial art with pigmented bacteria. 2. Group discussion on the role of microbes in solving environmental pollution problems. 3. Chart making on lignocellulolytic enzymes and their application. 	<p>18</p>
<p>IV</p>	<p>Medical Microbiology: Process of infection-Types, stages of infection, Establishment of pathogenic microorganisms: Entry, spread and tissue damage. Mechanism of bacterial adhesion, colonization and invasion of mucous membranes of respiratory, enteric and urogenital tracts. Aggressins and toxins.</p> <p>Pathogenic microbes: Morphological characteristics, pathogenesis and laboratory diagnosis including rapid methods of pathogenic bacteria, fungi, protozoa.</p> <p>Viral diseases: Structure, cultivation, pathogenicity, lab diagnostics, prevention and control of viral diseases-Hepatitis, Herpes, Measles, Rabies, Polio, Rubella, Rotaviruses, Japanese Encephalitis, HIV, SARS, Ebola, Avian Flu, Swine Flu, Covid-19 and future pandemics.</p> <p>Activity-</p> <ol style="list-style-type: none"> 1. Group discussion on future pandemics. 2. Chart making on pathogenic microbes. 3. Interaction session for characteristics and prevention of viral diseases. 	<p>18</p>
<p>V</p>	<p>Nanoparticle in microorganisms: Introduction - history and recent developments - sources of nanoparticles - microbial producers of nanoparticles - advantages of microbial nanoparticles – applications. Use of bacteria, fungi and actinomycetes for nanoparticle synthesis, magnetotactic bacteria, and viruses</p> <p>Nanotoxicity, nanocomposite biomaterials, carbon nanotubes in health care, nanomedicine and cancer therapy.</p> <p>Activity-</p> <ol style="list-style-type: none"> 1. Quiz competition on nanoparticles in microorganisms. 2. Group discussion on nanomedicine. 3. Application profile of microbial nanoparticles. 	<p>18</p>

Part C: Learning Resources

Text Books, Reference Books, Other resources

Suggested Readings:

1. Alexander, M., Introduction to Soil Microbiology. John Wiley, New York. 1977.
2. Paul, E.A., Soil Microbiology, Ecology and Biochemistry (3rd Ed.). Academic Press, New York. 2007.
3. Sylvia D.M., Fuhrmann, J.J., Hartel, P.G. & Zuberer, D.A., Principles and Applications of Soil Microbiology (2nd Ed.). Pearson Edu. 2004.
4. Van Elsas, J.D., Trevors, J.T. & Wellington, E.M.H., Modern Soil Microbiology. Marcel Dekker., NY. 1997.
5. Tate, R.L., Soil Microbiology, Wiley-Blackwell., NY. 2012.
6. Dixon G.R. & Tilston, E.L., Production. Springer, Heidelberg. 2010.
7. Coyne, M., Introduction to Soil Microbiology. Delmar Cengage Learning, NY. 1999.
8. Bloem, J., Hopkins, D.W. & Benedetti, A., Microbiological Methods for Assessing Soil Quality, CABI, Wallingford. 2008.
9. Maier, R.M., Pepper, I.L. & Gerba, C.P., Environmental Microbiology (2nd Ed.) Ed. Academic Press. 2009.
10. Wicket, L.P. & Hershberger, C.D., Biocatalysis and Biodegradation: Microbial transformation of organic compounds. ASM Publications. 2000.
11. Forster, C.F. & Wase, D.A.J., Environmental Biotechnology. Ellis Harwood Ltd. Publication. 2001.
12. Ryan, K.J., Sherris Medical Microbiology (5th Ed.). McGraw-Hill. 2010.
13. Atlas, R.M., Principles of Microbiology, McMillan, New York. 2006.
14. Tortora, G.J., Funke, B.R., Case, C.L., Microbiology – An Introduction, 8th Edition, Pearson education Pvt. Ltd. Singapore. 2004.
15. Goodsell, D.S., Bio-nanotechnology: Lessons from Nature, Wiley-Liss Inc. 2004.
16. Mahendra, R. & Nelson, D., Metal Nanoparticles in Microbiology. Springer. 2011.
17. Nicola, C. & Mahendra, R., Nano-Antimicrobials. Springer. 2012.
18. Freitas, R.A., Nanomedicine, Vol. IIA: Biocompatibility, Landes Bioscience. 2003.
19. Nalwa, H.S., Handbook of Nanostructured Biomaterials and Their Applications in Nanobiotechnology, American Scientific Publishers, 2005.
20. Mirkin, C.A. & Niemeyer, C.M. Nanobiotechnology II. Wiley-VCH Verlag GmbH & Co. KGaA. 2007.
21. Ventra, M.D., Introduction to Nano scale Science and Technology (Nano structure Science and Technology). 2009.
22. Ramakrishna, S., Murugan, R. & Kumar, T.S.S., Biomaterials: An nano approach, CRC Press/Taylor & Francis. 2010.
23. Dubey, R.C. - Vedic Microbiology- A Scientific Approach Motilal Banarsidass-. International Publishers Delhi 2022.
24. Books published by M.P. Hindi Granth Academy, Bhopal

Suggested equivalent online courses:

1. https://www.kuk.ac.in/wpcontent/uploads/notes/Notes_4090_soil%20microorganisms.pdf
2. https://faculty.ksu.edu.sa/sites/default/files/lecture_2microbial_interactionsppt.pdf
3. https://epgp.inflibnet.ac.in/epgpdata/uploads/epgp_content/food_technology/food_microbiology/16.starter_cultures_of_foods/et/96_et_m16.pdf
4. https://epgp.inflibnet.ac.in/epgpdata/uploads/epgp_content/food_technology/technology_of_milk_and_milk_products/17.fermented_milk_productsacidophilus_milk_kefir_koumiss_yoghurt/et/2922_et_m17.pdf
5. <https://adarshcollege.in/wp-content/uploads/2023/04/Unit-1-Industrial-food-ferm.pdf>
6. <https://egyankosh.ac.in/bitstream/123456789/99614/1/Unit-10.pdf>
7. <https://egyankosh.ac.in/bitstream/123456789/73129/1/Unit-14.pdf>
8. https://epgp.inflibnet.ac.in/epgpdata/uploads/epgp_content/food_technology/food_microbiology/07.conventional_methods_of_detectionand Enumeration_of_microbes_in_foods/et/87_et_m7.pdf
9. <https://www.tandfonline.com/doi/pdf/10.1080/23311932.2023.2176280>
10. <https://www.mdpi.com/2071-1050/12/18/7282>
11. <https://egyankosh.ac.in/bitstream/123456789/95592/1/Unit-8.pdf>
12. <https://www.mdpi.com/2223-7747/12/12/2307>
13. https://faculty.ksu.edu.sa/sites/default/files/lec_2_intro_viruses.pdf
14. <https://www.nios.ac.in/media/documents/dmlt/Microbiology/Lesson-08.pdf>
15. <http://www.mphindigranthacademy.org>

Part-D Assessment and Evaluation

Pattern of Marks Distribution THEORY PAPER for NEP PG courses

<p>Recommended Continuous Assessment Methods-: (It may vary for respective course subject but TOTAL marks distribution will remain same)</p> <p>Maximum Marks: 100</p> <p>Continuous Comprehensive Evaluation (CCE): 40 Marks</p> <p>University Examination: 60 Marks</p>		
<p>Internal Assessment: Continuous Comprehensive Evaluation (CCE):</p>	<p>Class Test Assignment/Presentation</p>	<p>20 Marks 20 Marks Total Marks = 40</p>
<p>External Assessment: University Examination: Time: 3 Hours</p>	<p>Section (A)- Five very short answer question (20 words each) Section (B)- Five short answer question (200 words each) Section (C)- Two long answer question (500 words each)</p>	<p>02 Marks x 05 Questions = 10 Marks <i>(All 5 Questions to be attempted)</i> 06 Marks x 05 Questions = 30 Marks <i>(5 Questions to be attempted out of total 8 Questions)</i> 10 Marks x 02 Questions = 20 Marks <i>(2 Questions with each having internal choice)</i> Total Marks = 60</p>

Part A: Introduction				
Program-	Class: M.Sc.	Year: II	Semester: IV	Session: 2025-2026
Subject: Microbiology				
1	Course Code	MMCB0402-P		
2	Course Title	Lab work for Applied Microbiology (Practical-II)		
3	Course Type	Core Course		
4	Pre-requisite (If any)	To study this course a student must have had the subject B.Sc. with Biology.		
5	Course Learning outcomes (CLO)	<p>The objectives of this course are to introduce the field of food, environment medical microbiology with special emphasis on applied importance microbes in this field.</p> <p>CLO- After successful completion of this course, students will be able to:</p> <ol style="list-style-type: none"> 1. Comprehend knowledge regarding fermented food products, food spoilage and infection. 2. Learn about general methods and techniques of water treatment, environmental, bioremediation and medical microbiology. 		
6	Credit Value	4		
7	Total Marks	Max. Marks: 40+60	Min. Passing Marks: 40	

Part B: Content of the Practical Course

Total numbers of Lectures (in hours per week): 8 hours per week /credit

Total Lectures: 120 hours

List of Practical

1. Bacteriological tests for potability of water
 - a. MPN, confirmed and completed test.
 - b. Membrane filter technique (Demonstration)
2. Enumeration of microbial population in soil
3. Measurement of microbial Cell load
4. Cultivation of Anaerobic Microorganisms
5. Maintenance and preservation of microbes

Part C: Learning Resources

Text Books, Reference Books, Other resources

Suggested Readings:

1. Alexander, M., Introduction to Soil Microbiology. John Wiley, New York. 1977.
2. Paul, E. A., Soil Microbiology, Ecology and Biochemistry (3rd Ed.). Academic Press, New York. 2007.
3. Sylvia D.M., Fuhrmann, J.J., Hartel, P.G. & Zuberer, D.A., Principles and Applications of Soil Microbiology (2nd Ed.). Pearson Edu. 2004.
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Suggested equivalent online courses:

1. https://www.kuk.ac.in/wpcontent/uploads/notes/Notes_4090_soil%20microorganisms.pdf
2. https://faculty.ksu.edu.sa/sites/default/files/lecture_2microbial_interactionsppt.pdf
3. https://epgp.inflibnet.ac.in/epgpdata/uploads/epgp_content/food_technology/food_microbiology/16.starter_cultures_of_foods/et/96_et_m16.pdf
4. https://epgp.inflibnet.ac.in/epgpdata/uploads/epgp_content/food_technology/technology_of_milk_and_milk_products/17.fermented_milk_productsacidophilus_milk_kefir_koumiss_yoghurt/et/2922_et_m17.pdf
5. <https://adarshcollege.in/wp-content/uploads/2023/04/Unit-1-Industrial-food-ferm.pdf>
6. <https://egyankosh.ac.in/bitstream/123456789/99614/1/Unit-10.pdf>
7. <https://egyankosh.ac.in/bitstream/123456789/73129/1/Unit-14.pdf>
8. https://epgp.inflibnet.ac.in/epgpdata/uploads/epgp_content/food_technology/food_microbiology/07.conventional_methods_of_detectionand Enumeration_of_microbes_in_foods/et/87_et_m7.pdf
9. <https://www.tandfonline.com/doi/pdf/10.1080/23311932.2023.2176280>
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13. https://faculty.ksu.edu.sa/sites/default/files/lec_2_intro_viruses.pdf
14. <https://www.nios.ac.in/media/documents/dmlt/Microbiology/Lesson-08.pdf>
15. <http://www.mphindigranthacademy.org>

Part-D Assessment and Evaluation

Pattern of Marks Distribution PRACTICAL PAPER for NEP PG courses

Suggested Continuous Evaluation Methods: (It may vary for respective course subject but TOTAL marks distribution will remain same)			
Internal Assessment	Marks	External Assessment	Marks
Class Interaction /Quiz	15	Viva Voce on Practical	10
Attendance in the lab	10	Practical Record File	10
Assignments (Charts/ Model Seminar / Rural Service/ Technology Dissemination/ Report of Excursion/ Lab Visits/ Survey / Industrial visit)	15	Table work / Experiments	40
TOTAL	40		60

Option-3 Only Research Work

(Applicable to the UTDs/Colleges having research centers recognized by the University)

The students of Semester- III and IV will perform the Research thesis/ Research project/ Patent of 22 credits each as per the Ordinance of PG program NEP 2020 and Governed by the prevailing internship guideline/dissertation guideline of Directorate of Higher Education/ University/HEIs.

The topics of the dissertation with synopsis will be decided by the Departmental Research Advisory Committee (DRAC).