## M.Sc. Microbiology

### Semester II

| **Name of the course: Bacteriology** | **Course Code: 25MB201** | **Credits: 4** |
|---|---|---|
| **Maximum Marks: 100**<br>**Theory: 30(Internal)+70(External)=100** | **Time of examination: 3 Hrs.** | |

**Note:** Examiner will set nine questions and the candidates will be required to attempt five questions in all. Question number one will be compulsory containing seven short answer type questions from all sections. Further, examiner will set two questions from each section and the candidates will be required to attempt one question from each Section. All questions will carry equal marks.

**Objective:** The students will learn how bacteria and archaea are classified according to their physiological traits and other characteristics.

**Course Outcomes:** After studying this course

- **CO1:** The students will be able to describe in detail the classification of bacteria by applying conventional and molecular approaches.
- **CO2:** The students will be familiar with the organization of bacterial cells, and *in vitro* cultivation of aerobic and anaerobic bacteria, and their preservation.
- **CO3**: Students will be acquainted with Brock's 2009 and Bergey's Manual of Systematic Bacteriology and Archaea.
- **CO4:** They will be well versed with the knowledge of different groups, i.e., Eubacteria, Non-Proteobacteria, Proteobacteria, and their morphology, metabolism, ecological significance, and economic importance.

**Section-I**

Bacterial Classification, Basis of Bacterial classification; conventional; molecular and recent approaches to polyphasic bacterial taxonomy; evolutionary chronometers; rRNA oligonucleotide sequencing; signature sequences; and protein sequences. Differences between eubacteria and archaebacteria.

**Section-II**

Organization of Bacterial Cell, Structure and function of Cell Wall; Cell Membrane; Cytoplasm; Flagella; Endoflagella; Fimbriae; Glycocalyx; Capsule; Endospore; Growth and Nutrition, Cultivation of aerobic, anaerobic, and accessing non-cultureable bacteria. Maintenance and preservation of bacterial cultures; Components of media and different types of culture media. Bacterial nutrition, Transport of nutrients; Salient features of bacterial growth curve.

**Section-III**

Important archaeal groups, Brock's 2009 and Bergey's Manual of Systematic Bacteriology. Archaebacteria, General characteristics; phylogenetic overview; genera belonging to

Nanoarchaeota (*Nanoarchaeum*); Crenarchaeota (Sulfolobus, Thermoproteus) and Euryarchaeota, Methanogens (Methanobacterium, Methanocaldococcus); thermophiles (*Thermococcus, Pyrococcus, Thermoplasma*)[2] and Halophiles (*Halobacterium, Halococcus*).

**Section-IV**

Eubacteria, Non Proteobacteria and Proteobacteria: Morphology, metabolism, ecological significance and economic importance of following groups: Gram Negative- Non proteobacteria *(Aquifex, Thermotoga, Deinococcus, Thermus, Chlorobium, Chloroflexus, Chlamydiae, Spirochaete)*, Alpha proteobacteria *(Rickettsia, Coxiella, Caulobacter, Rhizobium, Hyphomicrobium, Agrobacterium)*,Beta proteobacteria *(Neisseria, Burkholderia, Thiobacillus)*, Gamma proteobacteria (*Enterobacteriaceae* family, Purple sulphur bacteria, *Pseudomonas, Vibrio, Beggiatoa, Methylococcus, Haemophilus)*, Delta proteobacteria (*Bdellovibrio, Myxococcus)*, Epsilon proteobacteria (*Helicobacter, Campylobacter*). Gram Positive-Low G+C or Firmicutes (Mycoplasmas,*Clostridium, Heliobacterium, Lactobacillus, Lactococcus, Staphylococcus, Streptococcus, Leuconostoc, Bacillus)*, High G+C or Actinobacteria (*Arthrobacter, Bifidobacterium, Corynebacterium, Frankia, Mycobacterium, Nocardia, Streptomyces, Thermomonospora, Propionibacterium Cyanobacteria*)

**Books Recommended:**

1. Atlas, R.M. Principles of Microbiology, Wm C Brown Publishers, USA.
2. Madigan, M.T., Martinko, J. M., Parker, J. Brock Biology of Microorganisms, Pearson Ed.
3. Pelczar, M.J., Chan, E.C.S, Kreig, N.R. Microbiology: Concepts and Application, Tata Mc. Hill.
4. Stainier R.Y., Ingraham, J.L., Wheelis, M.L., Painter, P.R., General Microbiology, MacMillan.
5. Vandenmark, P.V, Batzing, B.L., The Microbes - An Introduction to their nature and Importance, Benjamin Cummings.
6. Whitman, W.B., Goodfellow, M., Kämpfer, P., Busse, H.J., Trujillo, M.E., Ludwig, W., Suzuki, K., Bergey's Manual of Systematic Bacteriology, Springer-Verlag.
7. Salle, A.J., Fundamental Principles of Bacteriology, McGraw-Hill Book Company.

**Teaching learning process:**

- **Lectures (online and offline mode):** Through white board, notes, power point presentation supported by smart class rooms and other online teaching platforms like Google meet and Google classroom. etc.
- **Doubt session :** once in a week
- **Assignments, seminars and different exercises**
- **Tests:** Learning level of the students will be tested through class tests, quizzes, surprise evaluation, assignments sessional exams and through interactive sessions.

**M.Sc. Microbiology**

**Semester II**

| **Name of the course: Molecular Immunology** | **Course Code: 25MB202** | **Credits: 4** |
|---|---|---|
| **Maximum Marks: 100**<br>**Theory: 30(Internal)+70(External)=100** | **Time of examination: 3 Hrs.** | |

**Note:** Examiner will set nine questions and the candidates will be required to attempt five questions in all. Question number one will be compulsory containing seven short answer type questions from all sections. Further, examiner will set two questions from each section and the candidates will be required to attempt one question from each Section. All questions will carry equal marks.

**Objective:** The focus of this course is on the immune system and its function in health and disease. The students will know about immune cell types, chemicals, and processes. An introduction to the most recent findings in immunology will also be discussed.

**Course Outcomes**: After studying this course

- **CO1:** The students will have a firm grasp on the fundamentals of the immune system, immunological responses, and its organization.
- **CO2:** The students will be able to comprehend the genetic organization of the genes that are responsible for the expression of immune cell receptors and their role in immunity.
- **CO3:** The students will have the ability to understand the workings of the immune response as well as the mechanisms that underlie it.
- **CO4:** The knowledge gained can be used to understand better immunity processes, including host defense, hypersensitivity (allergy), organ transplantation, and some immunological diseases.

**Section-I**

**Preface of immunology:** Primitive and advanced immunity, anatomical barriers in innate immunity, cardinal features of the acquired immune system. Internal structure and organization of the thymus, spleen, and lymph nodes.

**Cellular and humoral immunity:** Concept of antigen, super antigen, immunogen, epitopes, and hapten carrier system. Factors affecting immunogenicity. Molecular structure of antibodies and their functions. Complement system and its evasion by microbes[DSL]. Complement deficiencies and diseases.

**Section-II**

**Immune receptors and their diversity:** Structure and functions of Toll receptor, TCR, BCR, MHC; somatic recombination and generation of antibody diversity.

**Antigen presentation and tolerance:** Antigen processing and presentation, self-MHC

restriction. Immunological tolerance.

**Section-III**

**Activation of immune cells and cytotoxicity:** T cell activation, negative regulation of T cell activation. Mechanism of T cell and NK cell-mediated target cell lysis, antibody-dependent cell-mediated cytotoxicity, macrophage-mediated cytotoxicity [DSL]. Inflammatory bowel diseases: IBD-associated arthritis, Crohn's disease and ulcerative colitis.

**Regulation of the immune system:** Cytokines and their role in immune regulation

**Section-IV**

**Transplantation and disorders of immune response:** Transplantation and its rejection, autoimmunity, hypersensitivity, immunodeficiencies.

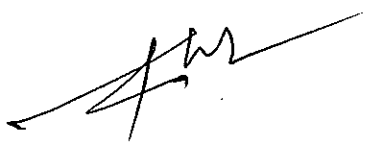
**Immunotechnology:** Antigen-antibody interactions, agglutination, immunoelectrophoresis, immunoblotting, ELISA, surface plasmon resonance. Abzymes, antibody engineering. Vaccines.

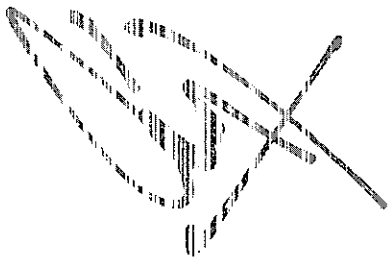
**Books Recommended:**

1. Kuby, J.W.H, Immunology. Freeman & Co.
2. Abul, K. A., Lichtman, A.H., Pillai, S., Cellular and Molecular Immunology. Elsevier.
3. Cioco, R., Sunshine, G., Immunology: A Short. Willey-Blackwell Press.
4. Roitt, I.M., Essential Immunology. Oxford Black Well Science, London.
5. Khanna, R., Immunology. Oxford Press.
6. Chakravarty, A.K., Immunology and Immunotechnology. Oxford press.
7. Fahim, H. K., The elements of Immunology. Pearson Education

**Teaching learning process:**

- **Lectures (online and offline mode):** Through white board, notes, power point presentation supported by smart class rooms and other online teaching platforms like Google meet and Google classroom. etc.
- **Doubt session :** once in a week
- **Assignments, seminars and different exercises**
- **Tests:** Learning level of the students will be tested through class tests, quizzes, surprise evaluation, assignments sessional exams and through interactive sessions.





**M.Sc. Microbiology**

**Semester II**

| **Name of the course: Molecular Biology** | **Course Code: 25MB203** | **Credits: 4** |
|---|---|---|
| **Maximum Marks: 100**<br>**Theory: 30(Internal)+70(External)=100** | **Time of examination: 3 Hrs.** | |

**Note:** Examiner will set nine questions and the candidates will be required to attempt five questions in all. Question number one will be compulsory containing seven short answer type questions from all sections. Further, examiner will set two questions from each section and the candidates will be required to attempt one question from each Section. All questions will carry equal marks.

**Objective:** To help students understand the molecular mechanisms of the cellular framework and different molecular biology techniques.

**Course Outcomes**: After studying this course

- **CO1**: The students will be capable of describing the structure of DNA and RNA as well as the organization of the eukaryotic genome. And also mechanisms of bacterial and eukaryotic DNA replication, repair, and transcription.
- **CO2:** The students will be able to describe prokaryotic and eukaryotic translation mechanisms, translation control, and post-translational processing.
- **CO3:** The students will be able to explain RNA editing, RNA interference, and microRNAs, and may provide a unifying framework for describing gene control at cellular and organismal levels.
- **CO4:** The students will possess the ability to clarify concepts in genome sequencing and preparation of genomic libraries.

**Section-I**

DNA: Properties, Structure, Composition, Forms, and its Types

DNA Replication: Mechanism of DNA replication in Prokaryotic and Eukaryotic cells. Enzymes and accessory proteins involved in DNA replication and DNA repair.

**Section-II**

Transcription: Prokaryotic & Eukaryotic transcription, RNA polymerase, General and specific transcription factors & their regulation, Transcriptional and post-transcriptional gene silencing, Modifications in RNA: 5'-Cap formation, Transcription termination, 3'-end processing and Polyadenylation, Splicing, Editing, Nuclear export of mRNA & its stability.

**Section-III**

Antisense and Ribozyme Technology: Molecular mechanism of antisense molecules, inhibition of splicing, polyadenylation, and translation, disruption of RNA structure, and capping.

Translation: Prokaryotic and Eukaryotic translation, Regulation of translation, genetic code, co- and post-translational modifications of proteins.

**Section-IV**

Biochemistry of ribozyme: hammer head & their designing strategies, hairpin and other ribozymes, Homologous Recombination: Holliday junction, excision repair, RecA and other recombinases, and DNA repair mechanisms. Molecular gene targeting, gene disruption, FLP/FRT and Cre/Lox recombination.

**Books Recommended:**

1. J.D. Watson, N.H. Hopkins, J.W. Roberts, J.A. Steitz and A.M. Weiner. Molecular Biology of the Gene. The Benjamin/Cummings Pub. Co.
2. J. Darnell, H. Lodish and D. Baltimore Molecular Cell Biology, Scientific American Books, Inc., USA.
3. B. Alberts, D. Bray, J. Lewis, M. Raff, K. Roberts and J.D. Watson Molecular Biology of the Cell, Garland Publishing Inc., New York.
4. R.A. Meyers, Molecular Biology and Biotechnology. A comprehensive desk reference, VCH Publishers, Inc., New York.
5. J. Sambrook, E.F. Fritsch and T. Maniatis. Molecular Cloning: a Laboratory Manual, Cold Spring Harbor Laboratory Press, New York.
6. P.D. Dabre, Introduction to Practical Molecular Biology, John Wiley & Sons Ltd., New York.

**Teaching learning process:**

- **Lectures (online and offline mode):** Through white board, notes, power point presentation supported by smart class rooms and other online teaching platforms like Google meet and Google classroom. etc.
- **Doubt session :** once in a week
- **Assignments, seminars and different exercises**
- **Tests:** Learning level of the students will be tested through class tests, quizzes, surprise evaluation, assignments sessional exams and through interactive sessions.

**M.Sc. Microbiology**

**Semester II**

| **Name of the course: Microbial Analytical Techniques** | **Course Code: 25MB204** | **Credits: 4** |
|---|---|---|
| **Maximum Marks: 100**<br>**Theory: 30(Internal)+70(External)=100** | **Time of examination: 3 Hrs.** | |

**Note:** Examiner will set nine questions and the candidates will be required to attempt five questions in all. Question number one will be compulsory containing seven short answer type questions from all sections. Further, examiner will set two questions from each section and the candidates will be required to attempt one question from each Section. All questions will carry equal marks.

**Objectives:** This course aims to provide a broad understanding of principles, applications, and instrumentation related to biophysical and biochemical techniques to the students.

**Course outcomes:**

**CO1:** Students will become capable of using techniques in various fields of research.

**CO2:** The course enables students to pursue careers as instrument experts in medical, chemical, and pharmaceutical sciences.

**Section-I**

**Microscopy:** Principles and applications of Simple microscope, Compound microscope, Electron microscope, Stereomicroscope, confocal, scanning, and transmission electron microscopy.

**Cell separation and flow cytometry**: Density gradient centrifugation; ultracentrifugation; FACSCAN; cell sorter.

**Section-II**

**Chromatography**: Principles and applications of Column chromatography, Ion exchange chromatography, Affinity chromatography, gas chromatography, high-pressure liquid chromatography (HPLC), and reversed-phase chromatography.

**Electrophoresis**: Principles and applications of 2D-PAGE; Method of coomassie and silver staining of gel; differential in gel electrophoresis (DIGE); electrophoretic mobility shift assay (EMSA).

**Section-III**

**Spectroscopy**: Principles and applications of UV-Visible spectroscopy, infrared, X-ray diffraction spectroscopy; NMR; mass spectrometry (LC- MS), FTIR spectroscopy.

**Section-IV**

**Blotting techniques:** Dot blot and colony hybridization, Southern, Northern, and Western blotting hybridization, Southern, Northern, and Western blotting.

**Applications of bio techniques:** Quality measurement and quantitation of DNA and RNA;

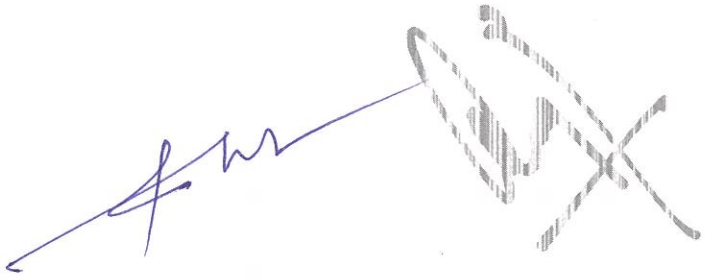
microarrays (DNA and protein); comparative genome hybridization (CGH)

**Suggested Readings:**

1. Molecular Cloning: a Laboratory Manual by J sambrook, EF Fritsch and T Maniatis, Cold Spring Harbor Laboratory Press, New York.
2. Principal and Practice of Bioanalysis by Richard E Venn, Taylor and Francis.
3. Principles and Techniques-Practical Biochemistry by Walker J and Wilson K, Cambridge University Press, London.
4. Radioisotopes in Biology-A Practical Approach by Slater RJ, Oxford University Press, New York
5. Introductory Practical Biochemistry by Sawhney SK and Singh R, Alpha Science International.
6. Biophysical Chemistry : Principles & Techniques by Upadhayaye A, Upadhyaye K and Nath N, Himalaya Publication House, New Delhi.
7. Physical Biochemistry; Principles and applications by David Sheehan, Wiley Press.

**Teaching learning process:**

- Lectures (online and offline mode): Through white board, notes, power point presentation supported by smart class rooms and other online teaching platforms like Google meet and Google classroom. etc.
- Doubt session: once in a week
- Assignments, seminars and different exercises
- Tests: Learning level of the students will be tested through class tests, quizzes, surprise evaluation, assignments sessional exams and through interactive sessions.



## M.Sc. Microbiology

### Semester II

| Name of the course: Microbial Physiology and Metabolism | Course Code: 25MB205 | Credits: 4 |
|---|---|---|
| **Maximum Marks: 100**<br>**Theory: 30(Internal)+70(External)=100** | **Time of examination: 3 Hrs.** | |

**Note:** Examiner will set nine questions and the candidates will be required to attempt five questions in all. Question number one will be compulsory containing seven short answer type questions from all sections. Further, examiner will set two questions from each section and the candidates will be required to attempt one question from each Section. All questions will carry equal marks.

**Objective:** The goal of this course is to familiarise students with the various bacterial cell shapes and their roles in growth, reproduction, energy generation, and metabolic pathways.

**Course outcome:** After studying this course

- **CO1:** The students will become familiar with nutritional categories, primary, secondary, group translocation transport systems and kinetics of bacterial growth.
- **CO2:** The students will acquire a detailed understanding of bacterial photosynthetic and accessory pigments and metabolic pathways.
- **CO3:** The students will understand bacterial carbon metabolism routes, their distinctions from eukaryotic systems, and regulation in different physiological situations.
- **CO4:** The students will understand the biosynthesis of peptidoglycan and regulation of inorganic/organic nitrogen assimilation. They will also become familiar with the spore dormancy and germination.

**Section-I**

Nutritional Categories of microorganisms based on carbon and energy sources, Metabolite Transport, Primary and secondary active transport, Group translocation, symport, antiport, uniport, electrogenic, electro-neutral transport, and transport of Iron. Microbial Growth, balanced and unbalanced growth, growth curve, the mathematics of growth, Generation time, specific growth rate, batch and continuous culture, synchronous growth, diauxic growth curve, effect of physical and chemical factors on growth.

**Section-II**

Brief account of photosynthetic and accessory pigments: chlorophyll, bacteriochlorophyll, rhodopsin, carotenoids, phycobiliproteins. Carbohydrates, anabolism. Autotrophy, oxygenic, anoxygenic photosynthesis, autotrophic generation of ATP, fixation of $CO_2$, Calvin cycle, C3, C4 pathway. Chemolithotrophy: sulphur, iron, hydrogen, nitrogen oxidations, methanogenesis, acetogenesis and luminescence.

**Section-III**

Respiratory metabolism, glyoxalate pathway, oxidative and substrate level phosphorylation, reverse TCA cycle, Pasteur effect; Fermentation of carbohydrates, homo and heterolactic fermentations by Lactic acid bacteria.

**Section-IV**

Biosynthesis of peptidoglycan, Assimilation of nitrogen; Dormancy and germination; Regulation of endospore formation, Microbial Differentiation, sporulation and morphogenesis Biosynthesis of biopolymers, Caulobacter as model microbe, Quorum sensing, Rumen microbiology

**Books Recommended:**

1. Caldwell, D.R. Microbial Physiology and Metabolism, Brown Publishers.
2. Gottschalk G. Bacterial Metabolism, Springer Verlag, New York.
3. Moat, A.G. Microbial Physiology, John Wiley & Sons, New York, USA.
4. Moat, AG, Foster J W, Spector M P. Microbial Physiology, Wiley India Pvt Ltd, Country.
5. Sokatch, J.R. Bacterial Physiology and Metabolism, Academic Press, USA.
6. Srivastava, B. Microbial Physiology and Metabolism, LAP Lambert Academic Publishing, USA

**Teaching learning process:**

- **Lectures (online and offline mode):** Through white board, notes, power point presentation supported by smart class rooms and other online teaching platforms like Google meet and Google classroom. etc.
- **Doubt session :** once in a week
- **Assignments, seminars and different exercises**
- **Tests:** Learning level of the students will be tested through class tests, quizzes, surprise evaluation, assignments sessional exams and through interactive sessions.

**M.Sc. Microbiology**
**Semester II**

| **Name of the course: Lab course-I**<br>**Type of course: Practical** | **Course Code: 25MB206** | **Credits: 4** |
|---|---|---|
| **Maximum Marks: 100**<br>**Practical: 30(Internal)+70(External)=100** | **Time of examination: 08 Hrs.** | |

**Objective:** The goal of this course is to give hands on experience of different immunological techniques.

**Course outcomes:** After studying this course

- **CO1:** The students will be able to perform morphological, physiological and biochemical characterization of isolated bacterial cultures.
- **CO2:** The students will learn to identify blood group antigens and its quantification using Radial Immuno diffusion methodology.
- **CO3:** The students will have gained knowledge of various Immunodiagnostics techniques via ICT Tools.

**Course contents:**

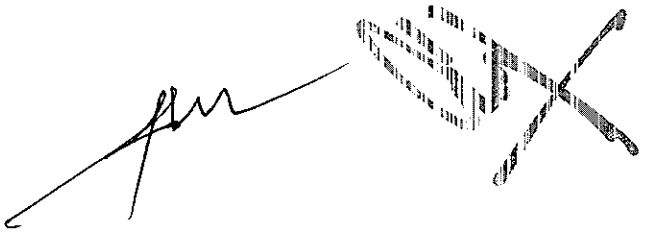
1. Methods of isolation, purification and maintenance of microorganisms from soil.
2. Isolation of Rhizobium from legume root nodule
3. Isolation of Azotobacter from soil
4. Enumeration of Microbial population in soil -Bacteria, Fungi and Actinomycetes
5. Enumeration of microbial population in soil bacteria, fungi and Actinomycetes.
6. Staining of bacteria and Actinomycetes
7. Use of selective media
8. Enrichment culture technique – isolation of asymbiotic nitrogen fixing bacteria
9. Morphological, physiological and biochemical characterization of isolated bacterial cultures. Blood film preparation and identification of cells
10. To identify blood group antigens
11. Immunoassays -Agglutination
12. Lymphoid organs and their microscopic organization
13. Immunization, Collection of Serum
14. Transfection of Hela Cells
15. Radial Immuno diffusion
16. Purification of IgG from serum
17. Separation of mononuclear cells by Ficoll-Hypaque method
18. Enzyme Linked Immuno Sorbent Assay
19. Hapten Conjugation and quantitation

20. Immunodiagnostics (demonstration using commercial kits)
21. Field Visit/Project report/presentation by the students.

**Suggested Reading:**

1. Cappucino JG and Welsh CT. Microbiology: A laboratory manual. 11th edition. Pearson.
2. Thompson DA. Biochemistry Lab Manual. 3rd edition.
3. Segel IH. Biochemical calculations: how to solve mathematical problems in general biochemistry, Wiley, 2nd Edition.
4. Sambrook J & Russell D. Molecular Cloning: A laboratory manual. 4th edition. Cold Spring Harbor laboratory Press.
5. Collee JG, Fraser AG, Marmion BP & Simmons A (eds.). Mackie & McCartney Practical Medical Microbiology. Churchill Livingstone, Edinburgh.
6. Atlas RM, Parks LC & Brown AL. Laboratory Manual of Experimental Microbiology. MosbyYear Book, Inc., Missouri.

**Note:** This is the list of suggested practicals. The final list of practicals will be declared in the running semester





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**M.Sc. Microbiology**

**Semester II**

| **Name of the course: Lab course-II**<br>**Type of course: Practical** | **Course Code: 25MB207** | **Credits: 4** |
|---|---|---|
| **Maximum Marks: 100**<br>**Practical: 30(Internal)+70(External)=100** | **Time of examination: 08 Hrs.** | |

**Objective:** The goal of this course is to give hands on experience to students of different molecular biological techniques.

**Course Outcomes:** After studying this course

- **CO1:** The students will have a practical understanding on DNA/RNA isolation techniques, their quantifications and electrophoresis.
- **CO2:** The students will acquire practical knowledge and skill on PCR methodology and its applications in biological sciences.
- **CO3:** The students will be able to measure the bacterial growth kinetics.
- **CO4:** The students will gain knowledge and practical exposure of various molecular techniques by visiting R & D laboratories and using various ICT Tools.

**Course contents:**

1. Isolation of Genomic DNA.
2. Quantitative analysis of DNA.
3. Restriction digestion of DNA.
4. Ligation of DNA fragments.
5. Molecular weight analysis using Agarose gel electrophoresis.
6. Isolation of plasmid DNA.
7. Preparation of competent cells
8. Demonstration of Blotting techniques.
9. Detection of a pathogen through PCR
10. To carryout metagenomic study using 16s rDNA technology
11. Demonstration of protein gel electrophoresis (SDS-PAGE).
12. Principle of Spectrophotometry-verification of Beer- Lambert's law, relation between O.D. and percentage transmission.
13. Demonstration of paper chromatography.
14. Bacterial growth kinetics.
15. Determination of yield coefficient and Monod's constant and metabolic quotient of *E.coli* culture on glucose.
16. Effect of temperature, pH, and salt on growth of given bacterial culture



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| 17. To prepare the Winogradsky's column |
| **Suggested Reading:**<br>1. Cappucino JG and Welsh CT. Microbiology: A laboratory manual. 11th edition. Pearson.<br>2. Thompson DA. Biochemistry Lab Manual. 3rd edition.<br>3. Segel IH. Biochemical calculations: how to solve mathematical problems in general biochemistry, Wiley, 2nd Edition.<br>4. Sambrook J & Russell D. Molecular Cloning: A laboratory manual. 4th edition. Cold Spring Harbor laboratory Press.<br>5. Collee JG, Fraser AG, Marmion BP & Simmons A (eds.). Mackie & McCartney Practical Medical Microbiology. Churchill Livingstone, Edinburgh.<br>6. Atlas RM, Parks LC & Brown AL. Laboratory Manual of Experimental Microbiology. MosbyYear Book, Inc., Missouri. |
| **Note:** This is the list of suggested practicals. The final list of practicals will be declared in the running semester |

**M.Sc. Microbiology**

**Semester II**

| **Name of the course: Microbial integrated organic farming** | **Course Code: 25MB208** | **Credits: 2** |
|---|---|---|
| **Maximum Marks: 50**<br>**Theory: 15(Internal)+35 (External)=50** | **Time of examination: 2 Hrs.** | |
| Examiner will set five questions and the candidates will be required to attempt five questions in all. Question number one will be compulsory containing seven short answer type questions (7x1) from all sections. Further, examiner will set two questions from each section and the candidates will be required to attempt one question from each Section (2x14). | | |
| **Course Objective**: The course is designed to impart basic knowledge about soil and microbial interactions and their impacts on organic farming.<br>**Course Outcome**: Basic knowledge about microorganisms presents in soil, their interaction with the plants and impacts on organic cultivation/farming. | | |
| **Section-I**<br>Role of microorganisms in sustainable agriculture and organic cultivation. Bio-fertilizers: types, Plant growth-promoting rhizobacteria (PGPR), Phosphate solubilizing microorganisms, Zinc solubilizing microorganisms, advantages and disadvantages. Biodegradation of pesticides, Microorganisms involved in the biological control of plant diseases. | | |
| **Section-II**<br>Introduction to sustainable agriculture and organic cultivation, Implications of organic agriculture on environment, Status of organic agriculture in Haryana & India. Organic Food and Human Health. Organic manure, Vermi-composting, Crop-rotation and mixed cropping. Biological indicators of soil health. Various methods of activating microbial activity in top soil, biological control microorganisms. | | |
| **Suggested reading:**<br>1. Alexander, M. Introduction to Soil Microbiology. John Wiley, New York<br>2. Paul, E.A. Soil Microbiology, Ecology and Biochemistry. 3rd Ed. Academic Press, New York.<br>3. Sylvia, D.M. et al. Principles and Applications of Soil Microbiology. 2nd Ed. Pearson Edu.<br>4. Tate, R.L. Soil Microbiology, Wiley-Blackwell., NY<br>5. Dixon; G.R. and Tilston, E.L. Production. Springer, Heidelberg.<br>6. Coyne, M. (1999). Introduction to Soil Microbiology, Delmar Cengage Learning, NY<br>7. Sharma, A. Hand Book of Organic Farming, Agrobios (India), Jodhpur.<br>8. Veeresh, G.K., Shivashankar, K., Suiglachar, M.A. Organic Farming and Sustainable Agriculture. Association for Promotion of Organic Farming, Bangalore. | | |



Date of PGBOS & R: August 14, 2025

9. Kristensen, P., Taji, A., Reganold, J. Organic Agriculture. A Global Perspective. CSIRO Press. Victoria, Australia.
10. (http://www.oardc.ohio-state.edu/apsbcc/).
11. (https://nptel.ac.in/course).
12. (https://apeda.gov.in).



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