

# **Mata Gujri College**

**Sri Fatehgarh Sahib**

(An Autonomous College)

Affiliated to Punjabi University Patiala

**Syllabus**

**For**

**M.Sc. (Hons.) Microbiology- First Year**

(Ist & IInd Semester)

## **SYLLABUS OF COURSES TO BE OFFERED**

**Core Courses, Elective Courses & Ability Enhancement Courses**



**Academic Session 2018-2019**

**M.Sc. (Hons.) Microbiology First Year**  
**Subjects and Marks Distribution**  
**Semester-I**

<b>Paper code</b>	<b>Paper No.</b>	<b>Name of paper</b>	<b>Period/ week</b>	<b>External Marks</b>	<b>Internal Marks*</b>	<b>Total Marks</b>	<b>Credits</b>
MMB-101 (C-1)	Paper I	General Microbiology	4	70	30	100	4
MMB-102 (C-2)	Paper II	Bacteriology & Virology	4	70	30	100	4
MMB-103 (C-3)	Paper III	Fundamentals of Biochemistry	4	70	30	100	4
MMB-104 (C-4)	Paper IV	Instrumentation and Biotechniques	3	70	30	100	3
MMB-105 (C-5)	Paper V	Research Methodology	2	70	30	100	2
MMB-106	LC-101	General Laboratory practices in Microbiology	4			50	2
MMB-107	LC-102	Basic Laboratory Procedures in Bacteriology	4			50	2
MMB-108	LC-103	Practical Biochemistry	4			50	2
MMB-109	LC-104	Practical exercise of Biotechniques	2			50	1
MMB-409		Research work (synopsis submission)				100	2
Total							26

\*Internal assessment (30): Seminar (5 Marks) MST (15 Marks), Assignment (5), Attendance/report for the seminar/symposium/industrial/Educational visit (5 marks)

## M.Sc. (Hons.) Microbiology First Year

### Subjects and Marks Distribution

#### Semester – II

Paper code	Paper No.	Name of paper	Period/Week	External Marks	Internal Marks*	Total Marks	Credits
MMB-201 (C-6)	Paper VI	Immunology	4	70	30	100	4
MMB-202 (C-7)	Paper VII	Food & Industrial Microbiology	4	70	30	100	4
MMB-203 (C-8)	Paper VIII	Mycology & Phycology	3	70	30	100	3
MMB-204 (DSE-1)	Paper IX-a	Computer & Bioinformatics	3	70	30	100	3
	Paper IX-b	Cell Biology	3	70	30	100	
MMB-205 (DSE-2)	Paper X-a	Microbial Biotechnology	3	70	30	100	3
	Paper X-b	Plant Tissue Culture	3	70	30	100	
MMB-206	LC-201	Practical Immunology	4			50	1
MMB-207	LC-202	Practical Industrial Food Microbiology	4			50	2
MMB-208	LC-203	Lab-practices in Mycology & Phycology	4			50	2
MMB-209	LC-204a	Practical use of Computer in Bioinformatics	2			50	1
	LC-204b	Practical Cell Biology	2			50	
MMB-210	LC-205a	Practical use of Microbes in Biotechnology	2			50	1
	LC-205b	Practical Plant Tissue Culture	2			50	
MMB-409		Research work				100	3
Total							27

\*Internal assessment (30): Seminar (5 Marks) MST (15 Marks), Assignment (5), Attendance/report for the seminar/symposium/industrial/Educational visit (5 marks)

## M.Sc. (Hons.) Microbiology Second Year

### Subjects and Marks Distribution

#### Semester III

Paper code	Paper No.	Name of paper	Period/Week	Internal Marks*	External Marks	Total Marks	Credits
MMB-301 (C-9)	Paper XI	Microbial Genetics & Genetic Engineering	4	70	30	100	4
MMB-302 (C-10)	Paper XII	Medical Microbiology	3	70	30	100	3
MMB-303 (C-11)	Paper XIII	Biostatistics	3	70	30	100	3
MMB-304 (AEEC-1)	Paper XIV-a	Microbial Quality Control In Food and Pharmaceutical	2	70	30	100	2
	Paper XIV-b	Diagnostic Microbiology	2	70	30	100	
MMB-305 (AEEC-2)	Paper XV-a	Biofertilizers and Biopesticides	2	70	30	100	2
	Paper XV-b	Food Fermentation Techniques	2	70	30	100	
MMB-306	LC-10	Practical Genetics	4			50	2
MMB-307	LC-11	Medical and Diagnostic Laboratory	4			50	2
MMB-308		Summer Training & seminar				50	2
MMB-409		Research project (Experimental work)				100	7
		Total					27

\*Internal assessment (30): Seminar (5 Marks) MST (15 Marks), Assignment (5), Attendance/report for the seminar/symposium/industrial/Educational visit (5 marks)

## M.Sc. (Hons.) Microbiology Second Year

### Subjects and Marks Distribution

#### Semester – IV

Paper code	Paper No.	Name of paper	Period/ week	Internal Marks*	External Marks	Total Marks	Credits
MMB-401 (C-12)	Paper XVI	Environmental Microbiology	4	70	30	100	4
MMB-402 (C-13)	Paper XVII	Soil & Agriculture Microbiology	3	70	30	100	3
MMB-403 (AECC)	Paper XIII	TQM & IPR	3	70	30	100	3
MMB-404 (DSE-3)	Paper XIX-a	Fermentation Technology	3	70	30	100	3
	Paper XIX-b	Recombinant DNA Technology	3	70	30	100	
MMB-405 (AECC-3)	Paper XX-a	Microbial Analysis of Air and Water	2	70	30	100	2
	Paper XX-b	Management of Human Microbial Diseases	2	70	30	100	
MMB-406	LC-12	Practical approaches in Environmental Microbiology	4			50	2
MMB-407	LC-13	Practical Microbiology in Soil and Agriculture	4			50	2
MMB-408	LC-14a	Practical Fermentation Technology	2			50	1
	LC-14b	Practical Recombinant DNA Technology	2			50	
MMB-409		Research project & seminar (Experimental work & Thesis writing)				100	8
		Total					28

\*Internal assessment (30): Seminar (5 Marks) MST (15 Marks), Assignment (5), Attendance/report for the seminar/symposium/industrial/Educational visit (5 marks).

**C-Core course, DSE-Discipline Specific Elective Course, AECC- Ability Enhancement Elective Course, AECC- Ability Enhancement Compulsory course**

#### Assessment Parameters

1. Quality of thesis
2. Quantitative data analysis
3. Significance of work
4. Presentation and defense

#### Weightage (%)

- 40
- 20
- 20
- 20

**M.Sc. (Hons.) (Microbiology) Semester-I**  
**Paper-I – General Microbiology (MMB-101)**

Lectures to be delivered: 60 (Credits-4)

Max. Marks: 70

Pass Marks: 40%

**Course Objectives:** Students will understand the classification system for microorganisms, Prokaryotic and eukaryotic cells and major microbial groups (bacteria, fungi, viruses, algae etc.). Also, they will be aware of various techniques related to the isolation, staining, identification, assessment of metabolism, and control of microorganisms.

**INSTRUCTIONS FOR THE PAPER SETTERS/CANDIDATES**

The question paper will consist of three sections A, B and C. Section-A and B will have four questions from the respective sections of the syllabus and carry 12 marks each. Section - C will consist of 11 short answer type questions which will cover the entire syllabus uniformly and will carry 22 marks in all. Candidates are required to attempt two questions each from sections A and B. Section-C is compulsory.

**Unit-I**

**Introduction to Microbiology:** Historical developments of microbiology, brief account of organization and classification of microorganisms, Haeckel's three kingdom concept, Whittaker's five kingdom concept, three domain concept and recent developments. Prokaryotic and eukaryotic cell, Brief account of major groups of microorganisms: Bacteria, algae, fungi, protozoa and viruses. Scope of microbiology in the field of medicine, food industry, agriculture, environmental etc.

**Methods of Microbiology:** Introduction to Microscopy: bright field & dark field microscopy, fluorescence microscopy, Isolation and maintenance of microbial cultures from different sources

**Strain improvement:** Mutation and screening of improved cultures, random and strategic screening methods, strategies of strain improvement for primary, secondary metabolites with relevant examples

**Unit-II**

**Nutrition types and growth of microorganisms:** Nutritional types (Concept of litho/organo, photo/chemo and auto/ heterotrophs), types of media (selective media, differential media, assay and enrichment media), choice of media, Growth of microorganisms: Population growth and growth kinetics, Methods of growth determination, effect of environmental conditions (pH, temperature, aeration, etc.) continuous culture, diauxic growth, synchronous cultures, Introduction to geochemical cycles: carbon, nitrogen, sulfur and Phosphorus cycles

**Control of microorganisms:** Control of microbes by physical (dry and moist heat, pasteurization, tyndalization, radiation, ultrasonication, and filtration) techniques, Control of microbes by chemical agents (disinfection sanitization, antiseptics, sterilants and fumigation), phenol coefficient, antibacterial agents, Mechanism of resistance to antimicrobial agents, Susceptibility testing of bacteria

**Books Recommended:**

Alcorno, I.E. (2011) Fundamentals of Microbiology, John and Barlett Publishers

Pelczar, M.J. Chan, E.C.S. and Krieg, N.R. (2010). Microbiology, Mc. Graw Hill Publishers

Prescott. L.M. Harley J.P. and L. Kleig D.A. (2013). Microbiology, Mc. Graw Hill Publishers

Stanier, R.Y. Adelberg, E.A. and Ingraham, J.L. (2004). General Microbiology, Mac Millan Press

**M.Sc. (Hons.) (Microbiology) Semester-I**  
**Paper-II: Bacteriology & Virology (MMB-102)**

Lectures to be delivered: 60 (Credits-4)

Max. Marks: 70

Pass Marks: 40%

**Course Objectives:** Course will throw light on detailed description on bacterial classification, methods of identification of bacteria, bacterial structures etc. Students will also understand the concept of virology, Virus structure, classification, diseases caused by viruses in plants and animals.

**INSTRUCTIONS FOR THE PAPER SETTERS /CANDIDATES**

The question paper will consist of three sections A, B and C. Section-A and B will have four questions from the respective sections of the syllabus and carry 12 marks each. Section - C will consist of 11 short answer type questions which will cover the entire syllabus uniformly and will carry 22 marks in all. Candidates are required to attempt two questions each from sections A and B. Section-C is compulsory.

**Unit-I**

**Introduction to bacteriology:** Introduction and history of bacteriology, Morphology and ultra structure of bacteria: types, cell wall, L-form, Cell wall synthesis, Cell membranes- structure, composition and properties, capsules, flagella, pili, gas vesicle, chromosomes, magnetosomes, endospore, capsules and S- layer, cytoskeleton structures in bacteria, Reserve food materials in bacteria (PHB, phosphate granules, oil droplets and sulphur inclusions) and bacterial chemotaxis

**Bacterial Classification:** Concepts of species and hierarchical taxa, biological nomenclature, Intuitive and numerical classification, DNA base homology, 16S rRNA and DNA hybridization. Outline of Bergey's system of Bacterial Classification. **Archaeobacteria:** general characteristics and classification: halophiles, thermophiles and barophiles, methanogens; adaptation, role of archaeobacteria in the evolution of microbial world, Differences from eubacteria and eukaryotes. **Mycoplasma** and **Actinomycetes:** General characteristics, classification, diversity and distribution, economic importance. **Rickettsiae and Chlamydia-** general characteristics and examples, life cycle, growth and multiplication, their significance

**Unit-II**

**History of virology:** History and development of virology. **Characteristics of virus:** morphological variations, envelope, capsid and nucleic acid of viruses, Replication and classification of viruses. Viroids, Prions

**Methods for the isolation of viruses:** criteria for purity of viruses, preservation of viruses, biophysical properties of viruses, plaque, pock method and direct count method, Haeme-agglutination, serological and molecular based detection of viruses, use of electron microscopy in virology

**Bacteriophages:** Types, general properties of bacteriophage, detailed description of lambda, M13 phage and T2 phage

**Plant Viruses-** structure, replication and transmission of viruses (Insect, amphids, innate), Viral diseases associated with wheat, tobacco and okra, their symptoms, mode of infections & multiplication, control **Animal Viruses:** structure, replication and transmission of animal viruses, Introduction to viral diseases, Foot and Mouth disease, Rabies

**Books Recommended:**

Cann, A (2011) Principles of Molecular Virology, Academic Press London

Carter J and Saunders V. (2007) Virology-Principles & Applications. John Wiley & Sons

Flint, SJ; Enquist, LW; Skalka, AMK (2004) Principles of Virology; molecular biology, pathogenesis and control, ASM press

Sherwood, and Woolverton Willey (2007), Prescott, Harley, and Klein's Microbiology (7<sup>th</sup> International Edition), McGraw-Hill.

Stanier, R.Y., Ingraham, J.L. Wheelis, M.L. and Painter, P.R (2013) General Microbiology, MacMillan Press



**M.Sc. (Hons.) (Microbiology) Semester-I**  
**Paper III – Fundamentals of Biochemistry (MMB-103)**

Lectures to be delivered: 60 (Credits-4)

Max. Marks: 70

Pass Marks: 40%

**Course Objectives:** Study of this course will provide knowledge of various pathways of macromolecules (carbohydrates, proteins, lipids, Nucleic acids). Students will also understand the structure, properties and functions of nucleic acids, proteins and biological membranes.

**INSTRUCTIONS FOR THE PAPER SETTERS /CANDIDATES**

The question paper will consist of three sections A, B and C. Section-A and B will have four questions from the respective sections of the syllabus and carry 12 marks each. Section - C will consist of 11 short answer type questions which will cover the entire syllabus uniformly and will carry 22 marks in all. Candidates are required to attempt two questions each from sections A and B. Section-C is compulsory.

**Unit-I**

Introduction to biomolecules and application in living system, Classification of amino acids, titration of amino acids, properties of amino acids, protein classification (Primary, secondary, tertiary, quaternary). Nitrogen metabolism (Transamination, oxidative deamination, Urea cycle), Enzymes and their nature, classification and nomenclature of enzymes, factors affecting rate of enzymes catalyzed reaction, allosteric enzymes, isozymes

Carbohydrates: Mono-saccharides, disaccharides (sucrose, lactose and maltose), polysaccharides, homo-polysaccharides (starch, cellulose, chitin), hetero-polysaccharides, muco-polysaccharides, Glycolysis, citric acid cycle, pentose phosphate pathway, glycogenesis, glycogenolysis, gluconeogenesis, Electron transport chain, Chemiosmotic model, Electron transport chain. Electron transport chain in heterotrophic and chemolithotrophic bacteria, Photosynthetic pigments, cyclic and non-cyclic electron flow, Calvin cycle, C3, C4 and CAM, photorespiration

**Unit-II**

**Structure and function of lipids:** Fatty acids, Neutral lipids (triglycerides), phospholipids (cephalin, phosphatidyl inositol and lecithin). Biological membrane, membrane proteins and their function, fluid mosaic model, membrane mediated transport (passive, active, facilitated), Biosynthesis and catabolism of fatty acids, triglycerides and phospholipids, Water soluble vitamins (B complex and vitamin C) and fat soluble vitamins (K, E, D and A), Hormones structure & function (classification Group I & Group II)

**Structure and function of nucleic acids:** Purines, pyrimidines, nucleosides, nucleotides, inter nucleotide bonding, tautomerism, Biosynthesis of purine and pyrimidine nucleotide, synthesis of deoxyribonucleotides, degradation of purines & pyrimidines

**Books Recommended**

Caldwell D.R. (1995) Microbial Physiology and Metabolism, Brown Publishers

Champe, PC and Harvey, RA (2011) Biochemistry, Lippincott Williams and Wilkins

Nelson, DL and Cox, MM Lehninger AL (2013) Principles of Biochemistry, 6<sup>th</sup> ed. New York publication

**M.Sc. (Hons.) (Microbiology) Semester-I**  
**Paper IV – Instrumentation and Biotechniques (MMB-104)**

Lectures to be delivered: 45 (Credits-3)

Max. Marks: 70

Pass Marks: 40%

**Course Objectives:** Student will learn the principle and working of important instruments used in the laboratory like microscope, spectrophotometer, centrifuge, chromatography, electrophoresis etc. This will help to develop the equipment working skills among the students.

**INSTRUCTIONS FOR THE PAPER SETTERS /CANDIDATES**

The question paper will consist of three sections A, B and C. Section-A and B will have four questions from the respective sections of the syllabus and carry 12 marks each. Section - C will consist of 11 short answer type questions which will cover the entire syllabus uniformly and will carry 22 marks in all. Candidates are required to attempt two questions each from sections A and B. Section-C is compulsory.

**Unit I**

**Microscopy:** Structure, principle and working of microscopic techniques: Bright field and dark-field microscopy, Fluorescence Microscopy, Phase contrast Microscopy, Electron Microscopy (Scanning and Transmission Electron Microscopy)

**Spectrophotometry:** Principle and working of Spectrophotometers (UV/VIS), Colorimetry and turbidometry, florescent spectroscopy, mass spectroscopy

**Centrifugation:** Preparative and analytical centrifugation, fixed angle and swinging bucket rotors. RCF and sedimentation coefficient, differential centrifugation, density gradient centrifugation and ultracentrifugation

**Unit II**

**Chromatography:** Principles and applications of paper chromatography (including Descending and 2-D), thin layer chromatography, Column packing and fraction collection. Gel filtration chromatography, ionexchange chromatography and affinity chromatography, GLC, HPLC

**Electrophoresis:** Principle and applications of native polyacrylamide gel electrophoresis, SDS-polyacrylamide gel electrophoresis, 2D gel electrophoresis, Isoelectric focusing, Zymogram preparation and Agarose gel electrophoresis

**Books Recommended**

Wilson K. and Walker J. (2010) Principles and Techniques of Biochemistry and Molecular Biology. 7<sup>th</sup> Ed., Cambridge University Press

Nelson D.L. and Cox M.M. (2008) Lehninger Principles of Biochemistry, 5th Ed., W.H. Freeman and Company

Willey M.J. Sherwood L.M. and Woolverton C.J. (2013) Prescott, Harley and Klein's Microbiology 9<sup>th</sup> Ed., McGraw Hill.

Karp G. (2010) Cell and Molecular Biology: Concepts and Experiments. 6<sup>th</sup> Ed. John Wiley & Sons. Inc.

De Robertis E.D.P. and De Robertis E.M.F. (2006) Cell and Molecular Biology. 8th Ed., Lipincott Williams and Wilkins, Philadelphia.

Cooper G.M. and Hausman R.E. (2009). The Cell: A Molecular Approach. 5th Ed., ASM Press & Sunderland, Washington D.C.

**M.Sc. (Hons.) (Microbiology) Semester-I**  
**Paper V – Research Methodology (MMB-105)**

Lectures to be delivered: 30 (Credits-2)

Max. Marks: 70

Pass Marks: 40%

**Course Objectives:** Student will learn the meaning of research, to find the research problem, to create the research objectives etc. They will also find suitable methods for finding the solution for their research problem. This course will throw light on various aspects of thesis writing and judicial ways of paper publishing.

**INSTRUCTIONS FOR THE PAPER SETTERS /CANDIDATES**

The question paper will consist of three sections A, B and C. Section-A and B will have four questions from the respective sections of the syllabus and carry 12 marks each. Section - C will consist of 11 short answer type questions which will cover the entire syllabus uniformly and will carry 22 marks in all. Candidates are required to attempt two questions each from sections A and B. Section-C is compulsory.

**Unit-I**

**Foundations of Research:** Meaning, Objectives, Motivation, Utility. Concept of theory, empiricism, deductive and inductive theory, Characteristics of scientific method – Understanding the language of research – Concept, Construct, Definition

**Problem Identification & Formulation**– Research Question – Investigation Question – Measurement Issues – formation of Hypothesis

**Research Design:** Concept and Importance in Research, Features of a good research design, Exploratory Research Design. Descriptive Research Designs and Experimental Design: Concept of Independent & Dependent variables

**Qualitative and Quantitative Research:** Qualitative research, Quantitative research, Concept of measurement, causality, generalization, replication, merging the two approaches

**Unit-II**

**Sampling:** Introduction to Sample types, sampling frame, Sample error, determining size of the sample– Practical considerations in sampling.

**Interpretation of Data and Paper Writing:** Layout of a Research Paper, Search for Journals, Impact factor of Journals, When and where to publish? Ethical issues related to publishing, plagiarism and self plagiarism, plagiarism detection.

**Use of tools /techniques for Research:** methods to search required information effectively, Software for paper formatting like MS Office

**Books Recommended:**

Kothari C.R. (2004) Research Methodology: Methods and Techniques, 2<sup>nd</sup> Ed., New Age International publishers

Marder M.P. (2011) Research Methodology for Science, First Ed. Cambridge University Press

Kumar R.(2011) Research Methodology: a step by step guide for beginners , 3<sup>rd</sup> Ed., SAGE Publications Ltd, 1 Oliver's Yard 55 City Road London

## **LC-101: General Laboratory practices in Microbiology (MMB-106)**

Practical Time: 4 Hours/week (Credits-2)

Max. Marks: 50

Pass Marks: 40%

### **INSTRUCTIONS FOR THE PAPER SETTERS /CANDIDATES**

The Final practical paper will consist of three sections A, B and C. Section A will contain write up (13 Marks) from the list of practical pertaining to lab course. Section B will contain practical to perform in examination (25 Marks). Section C will contain practical note Book Evaluation and Viva Voce (12 Marks).

1. Introduction to GLP (Good Laboratory Practices)
2. Introduction to general equipments (autoclave, BOD incubator, hot air oven, laminar air flow, pH meter, colony counter) used in microbiology lab and their calibration
3. Introduction to microscopes (Simple, compound and phase contrast)
4. Isolation and enumeration of bacteria from soil by serial dilution and agar plating method
5. To isolate fungi (mould & yeast) from various sources and study their morphology
6. Staining Techniques (Simple staining, Gram's staining, spore staining, capsule staining, acid fast staining, flagella staining)
7. To study morphology of bacteria isolated from soil sample
8. Determination of cell size of different microorganisms
9. Determination of cell count by SPC method and DMC method
10. Calculation of generation time and growth rate of bacterial culture
11. To study the diauxic growth

## **LC-102 Basic Laboratory Procedures in Bacteriology (MMB-107)**

Practical Time: 4 Hours/week (Credits-2)

Max. Marks: 50

Pass Marks: 40%

### **INSTRUCTIONS FOR THE PAPER SETTERS /CANDIDATES**

The Final practical paper will consist of three sections A, B and C. Section A will contain write up (13 Marks) from the list of practical pertaining to lab course. Section B will contain practical to perform in examination (25 Marks). Section C will contain practical note Book Evaluation and Viva Voce (12 Marks).

1. Effect of pH on the growth of bacteria
2. Effect of salt concentration on the growth of bacteria
3. Effect of temperature on the growth of bacteria
4. To perform various biochemical tests of bacteria: Acid and gas production from sugars, gelatin liquefaction, starch hydrolysis, casein hydrolysis, indole production, methyl red test, Vogues Proskauer test, citrate utilization, catalase activity, oxidase activity, H<sub>2</sub>S production
5. Isolation of bacteriophage from sewerage water using plaque technique
6. Isolation of genomic DNA from bacteria
7. To check the purity of DNA using UV-Vis spectrophotometer
8. Agarose gel electrophoresis
9. Symptoms of viral infection in plants

## **LC-103: Practical Biochemistry (MMB-108)**

Practical Time: 4 Hours/week (Credits-2)

Max. Marks: 50

Pass Marks: 40%

### **INSTRUCTIONS FOR THE PAPER SETTERS /CANDIDATES**

The Final practical paper will consist of three sections A, B and C. Section A will contain write up (13 Marks) from the list of practical pertaining to lab course. Section B will contain practical to perform in examination (25 Marks). Section C will contain practical note Book Evaluation and Viva Voce (12 Marks).

1. Applications of Handerson-Hasselbalch equation for the preparation of buffer solutions
2. Determination of pKa
3. Qualitative and quantitative analysis of reducing and total sugars
4. Determination of acid value of a fat/oil
5. Determination of cholesterol-total, free and esterified
6. Qualitative and quantitative analysis of protein by biochemical techniques
7. To determine vitamin C content in a citrus fruit
8. Estimation of  $\alpha$ - amylase activity
9. To evaluate Km & Vmax of  $\alpha$ - amylase

## **LC-104: Practical exercise of Biotechniques (MMB-109)**

Practical Time: 2 Hours/week (Credits-1)

Max. Marks: 50

Pass Marks: 40%

### **INSTRUCTIONS FOR THE PAPER SETTERS /CANDIDATES**

The Final practical paper will consist of three sections A, B and C. Section A will contain write up (13 Marks) from the list of practical pertaining to lab course. Section B will contain practical to perform in examination (25 Marks). Section C will contain practical note Book Evaluation and Viva Voce (12 Marks).

1. Working of pH meter
2. Working of spectrophotometer
3. Working of centrifuge
4. Chromatographic techniques for the separation product (paper, TLC)
5. Demonstration of HPLC
6. Demonstration of bioreactor (construction, working)
7. Demonstration of GC
8. Demonstration of Gel documentation
9. Demonstration of PCR
10. Gel electrophoresis (Agarose and PAGE)

**M.Sc. (Hons.) (Microbiology) Semester-II**  
**Paper VI-Immunology (MMB-201)**

Lectures to be delivered: 60 (Credits-4)

Max. Marks: 70

Pass Marks: 40%

**Course Objectives:** Course will illustrate the human immune system and its importance in protection from various diseases. Students will learn the various components of immune system like antigens, antibodies, B-cells, T-cells, Compliment system etc. This course will also through light on immunization and vaccines.

**INSTRUCTIONS FOR THE PAPER SETTERS /CANDIDATES**

The question paper will consist of three sections A, B and C. Section-A and B will have four questions from the respective sections of the syllabus and carry 12 marks each. Section - C will consist of 11 short answer type questions which will cover the entire syllabus uniformly and will carry 22 marks in all. Candidates are required to attempt two questions each from sections A and B. Section-C is compulsory.

**Unit-I**

**Introduction of immunology:** History, types of immunity, innate immunity, acquired immunity, active and passive immunity

**Nature and biology of antigens and antigenicity:** haptens, epitopes, adjuvants and super antigens,

**Immunoglobulins:** Types, structure, distribution, function.

**Cellular immunity:** Cells involved in immune system, organs of immune system, lymphocyte, macrophages

**Complement system:** Structure, components and properties, complement pathways and biological consequences of complement activation, Structure and function of major histocompatible complex I and II, transplantation immunity- graft v/s host reaction and rejection

**Humoral immune response:** T-dependent and T-independent immune response, structure of BCR and TCR

**Unit-II**

**Cell mediated immune response:** Introduction to cell mediated immune response, interferons, interleukines and other cytokines. Type I hypersensitivity; Type II, III and IV immune reactions,

**Autoimmunity:** Mechanism, diseases and treatment immunomodulation, immunosuppression and immunopotentialiation

**Immunization and vaccines:** Active and passive immunization: traditional and modern vaccines

**Evaluation of New vaccines:** Phase I, II, III and IV trials

**Immune response assays:** Methods to assay humoral immune response (agglutination, immunodiffusion, immunoelectrophoresis, RIA, fluorescent assays, ELISA, methods for isolation of antibodies; methods for enumeration of various types of cells in immune system, immuno blot, Methods of assay of cell mediated immune response and assay of complement



**Recommended Books**

Abbas A.K., Lichtman A.H, Pober J.S, Saunders W.B. (2005) Cellular and Molecular Immunology, Elsevier

Roitt I.M. (2010) Essential Immunology, Blackwell Scientific Publishers

Judith A.O., Jenni P., Sharon A.S., Patricia P.J., Kuby J. (2013) A text book of “Kuby Immunology” 7<sup>th</sup> Ed. New York.

Delves P.J., Martin S.J., Burton D.R., Roitt I.M (2017) Essential Immunology, 13<sup>th</sup> Ed., Wiley blackwell scientific publication

**M.Sc. (Hons.) (Microbiology) Semester-II**  
**Paper-VII Food and Industrial Microbiology (MMB-202)**

Lectures to be delivered: 60 (Credits-4)

Max. Marks: 70

Pass Marks: 40%

**Course Objectives:** Course will help in better understanding of the importance of microbes in food, and their applications in food industries. Students will learn the production techniques of various food products like milk and milk products, fermented cereals and grains, alcohols etc.

**INSTRUCTIONS FOR THE PAPER SETTERS /CANDIDATES**

The question paper will consist of three sections A, B and C. Section-A and B will have four questions from the respective sections of the syllabus and carry 12 marks each. Section - C will consist of 11 short answer type questions which will cover the entire syllabus uniformly and will carry 22 marks in all. Candidates are required to attempt two questions each from sections A and B. Section-C is compulsory.

**Unit-I**

**Introduction to food microbiology:** Food as substrate for microorganisms, microorganisms in food (moulds, yeast and bacteria) and their importance, principles of food preservation, detection of spoilage and characterization, aseptic control of microorganisms (physical methods, TDT curves, chemical preservatives and modified environments), factors influencing microbial growth in food- extrinsic and intrinsic factors

**Food contamination and spoilage:** Cereals, vegetables, fruits, milk and milk products, fish and sea foods, poultry, sugar products, spoilage of canned food

**Food borne infection and intoxications:** Infection and intoxication caused by: *Clostridium*, *Staphylococcus*, *Salmonella*, *Shigella* and *Vibrio*

**Food fermentations I: Raw materials and fermentative process for production** of fermented plant foods (Bread, soyabean), fermented vegetables (sauerkraut) Oriental fermented foods: soya sauce, meso, tempeh, idli and dosa

**Food fermentations II:** Fermented meat products, Fermented milk and milk products (kefir, kumis, yogurt, Bulgarian milk, acidophilus milk and cheese)

**Food testing and quality control:** Collection and handling of food samples, food plant sanitation, overview of HACCP, CODEX and FSSAI

**Unit-II**

**Introduction to industrial microbiology:** Importance of industrial microbiology, industrially important microorganisms, selection of raw materials and medium formulation

**Process technology:** fermentation system: upstream and downstream processing

**Important industrial products:** Non- distilled (beer and wine) and distilled alcoholic beverages (Whisky, rum, brandy), bio-ethanol, organic acids (vinegar and citric acid), lactam antibiotics (Pencillin and streptomycin)

**Industrial enzymes and amino acids:** Production and applications of: industrial enzymes (amylases, proteases); amino acid (glutamic acid and lysine)

**Industrial waste treatment:** types of industrial waste (solid and liquid) and their disposal methods

**Book Recommended:**

Adams M.R. and Moss M.O. (2008) Food Microbiology, 3<sup>rd</sup> Ed., RSC Publishers, UK

Frazier W.C. and Westhoff D.C. (2003) Food Microbiology, 18<sup>th</sup> Ed., Tata McGraw-Hill Publishers, New York

James M.J.(2013) Modern Food Microbiology, 6<sup>th</sup> Ed., Aspan Publication, Gaithersburg, Maryland

Prave, P. (2011) Fundamental of Biotechnology, VCH Publishers, New York

Stanbury P.F, Whitaker A. and Hall S.J. (2003) Principles of Fermentation Technology, 2<sup>nd</sup> Ed., Pergamon Press, Oxford, UK

**M.Sc. (Hons.) (Microbiology) Semester-II**  
**Paper-VIII Mycology & Phycology (MMB-203)**

Lectures to be delivered: 45 (Credits-3)

Max. Marks: 70

Pass Marks: 40%

**Course Objectives:** Students will study the features, characteristics and modes of nutrition and reproduction in fungi and algae their classification and life cycles, along with economic importance of fungi and algae.

**INSTRUCTIONS FOR THE PAPER SETTERS /CANDIDATES**

The question paper will consist of three sections A, B and C. Section-A and B will have four questions from the respective sections of the syllabus and carry 12 marks each. Section - C will consist of 11 short answer type questions which will cover the entire syllabus uniformly and will carry 22 marks in all. Candidates are required to attempt two questions each from sections A and B Section-C is compulsory.

**Unit-I**

**Introduction to mycology:** History, Different groups of fungi and their characteristics, diversity of fungi and fungus-like organisms, dimorphic fungi, fungal structure and ultra-structure, differentiation and development, types of reproduction. **Fungal physiology:** Growth parameters, Environmental conditions for growth, fungal nutrition and tolerance of extreme environments, fungal spores, spore dormancy, and spore dispersal, principles and practice of controlling fungal growth

**Economic importance of fungi:** role of fungi in biodegradation, bio-deterioration, enzyme production, biological control, myco-herbicides, mycorrhizal association, application of gene cloning in fungal biotechnology. **Value Added Products (VAP):** Primary and secondary metabolites, production of Value Added Products (VAP), role of fungi in nutraceuticals and pharmaceuticals

**Mushroom Biotechnology:** Edible mushrooms, production of button mushroom, oyster mushroom, paddy straw mushrooms.

**Unit-II**

**Introduction to algae:** Different groups of algae and their characteristics, Cellular organization of eukaryotic micro-algae and prokaryotic algae (cyanobacteria), planktonic and benthic algae, microscopic appearance. **Algal physiology:** Types of reproduction, growth parameters, Environmental conditions for growth, and tolerance of extreme environments, Principles and practice of controlling algal blooms

**Environmental applications:** Role of algae in fresh water and marine ecosystem, algae association with flora and fauna, algal bio-films, algae as bio-indicators **Agricultural applications:** Algae as primary producers and bio-fertilizers, reclamation of saline and sodic soils, algae as food (SCP), uses of algae in fisheries. **Industrial applications:** Industrial exploitation of algae, use of algae for production of agar-agar, alginate, diatomite, iodine, role of algae in cosmo-ceutics

**Books Recommended:**

Bellinger E. and Sigeo D. (2010) Freshwater Algae- Identification & use as bio-indicators, 1<sup>st</sup> Ed., Wiley Blackwell.

Deacon J.W. (2005) Fungal Biology, 3<sup>rd</sup> Ed., Blackwell publications

Kavangh K. (2011) Fungi Biology and applications, 2<sup>nd</sup> Ed., John Wiley and Sons

Mahendra R. and Bridge P.D. (2009) Applied Mycology, 14<sup>th</sup> Ed., CAB International

Webster J. and Weber R. (2007) Introduction to fungi, 3<sup>rd</sup> Ed., Cambridge University Press

**M.Sc. (Hons.) (Microbiology) Semester-II**  
**Paper IXa- Computer & Bioinformatics (MMB-204)**

Lectures to be delivered: 45 (Credits-3)

M. Marks: 70

Pass Marks: 40%

**Course objectives:** Students will study the basic structure and working of computer and its application in the field of biological sciences as Bioinformatics. Students will learn to access the various data bases for retrieving the sequential information regarding nucleotides and proteins. They will be able to use the various tool for constructing the phylogenetic tree and its evaluation.

**INSTRUCTIONS FOR THE PAPER SETTERS /CANDIDATES**

The question paper will consist of three sections A, B and C. Section-A and B will have four questions from the respective sections of the syllabus and carry 12 marks each. Section - C will consist of 11 short answer type questions which will cover the entire syllabus uniformly and will carry 22 marks in all. Candidates are required to attempt two questions each from sections A and B. Section-C is compulsory.

**Unit-I**

**Fundamentals of Computing:** Computer organization (Input and output devices, storage and memory devices), operating systems (WINDOWS), Softwares: MS word, Power point.

**Bioinformatics:** Introduction, goals and applications of bioinformatics

**Biological Databases:** Characteristics and classification of databases- Primary (INSDC, PIR), secondary (PROSITE, PATTERN), composite (UNIPROT, OWL) and specialized databases (REBASE, HGP database)

**File Formats:** FASTA, ASN.1, GenBank, EMBL, Clustal W, PHYLIP

**Unit-II**

**Sequence Analysis:** Introduction, methods of sequence analysis, local and global alignment; Dot plot and dynamic programming

**Heuristic methods:** Algorithm and versions of FASTA and BLAST. Scoring matrices: PAM and BLOSUM, gap penalties and statistical significance

**Multiple sequence alignment:** Methods and application of multiple sequence alignment (Clustal)

**Phylogenetic tree:** branches, nodes, clade, taxa, rooted and un-rooted tree, phylogram, cladogram, dendrogram

**Phylogenetic tree construction and evaluation:** Distance and character based methods, bootstrapping (parametric and non-parametric), Jack knifing

**Recommended Books**

Xiong J. (2006) Essential Bioinformatics, 1<sup>st</sup> Ed., Cambridge University Press, Cambridge, UK

Mount D.W. (2004) Bioinformatics: Sequence and Genome Analysis, 2<sup>nd</sup> Ed., Cold Spring Harbor Laboratory Press, New York

Rastogi R.C. (2009) Bioinformatics: Concepts, Skills and applications, 2<sup>nd</sup> Ed., CBS Publishers and distributors Pvt. Ltd, New Delhi

Sinha P.K. and Sinha P. (2000) Computer fundamentals, 6<sup>th</sup> Ed., BPB publications, New Delhi

**M.Sc. (Hons.) (Microbiology) Semester-II**  
**Paper IXb: Cell Biology (MMB-204)**

Lectures to be delivered: 45 (Credits-3)

M. Marks: 70

Pass Marks: 40%

**Course objectives:** Students will understand the structure and components of the prokaryotic and eukaryotic cells. The course will illustrate the detailed description of cell components like nucleus, mitochondria, chloroplast, paroxysms, cell wall etc. along with their importance.

**INSTRUCTIONS FOR THE PAPER SETTERS /CANDIDATES**

The question paper will consist of three sections A, B and C. Section-A and B will have four questions from the respective sections of the syllabus and carry 12 marks each. Section - C will consist of 11 short answer type questions which will cover the entire syllabus uniformly and will carry 22 marks in all. Candidates are required to attempt two questions each from sections A and B. Section-C is compulsory.

**Unit-I**

**Cells:** Prokaryotic and eukaryotic cells, cell size and shape.

**Composition of Cells:** Molecules of cell, cell membranes and cell Proteins

**The Nucleus:** Nuclear Envelope- structure of nuclear pore complex, nuclear lamina, Transport across Nuclear Envelope, Chromatin

**Protein Sorting and Transport:** The Endoplasmic reticulum, The Golgi Apparatus, Mechanism of Vesicular Transport, Lysosomes

**Mitochondria, Chloroplasts and Peroxisomes:** Structural organization, Function, Mitochondrial biogenesis, Protein import in mitochondria, Semiautonomous nature of mitochondria and chloroplast, chloroplast DNA

**Unit-II**

**The Plasma Membrane:** Structure; Transport of small molecules, Endocytosis

**Cell Wall, the Extracellular Matrix and Cell Interactions:** Bacterial and Eukaryotic Cell Wall; the extracellular matrix and cell matrix interactions; cell-cell interactions.

**Cell Signalling:** Signalling molecules and their receptor; functions of cell surface receptors; Intracellular signal transduction pathway; signalling networks.

**The Cell Cycle:** Eukaryotic Cell Cycle, Regulation of Cell cycle progression, Events of Mitotic Phase, Meiosis and Fertilization. **Cell Death:** Programmed Cell Death

**Books Recommended:**

Karp G. (2010) Cell and Molecular Biology: Concepts and Experiments, 6<sup>th</sup> Ed., John Wiley & Sons

De Robertis E.D.P. and De Robertis E.M.F. (2006) Cell and Molecular Biology, 8<sup>th</sup> Ed., Lippincott Williams and Wilkins, Philadelphia

Cooper G.M. and Hausman R.E. (2009) The Cell: A Molecular Approach. 5<sup>th</sup> Ed., ASM Press & Sunderland, Washington, DC

Becker W.M., Kleinsmith L.J., Hardin J. and Bertoni G.P. (2009) The World of the Cell, 7th Ed., Pearson Benjamin Cummings Publishing, San Francisco

**M.Sc. (Hons.) (Microbiology) Semester-II**  
**Paper Xa: Microbial Biotechnology (MMB-205)**

Lectures to be delivered: 45 (Credits-3)

M. Marks: 70

Pass Marks: 40%

**INSTRUCTIONS FOR THE PAPER SETTERS /CANDIDATES**

The question paper will consist of three sections A, B and C. Section-A and B will have four questions from the respective sections of the syllabus and carry 12 marks each. Section - C will consist of 11 short answer type questions which will cover the entire syllabus uniformly and will carry 22 marks in all. Candidates are required to attempt two questions each from sections A and B. Section-C is compulsory.

**Unit 1**

**Microbial Biotechnology and its Applications**

Microbial biotechnology: Scope and its applications in human therapeutics, agriculture (Biofertilizers, PGPR, Mycorrhizae), environmental, and food technology. Genetically engineered microbes for industrial application: Bacteria and yeast

**Therapeutic and Industrial Biotechnology**

Recombinant microbial production processes in pharmaceutical industries - Streptokinase, recombinant vaccines (Hepatitis B vaccine). Microbial polysaccharides and polyesters, Microbial production of bio-pesticides

**Applications of Microbes in Biotransformations**

Microbial based transformation of steroids and sterols. Bio-catalytic processes and their industrial applications

**Unit-II**

**Microbial Products and their Recovery:** Microbial product purification: filtration, ion exchange & affinity chromatography techniques

**Immobilization of enzymes:** Methods of enzyme immobilization (ionic bonding, adsorption, covalent bonding, microencapsulation and gel entrapment). Comparison of free and immobilized enzyme systems, Co-immobilization, Immobilized enzymes for production of High fructose corn syrup (HFCS) and 6-APA (Amino penicillic acid)

**Microbes for Bio-energy and Environment:** Bioethanol and bio-diesel production: commercial production from lignocellulosic waste and algal biomass, Biogas production. Microorganisms in bioremediation: Degradation of xenobiotics, mineral recovery, removal of heavy metals from aqueous effluents.

**RNAi:** RNAi and its applications in silencing genes.

**Drug resistance** and therapeutics.

**Books Recommended:**

Ratledge C. and Kristiansen B. (2001) Basic Biotechnology, 2nd Ed., Cambridge University Press

Demain A.L. and Davies J.E. (1999) Manual of Industrial Microbiology and Biotechnology, 2<sup>nd</sup> Edition, ASM Press

Swartz J.R. (2001) Advances in *Escherichia coli* production of therapeutic proteins. Current Opinion in Biotechnology, 12, 195–201.

Gupta P.K. (2009) Elements of Biotechnology, 2<sup>nd</sup> Ed., Rastogi Publications

Glick B.R. Pasternak J.J. and Patten C.L. (2010) Molecular Biotechnology, 4th Ed., ASM Press

**M.Sc. (Hons.) (Microbiology) Semester-II**  
**Paper Xb – Plant Tissue Culture (MMB-205)**

Lectures to be delivered: 45 (Credits-3)

M. Marks: 70

Pass Marks: 40%

**Course Objectives:** Students will understand various methods of plant tissue culturing such as cell culturing, tissue culturing, callus culturing, meristem culture, protoplast isolation etc. Also, course will through light on techniques for genetic transformation using *Agrobacterium*.

**INSTRUCTIONS FOR THE PAPER SETTERS /CANDIDATES**

The question paper will consist of three sections A, B and C. Section-A and B will have four questions from the respective sections of the syllabus and carry 12 marks each. Section - C will consist of 11 short answer type questions which will cover the entire syllabus uniformly and will carry 22 marks in all. Candidates are required to attempt two questions each from sections A and B. Section-C is compulsory.

**Unit 1**

Plant tissue culture: History, concepts of cell differentiation and totipotency, various aspects of plant tissue culture; pathways for in vitro regeneration: organogenesis, somatic and gametic embryogenesis; protoplast isolation, culture and regeneration; somatic hybridization; Applications: micropropagation, meristem culture, embryo rescue, synseed production, somaclonal and androclonal variations, cryopreservation and germplasm storage.

**Unit-II**

Principles, methods and applications of genetic transformation: *Agrobacterium* biology and biotechnology; Plant- *Agrobacterium* interactions; direct gene transfer methods: particle bombardment, electroporation, PEG-mediated and floral-dip; marker and reporter genes; marker-free transgenic; environmental, social and legal issues.

**Books Recommended**

Adrian S., Nigel W.S., Mark R.F. (2008) Plant Biotechnology: The genetic manipulation of Plants, 2<sup>nd</sup> Ed., Oxford University Press

Buchanan B., Gruissem G. and Jones R. (2000) Biochemistry and Molecular Biology of Plants, 2<sup>nd</sup> Ed., American Society of Plant Physiologists, USA

Butenko R.G. (2000) Plant Cell Culture, 2<sup>nd</sup> Ed., University Press of Pacific

Davies P.J. (2004) Plant Hormones, 3<sup>rd</sup> Ed., Kluwer Academic Publishers, Netherlands

Halford N (2006) Plant Biotechnology- Current and future applications of genetically modified crops, John Wiley and Sons, England



## **LC-201 Practical Immunology (MMB-206)**

Practical Time: 2 Hours/week (Credits-1)

Max. Marks: 50

Pass Marks: 40%

### **INSTRUCTIONS FOR THE PAPER SETTERS /CANDIDATES**

The Final practical paper will consist of three sections A, B and C. Section A will contain write up (13 Marks) from the list of practical pertaining to lab course. Section B will contain practical to perform in examination (25 Marks). Section C will contain practical note Book Evaluation and Viva Voce (12 Marks).

1. Determination of TLC and DLC
2. Demonstration of Widal Test
3. To perform Blood Grouping
4. Purification of IgG from serum by column chromatography
5. Determination of antigen and antibody reaction by rocket immuno-electrophoresis
6. Radial immuno-diffusion test
7. Determination of titre of serum by indirect haemagglutination cell mediated immunity by leucocyte migration inhibition test and antibodies by ELISA method

## LC-202 Practical Industrial Food Microbiology (MMB-207)

Practical Time: 4 Hours/week (Credits-2)

Max. Marks: 50  
Pass Marks: 40%

### INSTRUCTIONS FOR THE PAPER SETTERS /CANDIDATES

The Final practical paper will consist of three sections A, B and C. Section A will contain write up (13 Marks) from the list of practical pertaining to lab course. Section B will contain practical to perform in examination (25 Marks). Section C will contain practical note Book Evaluation and Viva Voce (12 Marks).

1. To study the impact of physical and chemical preservatives on shelf life of given food sample
2. Microbiological analysis of fresh food samples
3. To perform standard plate count for food sample and characterization of microorganisms
4. Isolation and characterization of milk microflora associated with raw and processed milk.
5. Isolation of *Salmonella* from given food samples
6. Study the microbial succession in sauerkraut production
7. To check the quality of milk sample using MBRT test.
8. Determination of TDT for given microorganism.
9. Determination of Iodine number of given fat sample
10. To determine fat, SNF, TSS of given milk sample
11. To determine acidity of food sample
12. Estimation of alcohol content produced during wine production

## **LC-203 Lab-practices in Mycology & Phycology (MMB-208)**

Practical Time: 4 Hours/week (Credits-2)

Max. Marks: 50  
Pass Marks: 40%

### **INSTRUCTIONS FOR THE PAPER SETTERS /CANDIDATES**

The Final practical paper will consist of three sections A, B and C. Section A will contain write up (13 Marks) from the list of practical pertaining to lab course. Section B will contain practical to perform in examination (25 Marks). Section C will contain practical note Book Evaluation and Viva Voce (12 Marks).

1. Preparation of selective media for fungi and algae
2. Isolation of algae and fungi from soil and water
3. Morphological and microscopic characterization of fungi and algae
4. Growth profile of fungi and algae
5. Quantification of total chlorophyll from algae
6. Quantification of total carotenoids from algae
7. Quantification of total phycobilliproteins from algae
8. Demomstration of mushroom cultivation
9. Production of a biofertilizers.

## **LC-204a Practical use of Computer in Bioinformatics (209)**

Practical Time: 2 Hours/week (Credits-1)

Max. Marks: 50

Pass Marks: 40%

### **INSTRUCTIONS FOR THE PAPER SETTERS /CANDIDATES**

The Final practical paper will consist of three sections A, B and C. Section A will contain write up (13 Marks) from the list of practical pertaining to lab course. Section B will contain practical to perform in examination (25 Marks). Section C will contain practical note Book Evaluation and Viva Voce (12 Marks).

1. Accession of molecular databases. ENTREZ
2. Flat file format of GENBANK and EMBL
3. Describe databases that can be used to access text information about human diseases
4. Perform pair-wise alignments of the proteins using PAM 30, PAM 70 and PAM 250 matrices
5. Use of windows for bioinformatic softwares
6. Compare sequence and taxonomy information from BLAST, PSI-BLAST, PHI-BLAST
7. Prediction of Secondary structure of protein
8. Perform Molecular modeling of given protein structure (3D) database using various softwares

## **LC-204b Practical Cell Biology (MMB-209)**

Practical Time: 2 Hours/week (Credits-1)

Max. Marks: 50

Pass Marks: 40%

### **INSTRUCTIONS FOR THE PAPER SETTERS /CANDIDATES**

The Final practical paper will consist of three sections A, B and C. Section A will contain write up (13 Marks) from the list of practical pertaining to lab course. Section B will contain practical to perform in examination (25 Marks). Section C will contain practical note Book Evaluation and Viva Voce (12 Marks).

1. To study the stained plant cell (onion cells) and its organelles under microscope.
2. To study the stained animal cell (cheek cells) and its organelles under the microscope.
3. To demonstrate the presence of mitochondria in striated muscle cells/ cheek epithelial cell using vital stain Janus Green B.
4. Isolation of chloroplast
5. Study of polyploidy in Onion root tip by colchicine treatment.
6. Preparations of temporary mount of onion root tips and study the different stages of mitosis.
7. Study of mitosis and meiosis from permanent slides

## **LC-205a Practical use of Microbes in Biotechnology (MMB-210)**

Practical Time: 2 Hours/week (Credits-1)

Max. Marks: 50

Pass Marks: 40%

### **INSTRUCTIONS FOR THE PAPER SETTERS /CANDIDATES**

The Final practical paper will consist of three sections A, B and C. Section A will contain write up (13 Marks) from the list of practical pertaining to lab course. Section B will contain practical to perform in examination (25 Marks). Section C will contain practical note Book Evaluation and Viva Voce (12 Marks)

1. Whole cell immobilization in calcium alginate gels.
2. Enzyme immobilization by calcium alginate method.
3. Pigment production from fungi (*Monascus*)
4. Isolation of lipase producing bacteria
5. Production of algal single cell proteins.
6. Qualitative and quantitative estimation of amylase
7. Physical, chemical and enzymatic hydrolysis of Lignocellulosic residue

## LC-205b Practical Plant Tissue Culture (MMB-210)

Practical Time: 2 Hours/week (Credits-1)

Max. Marks: 50

Pass Marks: 40%

### INSTRUCTIONS FOR THE PAPER SETTERS /CANDIDATES

The Final practical paper will consist of three sections A, B and C. Section A will contain write up (13 Marks) from the list of practical pertaining to lab course. Section B will contain practical to perform in examination (25 Marks). Section C will contain practical note Book Evaluation and Viva Voce (12 Marks).

1. Preparation of different types of standard tissue culture media
2. Preparation of synthetic seeds from different parts of plants using sodium alginate solution
3. Establishment of aseptic culture mediums following appropriate sterilization procedures
4. To perform Callus culture, shoot tip/meristem culture
5. Demonstration of protoplast isolation
6. Preparation of competent cells and *Agrobacterium* transformation by electroporation
7. To study the *Agrobacterium tumefaciens*-mediated transformation in plants
8. Analysis of crude extracts from medicinal plants using HPLC

## M.Sc. (Hons.) Microbiology Second Year

### Subjects and Marks Distribution

#### Semester III

Paper code	Paper No.	Name of paper	Period/Week	Internal Marks*	External Marks	Total Marks	Credits
MMB-301 (C-9)	Paper XI	Microbial Genetics & Genetic Engineering	4	70	30	100	4
MMB-302 (C-10)	Paper XII	Medical Microbiology	3	70	30	100	3
MMB-303 (C-11)	Paper XIII	Biostatistics	3	70	30	100	3
MMB-304 (AEEC-1)	Paper XIV-a	Microbial Quality Control In Food and Pharmaceutical	2	70	30	100	2
	Paper XIV-b	Diagnostic Microbiology	2	70	30	100	
MMB-305 (AEEC-2)	Paper XV-a	Biofertilizers and Biopesticides	2	70	30	100	2
	Paper XV-b	Food Fermentation Techniques	2	70	30	100	
MMB-306	LC-10	Practical Genetics	4			50	2
MMB-307	LC-11	Medical and Diagnostic Laboratory	4			50	2
MMB-308		Summer Training & seminar				50	2
MMB-409		Research project (Experimental work)				100	7
		Total					27

\*Internal assessment (30): Seminar (5 Marks) MST (15 Marks), Assignment (5), Attendance/report for the seminar/symposium/industrial/Educational visit (5 marks)



## M.Sc. (Hons.) Microbiology Second Year

### Subjects and Marks Distribution

#### Semester – IV

Paper code	Paper No.	Name of paper	Period/ week	Internal Marks*	External Marks	Total Marks	Credits
MMB-401 (C-12)	Paper XVI	Environmental Microbiology	4	70	30	100	4
MMB-402 (C-13)	Paper XVII	Soil & Agriculture Microbiology	3	70	30	100	3
MMB-403 (AECC)	Paper XIII	TQM & IPR	3	70	30	100	3
MMB-404 (DSE-3)	Paper XIX-a	Fermentation Technology	3	70	30	100	3
	Paper XIX-b	Recombinant DNA Technology	3	70	30	100	
MMB-405 (AECC-3)	Paper XX-a	Microbial Analysis of Air and Water	2	70	30	100	2
	Paper XX-b	Management of Human Microbial Diseases	2	70	30	100	
MMB-406	LC-12	Practical approaches in Environmental Microbiology	4			50	2
MMB-407	LC-13	Practical Microbiology in Soil and Agriculture	4			50	2
MMB-408	LC-14a	Practical Fermentation Technology	2			50	1
	LC-14b	Practical Recombinant DNA Technology	2			50	
MMB-409		Research project & seminar (Experimental work & Thesis writing)				100	8
		Total					28

\*Internal assessment (30): Seminar (5 Marks) MST (15 Marks), Assignment (5), Attendance/report for the seminar/symposium/industrial/Educational visit (5 marks).

**C-Core course, DSE-Discipline Specific Elective Course, AECC- Ability Enhancement Elective Course, AECC- Ability Enhancement Compulsory course**

#### Assessment Parameters

5. Quality of thesis
6. Quantitative data analysis
7. Significance of work
8. Presentation and defense

#### Weightage (%)

- 40
- 20
- 20
- 20

**M.Sc. (Hons.) Microbiology, Semester-III**  
**Paper XI-Microbial Genetics and Genetic Engineering (MMB-301)**

Lectures to be delivered: 60 (Credits-4)

Max. Marks: 70

Pass Marks: 35%

**Course Objectives:** Course will illustrate structure, properties, functions and biosynthesis of nucleic acids and helps to understand the central dogma of life. Course will also through light on principle and types and gene cloning along with the metagenomic approach of genetic engineering.

**INSTRUCTIONS FOR THE PAPER SETTERS/CANDIDATES**

The question paper will consist of three sections A, B and C. Section-A and B will have four questions from the respective sections of the syllabus and carry 12 marks each. Section- C will consist of 11 short answer type questions which will cover the entire syllabus uniformly and will carry 22 marks in all. Candidates are required to attempt two questions each from sections A and B. Section-C is compulsory.

**Unit-I**

**Structures of DNA and RNA/Genetic Material:** DNA structure, Salient features of double helix, types of DNA, denaturation and renaturation, topoisomerases; Organization of DNA, Prokaryotes, Viruses, Eukaryotes. RNA Structure, Types of RNA

**Replication of DNA:** Bidirectional and unidirectional replication, semi-conservative, Mechanism of DNA replication: Enzymes and proteins involved in DNA replication –DNA polymerases, DNA ligase, primase, telomerase – for replication of linear ends

**Transcription:** Definition of Transcription, promoter concept. Transcriptional machinery and mechanism of transcription

**Translation:** Definition, Genetic code, Translational machinery, role of tRNA, aminoacyl tRNA synthetases, Mechanisms of initiation, elongation and termination of polypeptides

**Recombination:** Mechanism and Proteins involved in recombination.

**Unit-II**

**Regulation of gene Expression:** Principles of transcriptional regulation, regulation at initiation with examples from lac and trp operons

**Mutations:** Mutations and mutagenesis: Definition and types of Mutations: Physical and chemical mutagens, Uses of mutations, DNA repair mechanisms.

**Mechanisms of Genetic Exchange:** Transformation- Discovery, mechanism of natural competence. Conjugation- Discovery, mechanism, Hfr and F' strains, Transduction- Generalized transduction, specialized transduction.

**Plasmids and Transposable Elements:** Property and function of plasmids, Types of plasmids, Prokaryotic transposable elements – Insertion Sequences, composite and non-composite transposons, Replicative and Non replicative transposition, Uses of transposons and transposition.

**Books Recommended**

Watson JD, Baker TA, Bell SP, Gann A, Levine M and Losick R (2008) Molecular Biology of the Gene, 6th edition, Cold Spring Harbour Lab. Press, Pearson Publication

Becker WM, Kleinsmith LJ, Hardin J and Bertoni GP (2009) The World of the Cell, 7th edition, Pearson Benjamin Cummings Publishing, San Francisco

Krebs J, Goldstein E, Kilpatrick S. (2013). Lewin's Essential Genes, 3rd Ed., Jones and Bartlett Learning

Russell PJ. (2009). Genetics- A Molecular Approach. 3rd Ed, Benjamin Cummings

**M.Sc. (Hons.) Microbiology, Semester-III**  
**Paper XII-Medical Microbiology (MMB-302)**

Lectures to be delivered: 45 (Credits-3)

Max. Marks: 70

Pass Marks: 35%

**Course Objectives:** Students will understand the various interactions between opportunistic and pathogenic microorganisms and their susceptible hosts in contacts that results in infection and/or disease and are able to observe the disease symptoms. Also, they will be aware of therapeutics used for different diseases along with their antimicrobial testing.

**INSTRUCTIONS FOR THE PAPER SETTERS/CANDIDATES**

The question paper will consist of three sections A, B and C. Section-A and B will have four questions from the respective sections of the syllabus and carry 12 marks each. Section - C will consist of 11 short answer type questions which will cover the entire syllabus uniformly and will carry 22 marks in all. Candidates are required to attempt two questions each from sections A and B. Section-C is compulsory.

**Unit-I**

**Introduction to Medical microbiology:** History and scope of medical microbiology, germ theory of disease, Koch's postulates

**Normal microbial flora:** Normal microbial residents of human body, characteristics of normal flora, distribution and occurrence of normal flora: skin, respiratory tract, gastrointestinal tract, urinary tract

**Host pathogen interaction:** Definitions-infection, invasion, pathogen, pathogenicity, virulence, toxigenicity, carriers and their types, Opportunistic infections, Nosocomial infections. Transmission of infection, portal of entry and exit of different pathogens, Sign and Symptoms

**Epidemiology:** types of diseases (epidemic, endemic and pandemic), sources of disease, reservoirs and carriers, transmission of pathogens, sign, symptoms and syndromes, route of infection, types of infectious diseases, primary and secondary infections

**Pathogenic bacteria:** Brief account of diseases associated with *Streptococcus*, *Staphylococcus*, *Mycobacteria*, *Salmonella*, and *Pseudomonas*

**Unit-II**

**Medical Mycology:** Superficial mycoses, systemic mycoses, fungal infections of skin, nail and hairs (Candidiosis and Aspergillosis), opportunistic fungal infections, antifungal drugs

**RNA Viruses:** Life cycles, pathogenicity, diagnosis, prevention and treatment of RNA Viruses: Orthomyxo viruses, Paramyxoviruses, HIV

**DNA Viruses:** Life cycles, pathogenicity, diagnosis, prevention and treatment of DNA Viruses: herpes viruses, hepatitis viruses, adenoviruses

**Vaccines and Vaccination:** Vaccines – definition, types, Antigens used as Vaccines, effectiveness of vaccines, Vaccine safety, current vaccines, adjuvants, active immunization and passive immunization.

**Antimicrobial Chemotherapy:** Development of chemotherapy; General characteristics of drugs and their testing; Mechanism of action. Antibacterial drugs; antifungal drugs, antiviral, MIC, antibiotic resistance; mechanism of antibiotic resistance

**Books Recommended:**

Goura Kudesia (2009) Clinical and Diagnostic Virology. Cambridge University Press. UK.

Richard A. McPherson and Matthew R. Pincus (2011). Henry's clinical diagnosis and management by laboratory methods. (22nd Ed) Philadelphia, PA : Elsevier/Saunders,

Alberto M. Marchevsky and Mark Wick. (2011). Evidence Based Pathology and Laboratory Medicine. Springer publication.

David E. Bruns; Edward R. Ashwood; Carl A. Burtis; Barbara G. Sawyer (2007). Fundamentals of Molecular Diagnostics St. Louis, Mo. Saunders Elsevier

**M.Sc. (Microbiology) Semester-III**  
**Paper XIII-Biostatistics (MMB-303)**

Lectures to be delivered: 45 (Credits-3)

M. Marks: 70

Pass Marks: 35%

**Course objectives:** Course will help in better understanding of basic statistical methods and application of various statistical tools in establishing relationships leading to justification of the numerical data etc.

**INSTRUCTIONS FOR THE PAPER SETTERS /CANDIDATES**

The question paper will consist of three sections A, B and C. Section-A and B will have four questions from the respective sections of the syllabus and carry 12 marks each. Section - C will consist of 11 short answer type questions which will cover the entire syllabus uniformly and will carry 22 marks in all. Candidates are required to attempt two questions each from sections A and B. Section-C is compulsory

**Unit-I**

**Introduction to biostatistics:** Basic definitions and applications, sampling (representative sample, sample size, sampling bias), sampling techniques

**Data collection and presentation:** Types of data, collection of primary and secondary data

**Methods of data presentation:** histogram, polygon and pie diagram

**Measures of central tendency:** Mean, median, mode

**Measures of variability:** Standard deviation, standard error, range, mean deviation and coefficient of variation

**Correlation and regression:** Positive and negative correlation, Karl- Pearsons co-efficient of correlation, Linear regression and regression equation and multiple linear regressions

**Unit-II**

**Tests of significance:** Small sample test (Chi-square test, t- test, F- test), large sample test (Z test)

**Introduction to probability theory and distributions:** concept of theory and distribution without derivation, binomial, Poisson and normal (only definitions and problems)

**Analysis of variance-I:** Analysis of variance with linear models

**Analysis of variance-II:** Analysis of variance for one-way classified data, analysis of variance for two-way classified data with one observation for cell

**Analysis of variance-III:** Analysis of variance for two-way classified data with multiple but equal number of observations per cell (data analysis only)

**Books Recommended:**

Bailey N T J. Statistical Methods in Biology, English University Press, London.

Banerjee PK. Introduction to biostatistics, S. Chand Publishers, New Delhi.

Bliss, C I.K. Statistics in biology, Mac-Graw Hill Publishers, New York.

Singh S, Bansal ML, Singh TP and Kumar R. Statistical Methods for Research Workers, Kalyani Publishers, New Delhi.

## M.Sc. (Microbiology) Semester-III

### (Paper XIV-a)-Microbial Quality Control in Food and pharmaceuticals (MMB-304)

Lectures to be delivered: 30 (Credits-2)

M. Marks: 70

Pass Marks: 35%

**Course objectives:** Students will learn good laboratory practices and determination of microbes in food/pharmaceutical samples. Also, students will become skilled at identifying pathogenic microbes of food and water.

#### INSTRUCTIONS FOR THE PAPER SETTERS /CANDIDATES

The question paper will consist of three sections A, B and C. Section-A and B will have four questions from the respective sections of the syllabus and carry 12 marks each. Section - C will consist of 11 short answer type questions which will cover the entire syllabus uniformly and will carry 22 marks in all. Candidates are required to attempt two questions each from sections A and B. Section-C is compulsory

#### Unit-I

**Microbiological Laboratory and Safe Practices:** Good laboratory practices, Good microbiological practices. Biosafety cabinets –Working of biosafety cabinets, using protective clothing, specification for BSL-1, BSL-2, BSL-3. Discarding biohazardous waste – Methodology of Disinfection, Autoclaving & Incineration

Microbes in Food/ Pharmaceuticals: Sample collections, Culture and microscopic methods - Standard plate count, Most probable numbers, Direct microscopic counts, Biochemical and immunological methods: Limulus lysate test for endotoxin, gel-diffusion and sterility testing for pharmaceutical products

Hazard analysis of critical control point (HACCP) for pharmaceuticals

#### Unit-II

**Pathogenic Microorganisms of importance in Food & Water:** Detection of specific microorganisms on XLD agar, *Salmonella Shigella* Agar, Manitol salt agar, EMB agar, McConkey Agar, Saboraud Agar

Ascertaining microbial quality of milk by MBRT, Rapid detection methods of microbiological quality of milk at milk collection centres

**Hazard analysis of critical control point (HACCP):** HACCP for Food Safety and Microbial Standards – Principles and limitations

Microbial Standards for Different Foods and Water – BIS standards for common foods and drinking water.

#### Books Recommended:

Harrigan WF (1998) Laboratory Methods in Food Microbiology, 3rd ed. Academic Press.

Garg N, Garg KL and Mukerji KG (2010) Laboratory Manual of Food Microbiology I K International Publishing House Pvt. Ltd.

Jay JM, Loessner MJ, Golden DA (2005) Modern Food Microbiology, 7th edition. Springer

Baird RM, Hodges NA and Denyer SP (2005) Handbook of Microbiological Quality control in Pharmaceutical and Medical Devices, Taylor and Francis Inc.

**M.Sc. (Microbiology) Semester-III**  
**(Paper XIV-b)- Diagnostic Microbiology (MMB-304)**

Lectures to be delivered: 30 (Credits-2)

M. Marks: 70

Pass Marks: 35%

**Course objectives:** Students will learn different methods of microbial and molecular diagnosis of different pathogens. They will also learn antimicrobial sensitivity assay resulting in determination of resistant and sensitive strains of microbes along with MICs of various antibiotics.

**INSTRUCTIONS FOR THE PAPER SETTERS /CANDIDATES**

The question paper will consist of three sections A, B and C. Section-A and B will have four questions from the respective sections of the syllabus and carry 12 marks each. Section - C will consist of 11 short answer type questions which will cover the entire syllabus uniformly and will carry 22 marks in all. Candidates are required to attempt two questions each from sections A and B. Section-C is compulsory

**Unit-I**

**Introduction of Diagnostic Microbiology:** diagnosis of bacterial, viral, fungal and protozoan diseases of humans and its importance

**Collection of Clinical Samples:** oral cavity, throat, skin, Blood, CSF, urine and stool samples, methods of transport of clinical samples to laboratory and storage

**Preparation and use of culture media-** blood agar, chocolate agar, Lowenstein-Jensen medium, MacConkey agar, colony characteristics of various bacterial pathogens

**Microscopic methods of diagnosis:** Microscopic examination of isolates: staining- (Gram staining, Ziehl-Neelson staining, Giemsa-staining, Lactophenol cotton blue staining)

**Unit-II**

**Serological and Molecular Diagnosis:** Immunodiffusion, Immunoprecipitation, agglutination, ELISA, immunofluorescence, Nucleic acid based methods-PCR, Nucleic acid probes, Diagnostic Kits for typhoid, HIV, swine flu

**Antibiotic sensitivity test:** Importance, Determination of resistance/sensitivity of bacteria using disc diffusion method, Determination of minimum inhibitory concentration (MIC) of an antibiotic

**Books Recommended:**

Ananthanarayan R and Paniker CKJ (2009) Textbook of Microbiology, 8th edition, Universities Press Private Ltd.

Brooks G.F., Carroll K.C., Butel J.S., Morse S.A. and Mietzner, T.A. (2013) Jawetz, Melnick and Adelberg's Medical Microbiology. 26th edition. McGraw Hill Publication.

Randhawa, VS, Mehta G and Sharma KB (2009) Practicals and Viva in Medical Microbiology 2nd edition, Elsevier India Pvt Ltd.

Tille P (2013) Bailey's and Scott's Diagnostic Microbiology, 13th edition, Mosby

Collee JG, Fraser, AG, Marmion, BP, Simmons A (2007) Mackie and McCartney Practical Medical Microbiology, 14<sup>th</sup> edition, Elsevier.

**M.Sc. (Microbiology) Semester-III**  
**(Paper XV-a)-Biofertilizers and Biopesticides (MMB-305)**

Lectures to be delivered: 30 (Credits-2)

M. Marks: 70

Pass Marks: 35%

**Course objectives:** Course will develop the practices of organic farming among the students. They will learn the importance and benefits of microbes in agriculture as biopesticides and biofertilizers.

**INSTRUCTIONS FOR THE PAPER SETTERS /CANDIDATES**

The question paper will consist of three sections A, B and C. Section-A and B will have four questions from the respective sections of the syllabus and carry 12 marks each. Section - C will consist of 11 short answer type questions which will cover the entire syllabus uniformly and will carry 22 marks in all. Candidates are required to attempt two questions each from sections A and B. Section-C is compulsory

**Unit-I**

**Biofertilizers:** General account of the microbes used as biofertilizers for various crop plants and their advantages over chemical fertilizers.

**Symbiotic N<sub>2</sub> fixers:** *Rhizobium*- Isolation, characteristics, types, inoculum production and field application, legume/pulses plants. *Frankia*- Isolation, characteristics, Alder, Casurina plants, non-leguminous crop symbiosis. *Cyanobacteria*, *Azolla* - Isolation, characterization, mass multiplication, Role in rice cultivation, Crop response, field application.

**Non - Symbiotic N<sub>2</sub> fixers:** Free living *Azospirillum*, *Azotobacter*- isolation, characteristics, mass inoculum production and field application.

**Phosphate and silicate solubilizers:** Phosphate and silicate solubilizing microbes- Isolation, characterization, mass inoculum production, field application.

**Unit-II**

**Mycorrhizal biofertilizers:** Importance of mycorrhizal inoculum, types of mycorrhizae and associated plants, Mass inoculum production of VAM, field applications of Ectomycorrhizae and VAM.

**Bioinsecticides:** General account of microbes used as bioinsecticides and their advantages over synthetic pesticides, *Bacillus thuringiensis*, production and field applications, Viruses—cultivation and field applications. Introduction to mycoinsecticides

**Books Recommended**

Kannaiyan, S. (2003). Bioethnology of Biofertilizers, CHIPS, Texas.

Mahendra K. Rai (2005). Hand book of Microbial Biofertilizers, The Haworth Press, Inc. New York.

Reddy,S.M. et. al. (2002). Bioinoculants for Sustainable Agriculture and Forestry, Scientific Publishers.

Subba Rao N.S (1995) Soil Microorganisms and Plant Growth, Oxford and IBH publishing co. Pvt. Ltd. NewDelhi.

Saleem F and Shakoori AR (2012) Development of Bioinsecticide, Lap Lambert Academic Publishing GmbH KG.

Aggarwal SK (2005) Advanced Environmental Biotechnology, APH publication

**M.Sc. (Microbiology) Semester-III**  
**(Paper XV-b)-Food Fermentation Techniques (MMB-305)**

Lectures to be delivered: 30 (Credits-2)

M. Marks: 70

Pass Marks: 35%

**Course objectives:** Study of food fermentation techniques will develop the fermented food production skills among the students and they will also learn the role of different microbes involved in production of different fermented foods.

**INSTRUCTIONS FOR THE PAPER SETTERS /CANDIDATES**

The question paper will consist of three sections A, B and C. Section-A and B will have four questions from the respective sections of the syllabus and carry 12 marks each. Section - C will consist of 11 short answer type questions which will cover the entire syllabus uniformly and will carry 22 marks in all. Candidates are required to attempt two questions each from sections A and B. Section-C is compulsory

**Unit-I**

**Fermented foods:** Definition, types, advantages and health benefits

**Probiotic foods:** Definition, types, microorganisms and health benefits

**Milk based fermented foods:** Dahi, Yogurt, Buttermilk (Chach) and cheese: Preparation of inoculums, types of microorganisms and production process

**Unit-II**

**Grain based fermented foods:** Soy sauce, Bread, Idli and Dosa: Microorganisms and production process

**Vegetable based fermented foods:** Pickles, Saurkraut: Microorganisms and production process

**Fermented meat and fish:** Types, microorganisms involved and production process

**Books Recommended:**

Hui YH, Meunier-Goddik L, Josephsen J, Nip WK, Stanfield PS (2004) Handbook of food and fermentation technology, CRC Press.

Holzappel W (2014) Advances in Fermented Foods and Beverages, Woodhead Publishing.

Yadav JS, Grover, S and Batish VK (1993) A comprehensive dairy microbiology, Metropolitan.

Jay JM, Loessner MJ, Golden DA (2005) Modern Food Microbiology, 7th edition. Springer.



**M.Sc. (Microbiology) Semester-III**  
**LC-10 Practical Genetics (MMB-306)**

Practical Time: 4 Hours/week (Credits-2)

Max. Marks: 50

Pass Marks: 35%

**INSTRUCTIONS FOR THE PAPER SETTERS /CANDIDATES**

The Final practical paper will consist of three sections A, B and C. Section A will contain write up (13 Marks) from the list of practical pertaining to lab course. Section B will contain practical to perform in examination (25 Marks). Section C will contain practical note Book Evaluation and Viva Voce (12 Marks).

1. Isolation of genomic DNA from bacteria
2. Isolation of plasmid DNA from bacteria
3. Determination of T<sub>m</sub> of DNA
4. Electrophoresis (Agarose, SDS- PAGE)
5. Generation of Competent cells and study the transformation using plasmid
6. PCR amplification of 16S rDNA region of bacterial DNA
7. Restriction digestion of genomic DNA and amplified DNA
8. RNA isolation from dry yeast cells
9. To study the effect of UV radiations on the growth of bacteria
10. To study the effect of chemical mutagens on the growth of bacteria

**M.Sc. (Microbiology) Semester-III**  
**LC-11 Medical and Diagnostic Laboratory (MMB-307)**

Practical Time: 4 Hours/week (Credits-2)

Max. Marks: 50

Pass Marks: 35%

**INSTRUCTIONS FOR THE PAPER SETTERS /CANDIDATES**

The Final practical paper will consist of three sections A, B and C. Section A will contain write up (13 Marks) from the list of practical pertaining to lab course. Section B will contain practical to perform in examination (25 Marks). Section C will contain practical note Book Evaluation and Viva Voce (12 Marks).

1. Isolation and characterization of normal micro-flora of human body parts
2. Isolation and characterization of microorganisms from UTI
3. Isolation and characterization of microorganisms from stool sample
4. Isolation and characterization of microorganisms from blood
5. Determination of total leukocyte count (TLC) in blood
6. Determination of differential leukocyte count (DLC) in blood
7. Demonstration of Enzyme linked immune-sorbent assay (ELISA) and its variants
8. Demonstration of WIDAL test using Kit
9. Demonstration of RPR test using kit.
10. Antibiotic sensitivity assay.
11. Determination of MIC of an antibiotic for a selective pathogen.
12. To study the multiple drug resistance for a selective pathogen.

**M.Sc. (Microbiology) Semester-IV**  
**(Paper XVI)-Environmental Microbiology (MMB-401)**

Lectures to be delivered: 60 (Credits-4)

M. Marks: 70

Pass Marks: 35%

**Course objectives:** Course will through light on basic components and impact of human activities on environment. Students will learn the role of microorganisms in controlling the environmental pollutions and in development of biological probes for detection of pollutants.

**INSTRUCTIONS FOR THE PAPER SETTERS /CANDIDATES**

The question paper will consist of three sections A, B and C. Section-A and B will have four questions from the respective sections of the syllabus and carry 12 marks each. Section - C will consist of 11 short answer type questions which will cover the entire syllabus uniformly and will carry 22 marks in all. Candidates are required to attempt two questions each from sections A and B. Section-C is compulsory.

**Unit-I**

**Introduction to environmental microbiology:** Structure and functions of ecosystems, ecological niche and microbial environments (soil microflora and aquatic microflora), Microbial interactions with microbes, plants and animals (mutualism, synergism, commensalism, competition, amensalism, parasitism, predation)

Microbial degradation of cellulose, hemicelluloses, lignin and chitin, Nitrogen cycle, phosphorous immobilization and solubilization, microbes involved in sulphur cycle, iron and maganese

**Metal microbe interactions:** Bioleaching and bio-mining-microbiology, mechanism and applications

**Unit-II**

**Waste management:** Collection and characterization of waste (solid and liquid), concept of BOD and COD, criteria for selection of treatment and design, primary secondary and tertiary treatment, methods of solid waste disposal (composting and sanitary landfill), Aerobic (Activated sludge (AS), Completely mixed conventional activated sludge (CCAS), contact stabilizer (CSAS), step aeration (SAAS), completely mixed (CMAS), extended aeration (EAAS), pure oxygen or high purity oxygen (POAS), tapered aeration (TAAS) systems, Aerated lagoons, aerobic and facultative tricking filters and rotating biological contactors) and anaerobic technologies (anaerobic decomposition, anaerobic filter reactor, anaerobic contact reactor, fluidized bed reactor, up-flow anaerobic sludge blanket (UASB), anaerobic baffled reactor), Biofuel cells

**Treatment of waste air:** Biological technologies of waste air treatment, biological deodorization, bioscrubbers

**Microbial bioremediation:** Principles and degradation of common pesticides, organic (hydrocarbon and oil spills) and inorganic matter (metals), biosurfactants and microbial enhanced oil recovery

**Biosensors:** Definition, types of biosensors, advantages and disadvantages of biosensor, construction of biosensors, Development of Biosensors for heavy metal ions (lead, cadmium), insecticides and/or pesticides (naphthalene, anthrene and lindane).

**Recommended Books:**

Pepper L, Gerba C.P, Gentry T, Maier R.M.(2009) Environmental Microbiology, Elsevier.

Scragg A (2005) Environmental Biotechnology, Oxford University Press.

Mohapatra P.K (2006) Textbook of Environmental biotechnology, I.K. Publishers

Cooper J.M., Cass A.E.G (2003) Biosensors, Oxford University Press.

**M.Sc. (Microbiology) Semester-IV**  
**(Paper XVII)-Soil and Agriculture Microbiology (MMB-402)**

Lectures to be delivered: 45 (Credits-3)

M. Marks: 70

Pass Marks: 35%

**Course Objectives:** Students will learn the presence, role and effects of microorganisms in different ecosystems. They will understand the importance of microbial populations specifically in agriculture i.e. biopesticides, biofertilizers and genetically modified microbes.

**INSTRUCTIONS FOR THE PAPER SETTERS /CANDIDATES**

The question paper will consist of three sections A, B and C. Section-A and B will have four questions from the respective sections of the syllabus and carry 12 marks each. Section - C will consist of 11 short answer type questions which will cover the entire syllabus uniformly and will carry 22 marks in all. Candidates are required to attempt two questions each from sections A and B. Section-C is compulsory.

**Unit-I**

**Introduction to soil:** Soil as a habitat for organisms, soil characteristics (physical, chemical and biological), Interaction between soil components

**Soil microorganisms:** major groups, decomposition of organic matter, soil health, role of rhizospheric microflora in plant productivity, microbial biomass

**Soil ecosystem:** biology of soil ecosystem, succession and, adaptation of microorganisms in ecosystem, microbial biomass and activities measurement: direct viable counts, biochemical methods, determination of microbial biomass

**Microbial interactions:** Root exudates and their effects on rhizospheric microflora, types of interactions (positive, negative and neutral)

**Micro organisms as geochemical agents :** Carbon, nitrogen, sulphur and phosphorus cycles

**Plant growth promoting rhizobacteria:** plant growth promoting microorganisms (phosphate solubilization, siderophore production)

**Unit-II**

**Microbial pesticides I:** Needs and advantages of bio-pesticides (herbicides, insecticides and fungicides), bacterial insecticides: *Bacillus thuringensis* and *Bacillus israelis*, endotoxins and their mode of action, mass production of biopesticides, cry genes, biopesticide gene transfer in higher organisms

**Microbial pesticides II:** Biology, mass production of fungal insecticides (*Trichoderma* sp.) and their mode of action

**Microbial pesticides III:** Biology of baculoviruses, Baculoviruses as insecticides, mode of action, mass production and their future potential

**Biological nitrogen fixation:** microbiology, root nodule formation and its functions; structure and functions of heterocyst, *Azolla* and *Anabaena* association

**Biofertilizers:** General account of microbes used as biofertilizers (nitrogen and phosphorous), industrial production of *Rhizobium* inoculants, assessment of N<sub>2</sub> –fixing ability of different strains (Direct and indirect methods), Packaging, quality control and storage, methods of application

**Genetically engineered microbes and their applications in agriculture:** Use of *Agrobacterium tumefaciens* and *A. rhizogenes* in genetic engineering of plants, Ti plasmids, Direct and indirect methods of gene transfer to plants

**Recommended Books:**

Dixon GR, Tilston EL. *Soil Microbiology and Sustainable Crop Production*, Springer, UK

Paul EA. *Soil Microbiology, Ecology, and Biochemistry*, Elsevier, Oxford, UK

Subba Rao NS. *Soil Microbiology*, Oxford & IBH Publishing Co Pvt Ltd, India

**M.Sc. (Microbiology) Semester-IV**  
**(Paper XVIII)-TQM and IPR (MMB-403)**

Lectures to be delivered: 45 (Credits-3)

M. Marks: 70

Pass Marks: 35%

**Course Objectives:** Students will gain knowledge of intellectual property rights, patents and bioethics. Also, the learning of various certification organizations and processes will facilitate in establishing business and management skills among them.

**INSTRUCTIONS FOR THE PAPER SETTERS /CANDIDATES**

The question paper will consist of three sections A, B and C. Section-A and B will have four questions from the respective sections of the syllabus and carry 12 marks each. Section - C will consist of 11 short answer type questions which will cover the entire syllabus uniformly and will carry 22 marks in all. Candidates are required to attempt two questions each from sections A and B. Section-C is compulsory.

**Unit-I**

**Intellectual property rights:** Intellectual property, types and related Indian legislations, international conventions (TRIPs, PCT, Paris convention, Budapest treaty, UPOV), intellectual property management.

**Patents:** Patentability criteria, subject matter, types of patents and patents claims

**Patenting system:** Patentability of biological processes and products in India, US and Europe

**Perceptions to Microbiology:** Social aspects of microbiology, status of microbiology in India and Punjab, university-industry relationships in microbiology, Government programs in development of microbiology, role of international organizations in development of microbiology

**Bio-safety Management and Bioethics:** IBC (institutional bio-safety committee), bio-safety levels. Ethical issues: ELSI.

**Good Safety practices:** GLP Standards, lab contaminants GMPs. The Cartagena protocol on bio-safety

**Unit-II**

**Total quality management:** Introduction, concept, role and its importance; contributions of management thinkers in quality delivery market

**Core concepts of TQM:** Quality of profit, cost and economics of quality, competitive bench market and quality delivery market

**Tools and techniques of TQM:** Techniques for analyzing quality process, statistical process control, problem solving tools, six sigma approach

**International organization for standardization (ISO):** Organization and its functioning, history and relevance of certification

**ISO standards I:** Members, various revisions and requirements for ISO 9000

**ISO standards II** Members, various revisions and requirements for 14000

**Recommended Books:**

Mclaughin GC. Total quality in research and development, CRC Press, USA

Early R. Guide to Total Quality Management systems for the food industry, Blackie Academic, NY

Singh KC. Intellectual Property Rights on Biotechnology, BCIL Publishers, New Delhi.

Cornish WR. Intellectual Property: Patents, Trade Marks and Allied Rights, Universal Law Publishing, New Delhi.

**M.Sc. (Microbiology) Semester-IV**  
**(Paper XIXa)-Fermentation Technology (MMB-404)**

Lectures to be delivered: 45 (Credits-3)

M. Marks: 70

Pass Marks: 35%

**Course Objectives:** Students will learn the role of different microbes in fermentation. They will understand the structural components of a bioreactor and industrial production of various products like enzymes, organic acids, Vitamins etc.

**INSTRUCTIONS FOR THE PAPER SETTERS /CANDIDATES**

The question paper will consist of three sections A, B and C. Section-A and B will have four questions from the respective sections of the syllabus and carry 12 marks each. Section - C will consist of 11 short answer type questions which will cover the entire syllabus uniformly and will carry 22 marks in all. Candidates are required to attempt two questions each from sections A and B. Section-C is compulsory.

**Unit-I**

Screening of industrially important microorganisms, Strain improvement: Directed evolution & selection molecular approaches.

Preservation of industrial microorganisms, Quality control of preserved stock cultures. Substrates for microbial fermentations, antifoaming agents

Basic concept and design of bioreactor, Aeration and agitation, Kinetics of batch and continuous process

Sterilization of media and air, Scale up of sterilization

Monitoring and control process: Fundamentals of process control, Feedback control, Factors to be controlled in bioreactor

**Unit-II**

An introduction to downstream processes, Microbial cell separation and disintegration, Extraction and purification of fermentation products, Drying and crystallization

Microbial production of organic acids: Citric acid, lactic acid

Microbial production of amino acids: lysine, glutamic acid

Fermentative production of antibiotics: Penicillin and semi synthetic antibiotics

Production of vitamin B12

Microbial production of commercial enzymes: protease, amylase

Production and applications of immobilization of cells and enzymes

**Books Recommended:**

Prescott and Dunn's industrial microbiology by B. Reed

Principles of fermentation technology by P. F. Stanbury, A, Whitaker and Hall

Comprehensive Biotechnology by Moo Young (Vol. 3 and 4)

Yeast Biotechnology by D. R. Berry, I. Russel and G.G. Stewart.

Microbial Biotechnology, Fundamentals of Applied Microbiology by A. N. Glazer and H. Nikaido

Biotechnology: Food Fermentation Technology by V. K. Joshi and A. Pandey

**M.Sc. (Microbiology) Semester-IV**  
**(Paper XIXb)-Recombinant DNA Technology (MMB-404)**

Lectures to be delivered: 45 (Credits-3)

M. Marks: 70

Pass Marks: 35%

**Course objectives:** Students will learn various molecular tools and techniques used in recombinant DNA technology e.g. restriction enzymes, cloning vectors, PCR, RFLP, DNA sequencing etc.

**INSTRUCTIONS FOR THE PAPER SETTERS /CANDIDATES**

The question paper will consist of three sections A, B and C. Section-A and B will have four questions from the respective sections of the syllabus and carry 12 marks each. Section - C will consist of 11 short answer type questions which will cover the entire syllabus uniformly and will carry 22 marks in all. Candidates are required to attempt two questions each from sections A and B. Section-C is compulsory.

**Unit-I**

**Introduction to Genetic Engineering:** Definition, concepts and scope of genetic engineering. History, Importance and future perspectives of Recombinant DNA Technology

**Tools in Genetic Engineering:** Enzymes in genetic engineering. Cloning vectors: Ti Plasmid, pBR322, pUC-series. Phage vectors-M13 phage vectors, Cosmids-Types, Phasmids or Phagemids, Shuttle vectors. YAC and BAC vectors, Retroviruses, Ti cloning vector

**rDNA Technology:** The basic principles of gene cloning strategies: Preparation, Manipulation and Insertion of desired DNA into vector. Introduction of DNA into host cells– Transformation, transduction, transfection, microinjection, biolistics, electroporation, liposome fusion and shotgun cloning

**Unit-II**

**Analysis of gene and gene products:** PCR–principles and types, Molecular markers in genome analysis: RFLP, RAPD, AFLP.

**Applications of gene cloning and ethics in Genetic Engineering:** Applications of gene cloning, Medicine, Agriculture, Forensic Science.

**Safety of recombinant DNA technology:** Restriction and regulation for the release of GMOs into Environment. Ethical, Legal, Social and Environmental issues related to rDNA technology.

**Books Recommended:**

Brown, T.A. (2010) Gene Cloning and DNA Analysis-An Introduction 6th edn. Blackwell Science.

Brown, T.A. (2011) Introduction to Genetics: A Molecular Approach 1st Ed. 3. Setlow, Jane K. (2004) Genetic Engineering: Principles and Methods. Springer.

Harvey Lodish, Arnold Berk, Chris A. Kaiser, Monty Krieger( 2007) Molecular Cell Biology 6th Ed. W.H. Freeman and Company, New York.

H.-J. Rehm, G. Reed. (2008) Biotechnology: Genetic Fundamentals and Genetic Engineering, Volume 2, Second Edition. Wiley

Maheshwari, D.K, Dubey, R.C. and Kang, S.C. (2006) Biotechnological Applications of Microorganisms. I.K. International Publishing House. New Delhi.

**M.Sc. (Microbiology) Semester-IV**  
**(Paper XXa)-Microbial Analysis of Air and Water (MMB-405)**

Lectures to be delivered: 30 (Credits-2)

M. Marks: 70

Pass Marks: 35%

**Course objectives:** Students will gain the knowledge of isolation and identification of different microorganisms present in air and water. They will also learn various measures used to control them.

**INSTRUCTIONS FOR THE PAPER SETTERS /CANDIDATES**

The question paper will consist of three sections A, B and C. Section-A and B will have four questions from the respective sections of the syllabus and carry 12 marks each. Section - C will consist of 11 short answer type questions which will cover the entire syllabus uniformly and will carry 22 marks in all. Candidates are required to attempt two questions each from sections A and B. Section-C is compulsory.

**Unit-I**

**Aeromicrobiology:** Bioaerosols, Air borne microorganisms (bacteria, Viruses, fungi) and their impact on human health and environment, significance in food and pharma industries and operation theatres, allergens.

**Air sample collection and analysis:** Bioaerosol sampling, air samplers, methods of analysis, CFU, culture media for bacteria and fungi, Identification characteristics.

**Control measures:** Fate of bioaerosols, inactivation mechanisms – UV light, HEPA filters, desiccation, Incineration.

**Unit-II**

**Water Microbiology:** Water borne pathogens, water borne diseases.

**Microbiological analysis of water:** Sample Collection, Treatment and safety of drinking (potable) water, methods to detect potability of water samples: (a) standard qualitative procedure: presumptive test(MPN test), confirmed and completed tests for faecal coliforms (b) Membrane filter technique and (c) Presence/absence tests.

**Control measures:** Precipitation, chemical disinfection, filtration, high temperature, UV light.

**Books Recommended:**

Da Silva N, Taniwaki MH, Junqueira VC, Silveira N, Nascimento MS, Gomes RAR (2012) Microbiological Examination Methods of Food and Water-A Laboratory Manual, CRC Press

Atlas RM and Bartha R. (2000) Microbial Ecology: Fundamentals & Applications. 4th edition. Benjamin/Cummings Science Publishing, USA

Maier RM, Pepper IL and Gerba CP. (2009) Environmental Microbiology. 2nd edition, Academic Press.

Hurst CJ, Crawford RL, Garland JL, Lipson DA (2007) Manual of Environmental Microbiology, 3<sup>rd</sup> edition, ASM press



## M.Sc. (Microbiology) Semester-IV

### (Paper XXb)-Management of Human Microbial Diseases (MMB-405)

Lectures to be delivered: 30 (Credits-2)

M. Marks: 70

Pass Marks: 35%

**Course Objectives:** Study of this course will provide knowledge of various microbes involved in different human diseases, their transmission, outbreaks and therapeutics. Course will also provide the information on immunization programs i.e. vaccination.

#### INSTRUCTIONS FOR THE PAPER SETTERS /CANDIDATES

The question paper will consist of three sections A, B and C. Section-A and B will have four questions from the respective sections of the syllabus and carry 12 marks each. Section - C will consist of 11 short answer type questions which will cover the entire syllabus uniformly and will carry 22 marks in all. Candidates are required to attempt two questions each from sections A and B. Section-C is compulsory.

#### Unit-I

**Introduction to Human Microbial Diseases:** Definition and concept of health, disease, Infection and Pathogen. Types of common human microbial diseases and their transmission, causative agents and symptoms of human microbial diseases: Respiratory microbial diseases, gastrointestinal microbial diseases, urinary tract diseases, sexually transmitted diseases, mosquito borne disease and Nosocomial infections.

**Recent outbreaks of human microbial diseases:** (SARS/ Swine flu/Ebola) – causes, spread and control.

**Therapeutics of Microbial diseases:** Treatment using antibiotics: Mechanism of action of antibiotics belonging to different classes: beta-lactam antibiotics (penicillin, cephalosporins), quinolones, polypeptides and aminoglycosides. Judicious use of antibiotics, importance of completing antibiotic regimen, Concept of DOTS, emergence of antibiotic resistance, current issues of MDR/XDR microbial strains.

#### Unit-II

**Prevention of Microbial Diseases:** General preventive measures, Importance of personal hygiene, environmental sanitation and methods to prevent the spread of infectious agents transmitted by direct contact, food, water and insect vectors.

**Vaccines:** Importance, types, vaccines available against microbial diseases, vaccination schedule (compulsory and preventive) in the Indian context.

#### Books Recommended:

Ananthanarayan R. and Paniker C.K.J. (2009) Textbook of Microbiology. 8th edition, University Press Publication.

Brooks G.F. Carroll K.C., Butel J.S., Morse S.A. and Mietzner, T.A. (2013) Jawetz, Melnick and Adelberg's Medical Microbiology. 26th edition. McGraw Hill Publication.

Goering R., Dockrell H., Zuckerman M. and Wakelin D. (2007) Mims' Medical Microbiology. 4th edition. Elsevier.

Willey JM, Sherwood LM, and Woolverton CJ. (2013) Prescott, Harley and Klein's Microbiology. 9th edition. McGraw Hill Higher Education.

Madigan MT, Martinko JM, Dunlap PV and Clark DP. (2014). Brock Biology of Microorganisms. 14th edition. Pearson International Edition.

**M.Sc. (Microbiology) Semester-IV**  
**(Paper LC-12)-Practical Approaches in Environmental Microbiology (MMB-406)**

Practical Time: 4 Hours/week (Credits-2)

Max. Marks: 50

Pass Marks: 35%

**INSTRUCTIONS FOR THE PAPER SETTERS/ CANDIDATES**

The Final practical paper will consist of three sections A, B and C. Section A will contain write up (13 Marks) from the list of practical pertaining to lab course. Section B will contain practical to perform in examination (25 Marks). Section C will contain practical note Book Evaluation and Viva Voce (12 Marks).

1. Handling and storage of waste samples
2. Characterization and quality evaluation of industrial effluents for pH, TS, TDS, TSS, alkalinity and hardness parameters
3. Water Quality test using most probable number (MPN) method
4. Evaluation of pollution potential of waste materials as Biochemical Oxygen Demand (BOD)
5. Determination of chemical oxygen demand (COD) in various effluents
6. Separation of pesticides by HPLC method
7. Determination of heavy metal ions in industrial effluents by spectrophotometric methods (Ni, Cr)
8. Demonstration of small-scale vermicomposting bin for commercialization
9. Demonstration of biogas production

**M.Sc. (Microbiology) Semester-IV**  
**(Paper LC-13)-Practical Microbiology in Soil and Agriculture (MMB-407)**

Practical Time: 4 Hours/week (Credits-2)

Max. Marks: 50

Pass Marks: 35%

**INSTRUCTIONS FOR THE PAPER SETTERS/ CANDIDATES**

The Final practical paper will consist of three sections A, B and C. Section A will contain write up (13 Marks) from the list of practical pertaining to lab course. Section B will contain practical to perform in examination (25 Marks). Section C will contain practical note Book Evaluation and Viva Voce (12 Marks).

1. Determination of organic carbon contents in the agricultural soils
2. Quantification of total nitrogen in the soils
3. Determination of phosphorous contents in the agricultural soils
4. Quantification of sulphur contents in the soils
5. Enumeration and characterization of microbes in different soil ecosystems
6. Isolation of symbiotically nitrogen fixing bacteria
7. Isolation of free living nitrogen fixing bacteria
8. Isolation of nitrifying bacteria
9. Isolation of phosphate solubilizing microorganisms
10. Microscopic examination of BT spores
11. Microscopic examination of *cyanobacteria* and heterocysts
12. Counting total number of viable bacteria in a biofertilizer packet
13. Counting the most probable number (MPN) of *Rhizobium*
14. Mass production and carrier mixing of *Rhizobium* inoculants

**M.Sc. (Microbiology) Semester-IV**  
**(Paper LC-14a)-Practical Fermentation Technology (MMB-408)**

Practical Time: 2 Hours/week (Credits-1)

Max. Marks: 50  
Pass Marks: 35%

**INSTRUCTIONS FOR THE PAPER SETTERS/ CANDIDATES**

The Final practical paper will consist of three sections A, B and C. Section A will contain write up (13 Marks) from the list of practical pertaining to lab course. Section B will contain practical to perform in examination (25 Marks). Section C will contain practical note Book Evaluation and Viva Voce (12 Marks).

1. Introduction to fermentors
2. Development of inoculums for the bacteria and fungi
3. Production of wine
4. Production of ethanol by submerged fermentation
5. Production and evaluation of SCP (yeast)
6. To study growth kinetics of given microbes
7. Visit to beverage industry (alcoholic)
8. Microbial production of amino acid: Aspartic acid
9. Microbial production of an antibiotic: Penicillin
10. Production of fermented milk products-Kefir
11. Production of Kumis
12. Production of Yogurt
13. Microbial production of citric acid

**M.Sc. (Microbiology) Semester-IV**  
**(Paper LC-14b)-Practical Recombinant DNA Technology (MMB-408)**

Practical Time: 2 Hours/week (Credits-1)

Max. Marks: 50

Pass Marks: 35%

**INSTRUCTIONS FOR THE PAPER SETTERS/ CANDIDATES**

The Final practical paper will consist of three sections A, B and C. Section A will contain write up (13 Marks) from the list of practical pertaining to lab course. Section B will contain practical to perform in examination (25 Marks). Section C will contain practical note Book Evaluation and Viva Voce (12 Marks).

1. Isolation of bacterial genomic DNA.
2. Isolation of bacterial Plasmid DNA
3. Isolation of Fungal Genomic DNA
4. Digestion of DNA using restriction enzymes and analysis by agarose gelelectrophoresis.
5. Ligation of DNA fragments.
6. Demonstration of PCR.
7. Interpretation of sequencing gel electropherograms.