

M. Sc. (Hons.) Microbiology Syllabus for 2023- 2024 (Ist, IInd, IIIrd & IVth Semester)

Mata Gujri College

Sri Fatehgarh Sahib

(An Autonomous College)

Affiliated to Punjabi University Patiala

M.Sc. (Hons.) Microbiology

(Syllabus for Ist, IInd, IIIrd & IVth Semester)



Academic Session 2023-2024

Program code: MSMB

Program Objectives: The program is intended to educate the students in basic and applied areas of microbiology, along with the latest advancement in the field of life sciences. Objectives of the program are to impart both theoretical and practical knowledge to the students in different fields of microbiology with major emphasis on the practical aspects and applications. Curriculum is framed with a motto to train students to plan and perform experiments, analyze the data and able to present the results both qualitatively and quantitatively. Program objective is also to inculcate a vision in the students towards ongoing developments in the field of microbiology with an outstanding knowledge of important areas in microbiology and to pursue a career of his/her choice.

Program Outcomes: The students will be able to understand and explain the different basic fields of microbiology such as Bacteriology, Virology, Mycology and Phycology. The students will also be able to implement the knowledge acquired in different fields such as Environment, Food, Agriculture, Medical and Diagnostic etc. Students will be well versed in the other applied fields such as immunology, molecular biology, genetic engineering, bioinformatics and biostatistics. With their hands-on experience in basic microbiological techniques and sophisticated instruments, pupils will be able to explore their career in different fields such as industries, research organization, teaching as well as an entrepreneur. The student will also be skilled with values of professional ethics and contribute to society as responsible individuals.

M. Sc. (Hons.) Microbiology Syllabus for 2023- 2024 (Ist, IInd, IIIrd & IVth Semester)

M.Sc. (Hons.) Microbiology First Year

Subjects and Marks Distribution

Semester-I

| Paper code | Nature of the paper | Name of paper | Period/week | External Marks | Internal Marks* | Total Marks | Credit |
|-------------------|----------------------------|---|--------------------|-----------------------|------------------------|--------------------|---------------|
| MSMB-101 | C1 | Fundamentals of Microbiology | 4 | 70 | 30 | 100 | 4 |
| MSMB-102 | C2 | Bacteriology and Virology | 4 | 70 | 30 | 100 | 4 |
| MSMB-103 | C3 | Research Methodology | 2 | 35 | 15 | 50 | 2 |
| MSBT-101 | C4 | Fundamentals of Biochemistry | 4 | 70 | 30 | 100 | 4 |
| MSMB-104 | C5 | Lab course of Instrumentation and Biotechniques | 4 | 50 | | 50 | 2 |
| MSMB-105 | C6 | Lab course pertaining to Fundamentals of Microbiology | 4 | 50 | | 50 | 2 |
| MSMB-106 | C7 | Lab course pertaining to Bacteriology | 4 | 50 | | 50 | 2 |
| MSBT-103 | C8 | Lab course pertaining to Fundamentals of Biochemistry | 4 | 50 | | 50 | 2 |
| MSMB-407 | | Dissertation (Synopsis submission) | 2 | | | 50 | 2 |
| | | Total | 32 | | | 600 | 24 |

*Internal assessment (30% of total marks): Seminar and Assignments (25% of total IA), MST (50% of total IA), Attendance (25% of total IA)

M. Sc. (Hons.) Microbiology Syllabus for 2023- 2024 (Ist, IInd, IIIrd & IVth Semester)

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Subjects and Marks Distribution

Semester –II

| Paper Code | Nature of the paper | Name of paper | Periods/ week | External Marks | Internal Marks | Total Marks | Credits |
|-----------------------|----------------------------|---|----------------------|-----------------------|-----------------------|--------------------|----------------|
| MSMB-201 | C9 | Mycology & Phycology | 4 | 70 | 30 | 100 | 4 |
| MSMB-202 | C10 | Molecular Biology | 4 | 70 | 30 | 100 | 4 |
| MZOO:201 | C11 | Immunology | 4 | 70 | 30 | 100 | 4 |
| MSMB-203 | C12 | Lab course pertaining to Mycology & Phycology | 4 | 50 | | 50 | 2 |
| MSMB-204 | C13 | Lab course pertaining to Molecular Biology | 4 | 50 | | 50 | 2 |
| MZP: 206 | C14 | Lab course pertaining to Immunology | 4 | 50 | | 50 | 2 |
| Elective paper | | | | | | | |
| MSMAT 001 | EC1 | Biostatistics | 4 | 70 | 30 | 100 | 3 |
| MSBT-202 | EC1 | Bioinformatics and Computational Biology | 3 | 50 | 25 | 75 | 3 |
| MSBT-206 | EC2 | Lab course pertaining to Bioinformatics and Computational Biology | 2 | 25 | | 25 | 1 |
| MSMB-407 | | Dissertation (Experimental work) | 4 | | | 100 | 4 |
| | | Total | 33 | | | 650 | 26 |

*Internal assessment (30% of total marks): Seminar and Assignments (25% of total IA), MST (50% of total IA), Attendance (25% of total IA)

M. Sc. (Hons.) Microbiology Syllabus for 2023- 2024 (Ist, IInd, IIIrd & IVth Semester)

Open Elective paper

| Paper code | Nature of the paper | Name of paper | Period / Week | External Marks | Internal Marks* | Total Marks | Credit |
|-------------------|----------------------------|---|----------------------|-----------------------|------------------------|--------------------|---------------|
| MSMB-205 | OE1 | Microbial technology | 4 | 70 | 30 | 100 | 4 |
| MSMB-206 | OE2 | Lab course pertaining to Microbial technology | 4 | 50 | - | 50 | 2 |

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M.Sc. (Hons.) Microbiology Second Year

Subjects and Marks Distribution

Semester III

| Paper code | Paper No. | Name of paper | Period/ Week | External Marks | Internal Marks* | Total Marks | Credit |
|-------------------|------------------|--|---------------------|-----------------------|------------------------|--------------------|---------------|
| MSMB-301 | C15 | Environmental Biotechnology | 4 | 70 | 30 | 100 | 4 |
| MSMB-302 | C16 | Food Microbiology | 4 | 70 | 30 | 100 | 4 |
| MSMB-303 | C17 | Agricultural Microbiology | 3 | 50 | 25 | 75 | 3 |
| MSBT-302 | C18 | Genetic Engineering | 4 | 70 | 30 | 100 | 4 |
| MSMB-304 | C19 | Lab course pertaining to Environmental Biotechnology | 4 | 50 | | 50 | 2 |
| MSMB-305 | C20 | Lab course pertaining to Food Microbiology | 4 | 50 | | 50 | 2 |
| MSMB-306 | C21 | Lab course pertaining to Agricultural Microbiology | 2 | 25 | | 25 | 1 |
| MSBT-306 | C22 | Lab course pertaining to Genetic Engineering | 4 | 50 | | 50 | 2 |
| MSMB-307 | | Industrial training | | | | 50 | 2 |
| MSMB-407 | | Dissertation (Experimental work) | 4 | | | 100 | 4 |
| | | Total | 33 | | | 700 | 28 |

*Internal assessment (30% of total marks): Seminar and Assignments (25% of total IA), MST (50% of total IA), Attendance (25% of total IA)

M. Sc. (Hons.) Microbiology Syllabus for 2023- 2024 (Ist, IInd, IIIrd & IVth Semester)

M.Sc. (Hons.) Microbiology Second Year

Subjects and Marks Distribution

Semester IV

| Paper code | Paper No. | Name of paper | Period/Week | External Marks | Internal Marks* | Total Marks | Credit |
|-----------------------|------------------|--|--------------------|-----------------------|------------------------|--------------------|---------------|
| MSMB-401 | C23 | Medical Microbiology | 4 | 70 | 30 | 100 | 4 |
| MSMB-402 | C24 | Industrial Microbiology | 4 | 70 | 30 | 100 | 4 |
| MSMB-403 | C25 | Lab course pertaining Medical Microbiology | 4 | 50 | | 50 | 2 |
| MSMB-404 | C25 | Lab course pertaining to Industrial Microbiology | 4 | 50 | | 50 | 2 |
| Elective paper | | | | | | | |
| MSMB-405 | EC3 | Advances in Microbiology | 4 | 70 | 30 | 100 | 4 |
| MSMB-406 | EC3 | Clinical and diagnostic microbiology | 4 | 70 | 30 | 100 | 4 |
| MSMB-407 | | Dissertation (Experimental work, Thesis submission and presentation) | 10 | | | 250 | 10 |
| | | Total | 30 | | | 650 | 26 |

*Internal assessment (30% of total marks): Seminar and Assignments (25% of total IA), MST (50% of total IA), Attendance (25% of total IA)

Assessment Parameters

- 1 Quality of Dissertation**
- 2 Quantitative data analysis**
- 3 Significance of work**
- 4 Presentation and defense**

Weightage (%)

- 40**
20
20
20

M. Sc. (Hons.) Microbiology Syllabus for 2023- 2024 (Ist, IInd, IIIrd & IVth Semester)

M.Sc. (Hons.) Microbiology Semester-I Fundamentals of Microbiology (MSMB-101)

Lectures to be delivered: 60 (Credit-4/week)

Max. Marks: 70

Pass Marks: 40%

Course Objectives: Objectives of this course is to introduce the students to the microbial world, their groups, techniques used in microbiology along with their nutrition. Besides this, students will also be introduced with growth patterns of microorganisms, their control and prevalence in different habitat.

Course Outcome: The student will be familiar with microbiology and microorganisms, their habitat, diversity, nutritional types and growth. Students will learn the basic techniques used in the field of microbiology.

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 units 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 and Scope of microbiology (in medicine, food industry, agriculture, and environment), evolution of microbial life, Difference between Prokaryotes, Archaeobacteria and eukaryotes

Introduction to microorganisms: Bacteria, algae, fungi, protozoa and viruses. Nomenclature and Classification of microorganisms: Hackel's three kingdom concept, Whittaker's five kingdom concept, three domain concept and recent developments

Techniques in Microbiology: Introduction to Microscopy: bright field & dark field microscopy, fluorescence microscopy, phase contrast and electron microscope, Isolation and maintenance of microbial cultures

Microbial Genetics: Conjugation-Discovery, mechanism, Hfr and F' strains, Transformation: Discovery, mechanism of natural competence, Transduction: Generalized transduction, specialized transduction, Abortive transduction

Unit-II

Nutritional types: Concept of litho/organo, photo/chemo and auto/ heterotrophs, types of media (selective media, differential media, assay and enrichment media)

Growth of microorganisms: Growth and growth kinetics, Methods of growth determination, effect of environmental conditions (pH, temperature, aeration), types of growth- continuous culture, diauxic growth, synchronous growth

Control of microorganisms by Physical and Chemical methods: Dry and moist heat, pasteurization, tyndallization, radiation, ultrasonication, and filtration. Disinfectants, sanitizers, antiseptics, sterilant and fumigants, phenol coefficient, antibacterial agents, Mechanism of resistance to antimicrobial agents, Susceptibility testing of bacteria

Microbiology of Air, Water and Soil: Air borne microorganisms (Bacteria, Viruses, Fungi) Water Borne Pathogens, Water Borne diseases, Soil as a habitat for microorganisms, Plant growth promoting microorganisms

Books Recommended

RC Dubey and D K Maheshwari (2013) A Text book of Microbiology (4TH Edition), S. Chand Publishers

Willey JM, Sandman KM, Wood DH (2020) Prescott's Microbiology, Mc. Graw Hill Publishers

Pelczar MJ et al (2010) Microbiology, Mc. Graw Hill Publishers

Stanier RY et al (2004) General Microbiology, Mac Millan Press

M. Sc. (Hons.) Microbiology Syllabus for 2023- 2024 (Ist, IInd, IIIrd & IVth Semester)

M.Sc. (Hons.) Microbiology Semester-I Bacteriology and Virology (MSMB-102)

Lectures to be delivered: 60 (Credit-4/week)

Max. Marks: 70

Pass Marks: 40%

Course Objectives: Course objectives are to introduce students with world of bacteria and viruses along with their ultra-structure, classification and identification along diseases caused by viruses in plants and animals.

Course Outcome: The student will have the knowledge of bacteria and viruses along with their structure, classification, and types.

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 units 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: Morphology and ultra structure of bacteria: types, cell wall, L-form, Cell membranes- structure, composition and properties, capsules, flagella, pili, gas vesicle, nucleoid, magnetosomes, endospore, capsules and S-layer, cytoskeleton structures in bacteria, reserve food materials in bacteria

Bacterial Classification: 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 significance, life cycle, growth and multiplication

Unit-II

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

Methods for the isolation of viruses: Criteria for purity of viruses, preservation of viruses, plaque and pock method, fluorescent focus method, infectious center assay, endpoint dilution assay, 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 plant viruses (Insect, amphids, innate), Viral diseases: wheat streak mosaic, leaf roll disease potato, tobacco mosaic disease and yellow vein mosaic of okra

Animal Viruses: Structure, replication and transmission of animal viruses, viral diseases: Foot and Mouth disease, Rabies

Books Recommended

Pelczar MJ et al (2010) Microbiology, Mc. Graw Hill Publishers

Stanier RY et al (2004) General Microbiology, Mac Millan Press

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

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

Flint SJ et al (2004) Principles of Virology; molecular biology, pathogenesis and control, ASM press

M. Sc. (Hons.) Microbiology Syllabus for 2023- 2024 (Ist, IInd, IIIrd & IVth Semester)

M.Sc. (Hons.) Microbiology Semester-I Research Methodology (MSMB-103)

Lectures to be delivered: 30 (Credit-2/Week)

Max. Marks: 35

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.

Course Outcome: The student will have the detailed knowledge about research problems, their types and their solutions as well. They will also be able to define the sampling methods, paper writing and tools of research.

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 units of the syllabus and carry 6 marks each. Section - C will consist of 11 short answer type questions which will cover the entire syllabus uniformly and will carry 11 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: Definition, Objectives, Motivation, Utility. Concept of theory, empiricism, deductive and inductive theory, Characteristics of scientific method, Understanding the language of research and Concept

Problem Identification and 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 and 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 (Urkund, Plagtracker)

Use of tools /techniques for Research: Patents and IPR, Methods to search required information effectively, Software for paper formatting (MS Office), statistical tools (SPSS)

Books Recommended

Kothari CR (2004) Research Methodology: Methods and Techniques, 2nd Ed., New Age International publishers

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

Kumar R (2011) Research Methodology: a step by step guide for beginners, 3rd Ed., SAGE Publications Ltd

M. Sc. (Hons.) Microbiology Syllabus for 2023- 2024 (Ist, IInd, IIIrd & IVth Semester)

M.Sc. (Hons.) Microbiology Semester-I Fundamentals of Biochemistry (MSBT-101)

Lectures to be delivered: 60 (Credit-4/week)

Max. Marks: 70

Pass Marks: 40%

Course Objectives: Course covers the structural and functional aspects of biomolecules present in a cell i.e. carbohydrates, proteins, lipids and vitamins etc. It also focuses on metabolic pathways and stoichiometry of metabolites that influence the production of certain industrially important metabolites.

Course Outcome: The student will be able to comprehend the structure and function of different biomolecules including proteins, lipids and vitamins. They will also be well-versed with metabolic pathways and their regulation in the cells.

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 units 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

Biomolecules: Origin of biomolecules, types of biomolecules, composition and properties, macromolecules and their monomeric subunits

Amino acids and Proteins: Classification of amino acids, Protein classification (Primary, secondary, tertiary, quaternary)

Nitrogen metabolism: Transamination, oxidative deamination, Urea cycle

Carbohydrates: Structure and function of Mono-saccharides, disaccharides (sucrose, lactose and maltose), polysaccharides, homo-polysaccharides (starch, cellulose, chitin), hetero-polysaccharides, muco-polysaccharides

Carbohydrate metabolism: Glycolysis, citric acid cycle, pentose phosphate pathway, glycogenesis, gluconeogenesis

Unit-II

Oxidative phosphorylation/respiration: Electron transport chain, Chemiosmotic model

Lipids: Structure and function of Fatty acids, Neutral lipids (triglycerides), phospholipids (Cephalin, phosphatidyl inositol and Lecithin)

Lipid metabolism: Biosynthesis and catabolism of fatty acids, Triglycerides, and Phospholipids

Biological membrane: Structure of Biological membrane, fluid mosaic model, membrane proteins and their function, membrane mediated transport (passive, active, facilitated)

Vitamins: Introduction, Structure and function of Water soluble (B complex and Vitamin C) and fat soluble (K, E, D and A) vitamins

Books Recommended

Biochemistry, by Voet, D. and J.G. Voet, John Wiley and Co, 5th Edition, 2018

Lehninger Principles of Biochemistry: by Nelson, D.L. and Cox, M.M. CBS publishers, New Delhi, Eight Edition, 2021

Biochemistry, by Stryer, L., W.H. Freeman Publishers and Distribution, New Delhi.9th Edition, 2019

Harper's Illustrated Biochemistry, by Murray, R.31st Edition, 2018

Biochemistry-an introduction, by Gurrand, M.L.A.I. James, Lipid. Chapman and Hall Ltd., London, 1980

Outlines of Biochemistry, by Conn E.E. and P.K. stump, Wiley Eastern Ltd. New Delhi, 5th Edition, 2006

M. Sc. (Hons.) Microbiology Syllabus for 2023- 2024 (Ist, IInd, IIIrd & IVth Semester)

MSMB 104: Lab Course of Instrumentation and Bio-techniques

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

Max. Marks: 50

Pass Marks: 40%

Course objectives: Student will be introduced to principle and working of different instruments.

Course outcome: Students will able to operate the instruments during their job. It will also enhance their technical knowledge and helps them to operate the different instruments.

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 microscopes (Phase contrast, compound)
2. Spectrophotometer: principle, working and its uses
3. Demonstration and working of centrifuge
4. Chromatographic techniques for the separation of product (paper, TLC and column)
5. Demonstration, principle and working of HPLC
6. Demonstration of bioreactor (construction and its working)
7. Demonstration and working of GC
8. Demonstration, principle and working of Gel documentation system
9. Demonstration and working of PCR and Real time PCR
10. Demonstration and working of FT-IR
11. Demonstration principle and working of lyophilizer
12. Demonstration of Gel electrophoresis (agarose and PAGE)

Books Recommended

Sapkota A (2020), Instruments used in microbiology lab with principle and uses

M. Sc. (Hons.) Microbiology Syllabus for 2023- 2024 (Ist, IInd, IIIrd & IVth Semester)

MSMB 105: Lab Course Pertaining To Fundamentals of Microbiology

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

Max. Marks: 50

Pass Marks: 40%

Course objective: Objectives of this course is to introduce the students with GLP along with basic microbiology techniques.

Course outcome: Student will be able to isolate, identify and use different microorganisms after completion of lab course.

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 Isolation and enumeration of bacteria from soil by serial dilution and agar plating method
- 4 Isolation of fungi (Mould & yeast) from various sources and study of their morphology
- 5 Staining Techniques (Simple staining, Gram's staining, negative staining, acid fast staining)
- 6 Study the colony characteristics of bacteria isolated from soil sample
- 7 Determination of cell size of different microorganisms
- 8 Determination of cell count by SPC method and DMC method
- 9 Study of bacterial growth curve and Calculation of generation time
- 10 Study of diauxic growth

Books Recommended

Dubey RC and Maheshwari DK (2012), Practical Microbiology, Published by S. Chand & Company
Ward Giltner (1916), Laboratory manual in General Microbiology, Published by John Wiley

M. Sc. (Hons.) Microbiology Syllabus for 2023- 2024 (Ist, IInd, IIIrd & IVth Semester)

MSMB 106: Lab Course Pertaining To Bacteriology and Virology

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

Max. Marks: 50

Pass Marks: 40%

Course objective: Students will be introduced with physiological properties of bacteria along with an exposure to viruses.

Course outcome: After completion, student will have thorough knowledge of physical conditions on growth of bacteria as well as inherited properties that lead to classify them. Students will also learn viral infection symptoms in plant.

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 Selective isolation of bacteria from different sources (soil, water and air)
- 2 Effect of pH on the growth of bacteria
- 3 Effect of salt concentration on the growth of bacteria
- 4 Effect of temperature on the growth of bacteria
- 5 Biochemical characterization of tests of bacteria: Acid and gas production from sugars, gelatin liquefaction, starch hydrolysis, casein hydrolysis, catalase activity, oxidase activity, H₂S production
- 6 IMViC test (Indole production, methyl red test, Vogues Proskauer test, citrate utilization).
- 7 Isolation of bacteriophage from sewage water using plaque technique
- 8 Study of viral infection symptoms in plants

Books Recommended

Salih A et al (2017), Medical Virology: A Laboratory Manual, Komar University of Science and Technology

Aneja KR (2014), Laboratory manual of microbiology and biotechnology, Scientific International New Delhi

M. Sc. (Hons.) Microbiology Syllabus for 2023- 2024 (Ist, IInd, IIIrd & IVth Semester)

MSBT 103: Lab Course Pertaining To Fundamentals of Biochemistry

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

Max. Marks: 50

Pass Marks: 40%

Course Objectives: This course covers the Qualitative and quantitative analysis of major biomolecules of a cell i.e. carbohydrates, proteins, lipids and nucleic acids and different techniques used.

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

1. Do the analysis of protein, carbohydrate, sugar.
2. Understand the importance and perform the different test to analysis the biomolecules
3. Do the qualitative and quantitative analysis of sugars.

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. Qualitative test for proteins.
2. Determination of pK_a value of amino acid.
3. Determination of protein by Biuret and Lowry's method.
4. Qualitative test for carbohydrates.
5. Determination of total sugars by anthrone method.
6. Determination of reducing sugars by Dinitro salicylic Acid (DNSA)
7. Determination of cholesterol.
8. Determine vitamin C content in a citrus fruit by titration method.
9. Isolation of casein protein from milk.
10. Determination of starch content from wheat flour

M. Sc. (Hons.) Microbiology Syllabus for 2023- 2024 (Ist, IInd, IIIrd & IVth Semester)

M.Sc. (Hons.) Microbiology Semester-II Mycology & Phycology (MSMB-201)

Lectures to be delivered: 60 (Credit-4/week)

Max. Marks: 70 Pass

Marks: 40%

Course Objectives: Students will be introduced with fungi and algae, their ultra-structure, nutrition, value added products and their importance in various fields.

Course Outcomes: Students will be able to utilize the knowledge gained in this course in an industry for exploiting the fungi and algae for production of value-added products.

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 units 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 or VAP of fungi: Primary and secondary metabolites, role of fungi in biodegradation, bio-deterioration, nutraceutical, and pharmaceuticals. Production of value-added products, myco-herbicides, mycorrhizal association,

Mushroom Biotechnology: Production technology of button mushroom, oyster mushroom, paddy straw mushrooms

Unit-II

Introduction to Phycology: Different groups of algae and their characteristics, Cellular organization of eukaryotic micro-algae and prokaryotic algae (cyanobacteria), planktonic and benthic algae

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 pisciculture

Industrial applications: Industrial exploitation of algae, use of algae for production of agar-agar, alginate, diatomite, biofuels, role of algae in cosmo-ceutics

Books Recommended

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

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

Mahendra R and Bridge PD (2009) Applied Mycology, 14thEd.,CAB International

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

M. Sc. (Hons.) Microbiology Syllabus for 2023- 2024 (Ist, IInd, IIIrd & IVth Semester)

M.Sc. (Hons.) Microbiology, Semester-II Molecular Biology (MSMB-202)

Lectures to be delivered: 60 (Credit - 4)

Max. Marks: 70 Pass

Marks: 40%

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 throw light on principle and types of genetic material

Course Outcomes: Students will be able to understand the Genetic material and their importance. They will be able to differentiate between DNA and RNA at their structural level in organisms and the way of their synthesis.

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 units 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: Structure of DNA and RNA, Salient features of double helix, types of DNA, denaturation and renaturation, Types of RNA 7

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, topoisomerases 9

Transcription: Definition, promoter concept. Transcriptional machinery and mechanism of transcription in prokaryotes and eukaryotes 8

Translation: Definition, Genetic code, Translational machinery, Mechanisms of initiation, elongation and termination of polypeptides in prokaryotes and eukaryotes 8

Unit-II

Recombination in Prokaryotes: Definition, Mechanism and Proteins involved in recombination 6

Regulation of Gene Expression: Transcriptional regulation, Operon: *lac* and *trp* operons 7

Mutations and Repair: Mutations and Mutagenesis: Definition and types of Mutations: Physical and chemical mutagens, Uses of mutations, DNA repair mechanisms 8

Plasmids and Transposable Elements: Property and function of plasmids, Types of plasmids, Transposable elements, Insertion Sequences, composite and non-composite transposons, replicative and Non-replicative transposition, Uses of transposons and transposition 7

Books Recommended

Watson JD et al (2008) Molecular Biology of the Gene, 6th edition, Cold Spring Harbour Lab. Press, Pearson Publication

Gardner EJ et al (2008) Principles of Genetics, 8th Ed. Wiley-India

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

Brown TA (2011) Introduction to Genetics: A Molecular Approach

M. Sc. (Hons.) Microbiology Syllabus for 2023- 2024 (Ist, IInd, IIIrd & IVth Semester)

M.Sc. (Hons.) Microbiology Semester-II Immunology (MZOO: 201)

Lectures to be delivered: 60 (Credit-4/ week)

Max. Marks: 70

Pass Marks: 40%

Course Objectives: To provide students with a well-balanced and integrated theoretical and practical knowledge of immunology, and to highlight the progress and intellectual challenges in this discipline.

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

1. Compare and contrast the humoral versus cell-mediated immune responses.
2. Critically review the role of cytokines in immunity and immune cell activation and be able to identify and characterize cytokines of particular immune importance.
3. Clearly state the role of the immune system against different pathogens.
4. Distinguish various cell types involved in immune responses and associated functions.
5. Gain knowledge about immunologic processes governing graft rejection and therapeutic
6. Modalities for immune suppression in transplantation

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 units 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

Immune Response: Types of immunity (Innate and adaptive immunity), Features of immune response
Cells, organs and microenvironments of the immune system: Haematopoiesis, Antigen presenting cells Primary lymphoid organs, Secondary lymphoid organs, Lymphocyte traffic, Mucosa associated lymphoid tissue (MALT), Gut associated lymphoid tissue (GALT), Cutaneous associated lymphoid tissue (CALT)

Antibody: Classes, Structure and interactions of antibodies, Biological Functions

Generation of Antibody Diversity: Variable region gene arrangement of light and heavy chain of immunoglobulin, Mechanism of variable region DNA rearrangement, allelic exclusion, Generation of antibody diversity, Somatic hypermutation, Class switching among constant region genes.

Antigen: Nature, Properties, Types of antigen, epitopes, Haptens, Adjuvant, Antigenicity and immunogenicity

Major Histocompatibility Complex: General organization and inheritance of MHC, Structure and function of MHC molecules, Regulation of MHC expression, MHC and immune responsiveness, MHC and disease susceptibility.

Antigen processing and presentation: Exogenous and Endogenous pathways.

Lymphocyte Maturation and Activation: T cell maturation and activation. B cell maturation and activation

Cytokines: Properties and Functions of Cytokines, Therapeutic uses of cytokines

The complement system: Major pathways and regulation of complement activation, Functions of components of complement system, Complement deficiencies

Unit –II

Immune Response: Immune response to viruses, bacteria, protozoa, helminths and tumours.

Auto immunity: Organ specific autoimmune diseases, systemic autoimmune diseases, Mechanisms for induction of autoimmunity. AIDS, Chronic inflammation

Vaccines: Active and passive immunization, Whole organism vaccines, Purified macro-molecules as vaccines, Recombinant vaccines, DNA vaccines, Synthetic peptide vaccines, Multivalent subunit vaccines.

Hypersensitive reactions: Classification, IgE mediated (Type-I) hypersensitivity, Antibody –mediated

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cytotoxic (Type-II) hypersensitivity, Immune complex mediated (Type-III) hypersensitivity, TDTH mediated (Type –IV) hypersensitivity.

Transplantation Immunology: Immunological basis of graft rejection, Clinical manifestation of graft rejection, Immunosuppressive therapy, Clinical transplantation.

Cancer and immune system: Origin, Malignant transformation of cells, Oncogenes and cancer induction, Tumors of the immune system, Tumor evasion of the immune system, Cancer immunotherapy.

Brief introduction to experimental methods: Antibody generation by hybridoma technology, Immunoprecipitation based techniques, Agglutination reactions, Antibody assays (Enzyme-linked immunosorbent assay, Radial Immunodiffusion), Immunofluorescence based techniques. Flow cytometry, Cell sorting.

Books Recommended

Abul Abbas Andrew H. Lichtman Shiv Pillai. (2000) Cellular and Molecular Immunology W.B. Saunders.

Eli Benjamini, Richard Coico, and Geoffrey Sunshine (2000) Immunology – A short course, Wiley Liss.

Cooper, E.L. (1976) Comparative Immunology, Prentice Hall.

M. Sc. (Hons.) Microbiology Syllabus for 2023- 2024 (Ist, IInd, IIIrd & IVth Semester)

M.Sc. (Hons.) Microbiology Semester-II Biostatistics (MSMAT 001)

Lectures to be delivered: 60 (Credit-4/ week)

Max Marks: 70

Pass Marks: 40%

Course Objective: The Objective of this course is to make the students conversant with various techniques used in summarization and analysis of data. Handling of variable and attribute data to study their characteristics & association, regression analysis and hypotheses testing will be aimed at.

Course Outcomes: Upon completion of this course, students should be able to:

- Understand the Applications of Bio statistics. Identify the population of interest, parameter, sample and statistics from a study. Select and analyses the sample according to simple random sampling.
- Correctly identify the appropriate null and alternative hypotheses, including one or two sided, for a given study objective.
- Identify correctly what the Type I and Type II errors would be when presented with the results of a statistical study. Compute and interpret the results of Bivariate Regression and Correlation Analysis.
- Ability to apply parametric and non-parametric tests and able to make the appropriate statistical decision.
- Recognize the situation in which the analysis of variance (ANOVA) is appropriate and able to perform one-way and two-way ANOVA.

INSTRUCTIONS FOR THE PAPER SETTERS /CANDIDATES

The question paper will consist of three Sections A, B and C. Sections A and B will have four questions from respective units of the syllabus. Each question will have 10 marks. The students are required to attempt two questions from each section. Section C will be compulsory having only one question which will consist of ten short answer type parts covering the whole syllabus. This question carries 30 marks.

Use of scientific non-programmable calculator is allowed.

Unit-I

Introduction to Bio-Statistics: Basic definitions and applications of Bio-statistics

Simple random sampling with and without replacement (definition only), stratified sampling (definition only)

Testing of Hypotheses: The concept of statistical hypotheses, null and alternative hypotheses, simple and composite hypotheses, critical region, level of significance, two types of errors (definition only), concept of p-value

Correlation: Positive and negative correlation, Karl-Pearson's co-efficient of correlation, Spearman Rank Correlation Coefficient

Unit-II

Regression: Linear and non-linear regression.

Tests of significance: Small sample tests (Chi-square test, t- test, F- test), large sample tests (Ztest) (applications only).

Analysis of variance: Analysis of variance with one way and two way classified data (concept and examples only)

Books Recommended

S.C. Gupta, V. K. Kapoor: Fundamentals of Applied Statistics, Sultan Chand & Sons Educational Pub. New Delhi, 2018

S.C. Gupta, V. K. Kapoor: Fundamentals of Mathematical Statistics, Sultan Chand & Sons Educational Pub. New Delhi, 2019

Gun, A.M., Gupta, M. K. and Dasgupta, B.: Fundamentals of Statistics, Vol. I, World Press Pvt. Ltd., 2013

Gun, A.M., Gupta, M. K. and Dasgupta, B.: An outline of Statistical Theory Vol.-II, World Press Pvt. Ltd., 2016

M. Sc. (Hons.) Microbiology Syllabus for 2023- 2024 (Ist, IInd, IIIrd & IVth Semester)

M.Sc. (Hons.) Microbiology Semester-II

Bioinformatics and computational Biology (MSBT-202)

Lectures to be delivered: 45 (Credit-3)

Max Marks: 50

Pass Marks: 40%

Course Objectives: To make the student familiar with the fundamentals of computer and Bioinformatics. To become familiar with Sequence Analysis and Phylogenetic Trees & their construction.

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

1. Utilize the applications of computer in biological sciences.
2. Access and retrieve information from various primary and secondary databases.
3. Analyze and align the sequence by using different bioinformatics techniques.

INSTRUCTIONS FOR THE PAPER SETTER/CANDIDATE

The question paper will consist of three sections A, B and C. Section-A and B will have four questions from the respective units of the syllabus and carry 09 marks each. Section- C will consist of 07 short answer type questions which will cover the entire syllabus uniformly and will carry 14 marks in all. Candidates are required to attempt two questions each from sections A and B. Section-C is compulsory.

Unit-I

Bioinformatics: Introduction, its goals and Applications, Role of Computers in Bioinformatics.

Biological Databases: Characteristics and Classification of Databases- Primary (INSDC), secondary (PROSITE), Composite (UNIPROT) and Specialized Databases (REBASE).

Sequence Analysis: Introduction, methods of sequence analysis, Local and Global alignment; Dot plot & Dynamic Programming

Unit-II

Heuristic methods: algorithm and versions of FASTA & BLAST. Scoring matrices: PAM & BLOSSUM

Multiple Sequence Alignment: Methods and Applications of multiple seq. alignment, Introduction to Clustal W

Phylogenetic Trees & their construction: Branches, Nodes, Clade, Taxa, OUT, Rooted and Unrooted tree. Forms of Tree representation: Phylogram, Cladogram, Dendrogram. Methods used for construction and evaluation of phylogenetic trees

Books Recommended

Xiong J. Essential Bioinformatic, Cambridge University Press.

David W. Mount. Bioinformatics: Sequence and Genome Analysis, CSHL Press.

Rastogi RC. Bioinformatics: Concepts, Skills and applications, CBS publishers.

Westhead DR, Parish JH, Twyman RM. Bioinformatics, BIOS.

Baxevanis D, Ouellette BF. Bioinformatics: A Practical Guide to analysis of Genes and Genomes, John Wiley & Sons.

Tomita M, Nishioka T. Metabolomics: The Frontier of Systems biology. Springer Verlag.

James FK, Keith WR. Computer Networking: A Top-Down Approach Featuring the Internet. Prentice Hall

M. Sc. (Hons.) Microbiology Syllabus for 2023- 2024 (Ist, IInd, IIIrd & IVth Semester)

MSMB 203: Lab course pertaining to Mycology & Phycology

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

Max. Marks: 50

Pass Marks: 40%

Course objective: Student will learn about fungi and algae. Student will learn isolation of fungi and algae, their growth profile, morphological and microscopic characterization, mushroom cultivation and also the biofuels production from algae.

Course outcome: After completion of this subject student will be able to understand about the basic requirements for the growth of fungi and algae along with their applications in daily life.

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 fungi from soil and water
- 3 Morphological and microscopic characterization of fungi
- 4 Growth profile of fungi
- 5 Detection of aflatoxin in given samples
- 6 Isolation of algae from water
- 7 Morphological and microscopic characterization of algae
- 8 Production of button mushroom
- 9 Production of algal biofertilizers
- 10 Production of algal Biofuels

Books Recommended

R.S Mehrotra and K R Aneja (2005) An Introduction to mycology, New age International Publisher.

Mohammed S et al (1998) Mycology Manual

Christopher S. et al (1988) Experimental Phycology: a laboratory manual

M. Sc. (Hons.) Microbiology Syllabus for 2023- 2024 (Ist, IInd, IIIrd & IVth Semester)

MSMB 204: Lab course pertaining to Molecular Biology

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

Max. Marks: 50

Pass Marks: 40%

Course objective: Student will be introduced to molecular background of living beings along with the impact of different physical and chemical agents on them.

Course outcome: After completion of this paper student will be able to apply this knowledge in the various fields with the development of genetically improved microorganisms by different physical and chemical means.

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 total RNA from yeast cell
- 3 Determination of λ_{\max} for given nucleic acid
- 4 Qualitative and quantitative estimation of DNA
- 5 Determination of molecular weight/ size of given DNA using Agrose gel and Gel Doc
- 6 Determination of T_m of given DNA sample
- 7 To study the effect of UV radiations on the growth of bacteria
- 8 To study the effect of chemical mutagens on the growth of bacteria
- 9 To perform Replica plating

Books Recommended

R K Sharma and SPS Sangha (2013) Basic Techniques in Biochemistry and molecular biology, I.K. International

Sue Carson et al (2019) Molecular Biology Techniques

M. Sc. (Hons.) Microbiology Syllabus for 2023- 2024 (Ist, IInd, IIIrd & IVth Semester)

MZ P: 206: Lab Course pertaining to Immunology

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

Max. Marks: 50

Pass Marks: 40%

Course Objectives: To provide students with a well-balanced and integrated practical knowledge of immunology, and to highlight the progress and intellectual challenges in this discipline.

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

1. Perform techniques like ELISA, hemagglutination assay, SDS-PAGE.
2. To check the viability of WBC and separate lymphocytes from peripheral blood.
3. Understand the practical knowledge of immune response.

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 demonstrate the process of Hemagglutination assay
2. To demonstrate ELISA (Enzyme linked Immunosorbent Assay) technique
3. To separate lymphocytes from peripheral blood
4. To estimate the viability of the WBCs isolated from the blood
5. Ouchterlony (double diffusion) assay for Antigen -antibody specificity and titre
6. Demonstration of SDS-PAGE
7. To demonstrate Immuno-electrophoresis
8. Study of histological slides of lymphoid tissue: Spleen, thymus, lymph node and bone marrow
9. To study the immunodiffusion technique by Single Radial Immunodiffusion
10. Enumeration and calculation of lymphocytes for analyzing lymphocyte subset in Flow Cytometry
11. Study of autoimmune diseases- Systemic lupus erythematosus, Graves' disease, Rheumatoid arthritis and Myasthenia gravis (through pictures/videos)
12. To demonstrate the technique of Western blotting

M. Sc. (Hons.) Microbiology Syllabus for 2023- 2024 (Ist, IInd, IIIrd & IVth Semester)

MSBT-202: Lab Course pertaining to Bioinformatics and computational Biology

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

Max. Marks: 25

Pass Marks: 40%

Course Objectives: This course will enhance the technical knowledge of the students. They will learn different database and software used for study the biomolecules.

Course Outcomes: After the completion of this course student will able to:

1. Use the different software used to analyze the structure of protein.
2. Use different databases to describe the taxonomy information and sequences of different biomolecules.

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 (7.5 Marks) from the list of practical pertaining to lab course. Section B will contain practical to perform in examination (12.5 Marks) Section C will contain, practical note Book Evaluation and Viva Voce (5 Marks).

1. Flat file format of GENBANK
2. Describe databases that can be used to access text information about human diseases.
3. Compare the use of Entrez and ExPasy to retrieve information about a protein sequence.
4. Perform pairwise alignments of the proteins using PAM 30, Pam 70 and PAM 250 matrices.
5. Compare sequence and taxonomy information from BLAST, PSI-BLAST, PHI-BLAST
6. Creation of molecules and calculation of energy minimization, torsion angles, band distance, bond angle, Ramachandran plot.
7. To perform multiple sequence alignment and evaluation of phylogenetic trees.

M. Sc. (Hons.) Microbiology Syllabus for 2023- 2024 (Ist, IInd, IIIrd & IVth Semester)

Open Elective paper Microbial Technology (MSMB-205)

Lectures to be delivered: 60 (Credit-4)

Max. Marks: 70

Pass Marks: 40%

Course Objectives: Course will help in better understanding of the importance and applications of microbes in therapeutics, food, agriculture and environment. Students will also learn the production and purification techniques for microbial products.

Course outcome: Students get advanced knowledge of applications of microorganisms in different fields. They will be able to use different techniques at industrial level like production, purification of different products.

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 units 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 **10**

Microbial Products and their Recovery: Microbial product purification: filtration, ion exchange & affinity chromatography techniques **6**

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) **8**

RNAi: RNAi and its applications in silencing genes, drug resistance and therapeutics. **7**

Unit-II

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 **10**

Applications of Microbes in Biotransformations: Microbial based transformation of steroids and sterols. Biocatalytic processes and their industrial applications **7**

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. **13**

Books Recommended

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

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

M. Sc. (Hons.) Microbiology Syllabus for 2023- 2024 (Ist, IInd, IIIrd & IVth Semester)

MSMB-205: Lab course pertaining to Microbial technology

Practical Time: 4 Hours/week (Credit -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 Cell immobilization in calcium alginate gels
- 2 Enzyme immobilization by calcium alginate method
- 3 Isolation of lipase producing bacteria
- 4 Isolation of xylanase producing bacteria
- 5 Production of yeast biomass as single cell proteins.
- 6 Qualitative and quantitative estimation of amylase
- 7 Physical, chemical and enzymatic hydrolysis of lignocellulosic residue
- 8 Production of biodiesel
- 9 Whole cell adsorption on alginate and activated charcoal
- 10 Production of nanozymes

Books Recommended

K R Aneja (2014), Laboratory manual of microbiology and biotechnology, Scientific International New Delhi

Surjit Das, Hirak Ranjan Dash (2015), Microbial Biotechnology- A Laboratory Manual for bacterial systems, Springer

M. Sc. (Hons.) Microbiology Syllabus for 2023- 2024 (Ist, IInd, IIIrd & IVth Semester)

M.Sc. (Hons.) Microbiology, Semester-III Environmental Biotechnology (MSMB-301)

Lectures to be delivered: 60 (Credit-4)

Max. Marks: 70

Pass Marks: 40%

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

Course Outcome: Students will be able to understand about environment including pollution, importance of micro-organisms in different environmental Process. Along with this they also learn about the methods to manage the environmental waste to reduce the environmental pollution.

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 units 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: Environmental pollution, types of pollutants, biochemical and physiological effects of pollutants on environments, Indicators of air and water pollution

Metal Microbe Interactions: Bioleaching and Bio-mining-microbiology, biochemistry and applications

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

Treatment of Polluted Air: Biological technologies of Polluted air treatment, Biological Deodorization, Bioscrubbers

Biosensors: Definition, types of biosensors, advantages and disadvantages of biosensor, construction of biosensors, development of biosensors for heavy metal ions (lead and cadmium), insecticides and pesticides (Naphthalene, Anthrene and Lindane)

UNIT-II

Waste Management: Collection and characterization of waste, 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 Waste Management: Activated sludge treatment (AS), Completely mixed conventional activated sludge (CCAS), contact stabilizer (CSAS), separation (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)

Anaerobic Waste Management: anaerobic technologies (anaerobic decomposition, anaerobic filter reactor, anaerobic contact reactor, fluidized bed reactor, up-flow anaerobic sludge blanket (UASB), anaerobic baffled reactor)

Books Recommended

Pepper L, Gerba CP, Gentry T and Maier RM (2009) Environmental Microbiology, Elsevier. ScraggA (2005) Environmental Biotechnology, Oxford University Press.

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

Cooper JM and Cass AEG (2003) Biosensors, Oxford University Press.

M. Sc. (Hons.) Microbiology Syllabus for 2023- 2024 (Ist, IInd, IIIrd & IVth Semester)

M.Sc. (Hons.) Microbiology, Semester-III

Food Microbiology (MSMB-302)

Lectures to be delivered: 60 (Credit-4)

Max. Marks: 70

Pass Marks: 40%

Course Objective: Course objectives are to introduce students with microorganisms associated with food, importance of microbes in food and their applications in food industries along with HACCP and FSSAI standards.

Course outcome: Student will be able to identify the microorganisms associated with food spoilage along with important physico-chemical methods to control these microorganisms. Along with this, students will also be able to utilize the microorganisms in different fermentation and production processes.

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 units 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, factors influencing microbial growth in food, extrinsic and intrinsic factors 5

Food spoilage and preservation: Detection of spoilage and characterization of spoilage organisms, spoilage of cereals, vegetables, fruits, milk and milk products, fish and sea foods, poultry, sugar products and canned food, Principles of food preservation, aseptic control of microorganisms (physical methods, TDT curves, chemical preservatives and modified environments 12

Food borne infection and intoxications: Infection and intoxication caused by: *Clostridium*, *Staphylococcus*, *Salmonella*, *Shigella* and *Vibrio* 7

Packaging Material: Selection of packaging material and characteristics of packaging materials: paper (paper board, corrugated paper, fiber board), glass, metals, plastics, foils and laminates, retort pouches and package forms. Packaging techniques: vacuum packaging, modified atmosphere packaging (MAP) and Eco-friendly packaging 6

Unit-II

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), Indian Fermented Foods (Dhokla, Wadas, Rabdi, Idli and Dosa, Bhatore, Jalebi) 10

Food Fermentations II: Fermented meat products, Fermented milk and milk products: kefir, kumis, yogurt, Bulgarian milk, acidophilus milk and cheese 8

Probiotics: Definition, types, microorganisms and health benefits 4

Food testing and quality control: Collection and handling of food samples, food plant sanitation, overview of HACCP and FSSAI standards for potable water and milk 8

Books Recommended

Frazier WC et al (2013) Food Microbiology, 5th edition, McGraw Hill Education

Jay JM et al (2006) Modern Food Microbiology, 7th edition, Springer

Adams M R et al (2015) Food Microbiology, 4th edition, Royal Society of Chemistry

M. Sc. (Hons.) Microbiology Syllabus for 2023- 2024 (Ist, IInd, IIIrd & IVth Semester)

M.Sc. (Hons.) Microbiology, Semester-III Agricultural Microbiology (MSMB-303)

Lectures to be delivered: 60 (Credit-4)

Max. Marks: 50

Pass Marks: 40%

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.

Course Outcome: student will get the deep knowledge of soil and microbial application in agriculture field. They will also able to define the microbial interaction with plants, importance of these microorganisms in geochemical cycles and also production of microbial pesticides.

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 units of the syllabus and carry 09 marks each. Section - C will consist of 07 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 microbiology: History, Soil biota, soil microbial ecology, types of organisms. Soil microbial biomass, microbial interactions, un-culturable soil biota. Microbiology and biochemistry of root-soil interface.

Soil microorganisms: major groups, decomposition of organic matter, soil health, role of rhizospheric microflora in plant productivity, microbial biomass, phyllosphere, Soil enzymes, origin, activities and importance, Soil characteristics influencing growth and activity of microflora.

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: Cycles of important organic nutrients of agriculture (Carbon, nitrogen, sulphur and phosphorus cycles)

Unit-II

Microbial pesticides I: Needs and advantages of bio-pesticides (herbicides, insecticides and fungicides), bacterial insecticides: *Bacillus thuringiensis* 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 and mass production of *Trichoderma* sp. and their mode of action

Microbial pesticides III: Biology of baculoviruses, Baculoviruses as insecticides, mode of action, mass production and applications

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

Bio-fertilizers: General account of microbes used as biofertilizers (nitrogen and phosphorous), industrial production of *Rhizobium* inoculants, assessment of N₂-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

Books Recommended

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. (Hons.) Microbiology Syllabus for 2023- 2024 (Ist, IInd, IIIrd & IVth Semester)

M.Sc. (Microbiology) Semester-III Genetic Engineering (MSBT-302)

Lectures to be delivered: 60 (Credit-4)

Max. Marks: 50

Pass Marks: 40%

Course Objective

1. To make the students conversant with tools and techniques of recombinant DNA technology
2. To make the student acquire sound knowledge of DNA libraries and cloning aspect in organisms
3. To acquaint the student with application of RDT in industry and agriculture

Course Learning Outcomes (CLO)

Students will be able to:

Acquainted to versatile tools and techniques employed in genetic engineering and appraise them with its applications.

Learn about various tools, enzymes used in recombinant DNA technology and can apply the knowledge to modify the useful organisms

INSTRUCTIONS FOR THE PAPER SETTER/CANDIDATE

The question paper will consist of three sections A, B and C. Section-A and B will have four questions from the respective units 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 basic tools: DNA cutting and modifying enzymes (restriction enzymes, alkaline phosphatase, polynucleotide kinase, DNA ligase, endonucleases, exonucleases)

Techniques of Cloning: Principle and types of PCR, Chemical synthesis of DNA: Adaptors, linkers and Homopolymer tailing for in-vitro ligation.

Cloning & Transformation techniques: Plasmids, phages, cosmids, phasmids, their salient features and host-range. Chemical, physical and biological strategies of transformation

DNA libraries: Genomic & cDNA libraries: construction and applications.

Recombinant Selection and identification: Direct and indirect methods: Antibiotic resistant marker selection, X-gal IPTG selection, reporter genes, South-Western screening, North-western screening

Unit-II

Cloning in Prokaryotes: Cloning in model organism: E.coli (vectors and strategies)

Cloning in Eukaryotes: Cloning in Yeast and mammalian cells (vectors and strategies)

Gene Expression in recombinants: Principles of maximizing gene expression, Expression vectors, their salient features and host range: His-tag & GST tag.

Nucleic acid Sequencing I: Principle, procedure and application: NG Sequencing, pyrosequencing, Illumina (Solexa) sequencing, Single molecule real time (SMRT) sequencing.

Applications of rDNA Technology: Recombinant medicinal products; Vaccines and Nucleic acid therapeutics, Agricultural applications: Bt cotton and Flavr Savr Tomato

Books Recommended

Principles of Gene Manipulations by R.W. Old and S.B. Primrose Blackwell Scientific Publication (1981).

Genomes 3 by T.A. Brown, Garland Science, USA (2006)

Principles of Gene Manipulation and Genomics by S.B. Primrose and R. Twymann, Wiley-Blackwell Publishers, USA (2006)

Molecular Cloning by J. Sambrook, E.F. Fritsch and T. Maniatis Cold Spring Harbor, NY(1989)

Gene Cloning by T.A. Brown, Van Nosterland and Teinhold, NY(1986).

M. Sc. (Hons.) Microbiology Syllabus for 2023- 2024 (Ist, IInd, IIIrd & IVth Semester)

MSMB-301: Lab course pertaining to Environmental Biotechnology

Practical Time: 4 Hours/week (Credit -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. 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

Books Recommended

Christon J. Hurst, Ronald L. Crawford, Jay I. Garland, David A. Lipson, Aaron L. Mills, Linda D. Stetzenbach

M. Sc. (Hons.) Microbiology Syllabus for 2023- 2024 (Ist, IInd, IIIrd & IVth Semester)

MSMB-302: Lab course pertaining to Food Microbiology

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

Max. Marks: 50

Pass Marks: 40%

Course objective: Students will be introduced with physical and chemical preservatives, along with quality check of different foods and food products.

Course outcome: After completion, student will have thorough knowledge of physical and chemical preservatives along with their importance in food industry. Students will also be able to perform various quality tests of these products.

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 and TSS of given milk sample
- 11 To determine acidity of food sample

Books Recommended

Neelima Garg, K.L. Garg, K.G. Mukerji (2010), Laboratory Manual of Food Microbiology, I.K. International Publishing House Pvt. Ltd, New Delhi

Ahmed E. Yousef, Carolyn Carlstrom (2003), Food Microbiology: A Laboratory Manual

M. Sc. (Hons.) Microbiology Syllabus for 2023- 2024 (Ist, IInd, IIIrd & IVth Semester)

MSMB-303: Lab course pertaining to Agricultural Microbiology

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

Max. Marks: 25

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 (06 Marks) from the list of practical pertaining to lab course. Section B will contain practical to perform in examination (13 Marks). Section C will contain practical note Book Evaluation and Viva Voce (06 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 Mass production and carrier mixing of *Rhizobium* inoculants
- 13 Counting the most probable number (MPN) of *Rhizobium*
- 14 Counting total number of viable bacteria in a biofertilizer packet

Books Recommended

K R Aneja (2017), Fundamentals Agricultural Microbiology, New Age International (P) Ltd Publisher

M. Sc. (Hons.) Microbiology Syllabus for 2023- 2024 (Ist, IInd, IIIrd & IVth Semester)

MSBT-306: Lab course pertaining to Genetic Engineering

Practical Time: 4 Hours/week (Credit -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. Isolation of plasmid DNA from *E. coli* cells.
2. Restriction digestion of plasmid DNA.
3. Determination of Molecular weight of DNA by agarose gel electrophoresis.
4. Determine the transformation efficiency of *E. coli* cells by chemical method.
5. Selection of transformants in *E.coli* by X gal/ ampicilin markers
6. Amplification and evaluation of DNA with Polymerase Chain Reaction (PCR).
7. Isolation and analysis of total RNA from eukaryotic cells

M. Sc. (Hons.) Microbiology Syllabus for 2023- 2024 (Ist, IInd, IIIrd & IVth Semester)

M.Sc. (Hons.) Microbiology, Semester-IV Medical Microbiology (MSMB-401)

Lectures to be delivered: 60 (Credit – 4/week)

Max. Marks: 70

Pass Marks: 40%

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.

Course Outcome: student will get the deep knowledge of pathogenic microorganism and their effects on host. They will able to distinguish between normal micro-flora, pathogenic microorganism and pathogens and get the knowledge of 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 units 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 aeruginosa*, *Clostridium*

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 Edi) Philadelphia, PA : Elsevier/Saunders,

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

M. Sc. (Hons.) Microbiology Syllabus for 2023- 2024 (Ist, IInd, IIIrd & IVth Semester)

M.Sc. (Hons.) Microbiology, Semester-IV Industrial Microbiology (MSMB-402)

Lectures to be delivered: 60 (Credit – 4/week)

Max. Marks: 70

Pass Marks: 40%

Course Objectives: Course objectives are to inculcate a better understanding of the microbes in industries and to introduce students with various industrial enzymes, antibiotics, alcoholic beverages, organic acids along with different immobilization techniques.

Course Outcome: Student will be able to exploit the microorganisms in different industries and associated fermentation productions like beverages, antibiotics, enzymes, organic acids.

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 units 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 Industrial Microbiology: Importance of industrial microbiology, industrially important microorganisms, inoculum development, strain improvement, selection of raw materials, medium optimization and formulation

Microbial fermentation processes: Types of fermentations (batch, continuous and fed-batch), open and closed systems, media sterilization: batch and continuous sterilization, concept of heat and mass transfer, Digital control and automation in fermentation process

Fermenter design: Basic components of a fermenter, fermenter construction materials, types of fermenter, impellers, baffle and spargers, sampler design, foam controller

Upstream and Downstream Processing: Inoculum preparation, scale up, Batch filtration, centrifugation, cell disruption, liquid-liquid extraction, solvent recovery, chromatography techniques in product recovery, ultra-filtration and reverse osmosis, drying (lyophilization and spray drying), crystallization

Unit-II

Important industrial products: Bio-ethanol, single cell protein, Baker's yeast production, organic acids (acetic acid and citric acid), lactam antibiotics (Penicillin and streptomycin).

Alcoholic beverages: Non- distilled (beer and wine) and distilled alcoholic beverages (Whisky, rum, brandy).

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

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

Book Recommended

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

Whitaker A and Hall SJ (2003) Principles of Fermentation Technology, 2nd Ed., Pergamon Press,

Oxford, UK Reed B (2005) Prescott and Dunn's Industrial microbiology, 4th edition Young MO

(2011) Comprehensive Biotechnology, 2nd edition, Elsevier

M. Sc. (Hons.) Microbiology Syllabus for 2021- 2022 (Ist ,IInd, IIIrd & IVth Semester)

MSMB-403: Lab course pertaining to Medical Microbiology

Practical Time: 4 Hours/week (Credit -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. 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 as elective pathogen
12. To study the multiple drug resistance for a selective pathogen

Books Recommended

CP Prince (2009), Practical Manual of medical microbiology, Jaypee brothers medical publishers (P) Ltd

M. Sc. (Hons.) Microbiology Syllabus for 2021- 2022 (Ist, IInd, IIIrd & IVth Semester)

MSMB-404: Lab course pertaining to Industrial Microbiology

Practical Time: 4 Hours/week (Credit -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. Construction and working of lab scale bioreactor
2. Production of alcoholic beverages
3. Estimation of alcohol content produced during wine production
4. Whole cell immobilization in calcium alginate gels
5. Enzyme immobilization by calcium alginate method
6. Isolation of lipase producing bacteria
7. To study amylase production and its estimation
8. To study protease production and its estimation
9. To study cellulase production and its estimation
10. Production and estimation of organic acid (citric acid)

Books Recommended

Sugitha Thankappan, P. Raja, R. Rajesh, Shiva kumar Uthandi (2020), Practical Manual cum Work book on industrial Microbiology. Tamil Nadu Agricultural University

Nupur Mathur and Anuradha Singh (2007), Industrial Microbiology: A Laboratory Manual, Aavishkar Publisher Distributors.

M. Sc. (Hons.) Microbiology Syllabus for 2021- 2022 (Ist ,IInd, IIIrd & IVth Semester)

Elective paper

M.Sc. (Hons.) Microbiology, Semester-IV

Advances in Microbiology (MSMB-405)

Lectures to be delivered: 50 (Credit - 3)

Max. Marks: 70

Pass Marks: 40%

INSTRUCTIONS FOR THE PAPER SETTERS

The question paper will consist of three sections A, B and C. Section-A and B will have four questions from the respective units 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

Metagenomics: Definition, collection of diverse environmental samples, Isolation of DNA and RNA, PCR amplification, sequencing, Characterization of the novel genes and strains Recovery, isolation and Molecular characterization of bacteria from Polar and Non-polar glacial Iceland applications of gene cloning of fungal

Metabolomics: History, Metabolome, Metabolites, Metabonomics, Analytical technologies, Separation and detection methods, Key applications

Recent developments in neutraceuticals, pharmaceutical and bioactive potential of microbes

Unit-II

Genetically Engineered Microbes and their applications in medicine, industry and agriculture

Role of bioinformatics in phylogenetic prediction and genome analysis

Signal transduction: History, Signaling molecules, Environmental stimuli, Cellular responses, Types of receptor, Cell-surface receptors, G-protein-coupled receptors, Receptor tyrosine kinases, Integrins, Toll-like receptors, Ligand-gated ion channel receptors, Intracellular receptors, Second messengers(Calcium, Lipophilic, Nitric oxide)

Application of molecular tools (rep, eric, ISR etc) in microbial taxonomy

Books Recommended

Muniyandi Nagarajan (2018), Metagenomics Perspectives, Methods and applications.

Reena Singh Chopra, Chirag Chopra, Neeta Raj Sharma (2020), Metagenomics: Techniques, Applications, Challenges and opportunities

Paul L.Wood (2020), Metabolomics, Springer US, 2020

M. Sc. (Hons.) Microbiology Syllabus for 2021- 2022 (Ist ,IInd, IIIrd & IVth Semester)

M.Sc. (Hons.) Microbiology, Semester-IV Clinical and Diagnostic Microbiology (MSMB-405)

Lectures to be delivered: 50 (Credit – 3/week)

Max. Marks: 70

Pass Marks: 40%

Course Objectives: Course will help in better understanding of the clinical Microbiology. Students will learn about the procedures to test (hematology, immunology and urology) laboratory samples (like urine, blood, sputum. Wound, CSF, Nasopharyngeal etc), their handling and result analysis.

Course Outcome: after the completion of this course student get perfection to handle the different body samples to analyses their hematology, immunology and urology studies. They will also get awareness about the laboratory practices and safety procedures to handle the pathogenic samples in lab

INSTRUCTIONS FOR THE PAPER SETTERS

The question paper will consist of three sections A, B and C. Section-A and B will have four questions from the respective units 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 Clinical Microbiology: history and application of microbiology in clinical diagnosis of different diseases. Define and contrast: (i) endemic and epidemic; (ii) disease prevalence and incidence, pandemic and epidemic

Laboratory Practices: List and describe the possible routes of laboratory- acquired infections, Name the agencies that recommend policy for laboratory safety, GLP, Discuss personal protective equipment and its purpose in the clinical laboratory, Summarize the criteria for and differentiate Biosafety Levels 1, 2, 3, and 4, Describe the five types of hazardous chemicals

Unit II

Specimen collections: Concept of specimen collection and instructions follow during the specimen collection in lab, basic requirement for nasopharyngeal, sputum, urine (clean catch, catheterized, suprapubic), wound, stool, cerebral, throat, spinal fluid (CSF), blood

Hematology and Immunology: Introduction to hematology, Physical and chemical properties of body fluids like amniotic fluid, CSF, pleural fluid, synovial fluid, peritoneal their micro-organism, Qualitative test for ABO grouping, HB, TLC, DLC, VDRL, WIDAL, Rheumatoid Arthritis test, HBsAG, Leptospira IgM determination by ELISA

Urology: Physical and microscopic examination of urine sample, UTI microflora

Biochemistry: serum electrolytes and ions, Blood Sugar and serum Cholesterol, test related to liver: serum bilirubin estimation, Serum enzymes (SGOT, SGPT), Serum Proteins, Blood ammonia level, Serum albumin, Blood Urea, Serum Uric acid, Serum creatinine

Books Recommended

Sarah Jane Pitt (2018), Clinical Microbiology for diagnostic laboratory Scientists, Wiley-Blackwell publisher

Patricia Tille (2016), Bailey & Scott's Microbiology, Mosby publisher.