Anekant Education Society's

# Tuljaram Chaturchand College, Of Arts, Science & Commerce, Baramati (Autonomous Institute)

## Syllabus (CBCS) for M.Sc. Microbiology

w.e.f. June 2019

# Anekant Education Society's
# Tuljaram Chaturchand College of Arts, Science and Commerce, Baramati

## Autonomous

### Course Structure for M.Sc. - I: Microbiology

| Semester | Paper Code | Title of Paper | No. of Credits |
|---|---|---|---|
| I | MICRO4101 | Microbial Systematics and Diversity | 4 |
| | MICRO4102 | Quantitative Biology | 4 |
| | MICRO4103 | Biochemistry | 4 |
| | MICRO4104 | Cell Biology | 4 |
| | MICRO4105 | Practical Course: Microbial Systematics | 4 |
| | MICRO4106 | Practical Course: Cell biology and Biochemistry | 4 |
| II | MICRO4201 | Virology | 4 |
| | MICRO4202 | Instrumentation | 4 |
| | MICRO4203 | Metabolism | 4 |
| | MICRO4204 | Evolution and Ecology | 4 |
| | MICRO4205 | Practical Course: Biophysics & Virology | 4 |
| | MICRO4206 | Practical Course: Enzymology & Microbial Metabolism | 4 |

# SYLLABUS (CBCS) FOR M.Sc. I.
# Microbiology (w. e. from June, 2019)
# Academic Year 2019-2020

| | |
|---|---|
| Class | : M. Sc. I (Semester- II) |
| Paper Code | : MICRO4201 |
| Paper | : I |
| Title of Paper | : Virology |
| Credit | : 4 |
| No. of lectures | : 60 |

**Course Objectives:**

1. To enrich student's Knowledge about basic chemistry belongs to microbiology.
2. To describe and review the elements of the viral life cycle.
3. Explain vaccine strategies and mechanism of antiviral drug.
4. To help student's build-up a progressive and successful career.
5. Discuss and identify the different viral detection methods.
6. Describe the different cultivation methods of viruses.
7. To describe the mechanism of action of antiviral and antiretroviral drugs.

**Course Outcome:**

**CO1.** Understand basic structures of viruses

**CO2.** Student will understand principles of virus pathogenesis.

**CO3.** Understand basic knowledge of virus cultivation and detection methods.

**CO4.** Over all understanding about bacteriophages therapy for control bacterial diseases.

**CO5.** Students will understand viral replication strategies and compare replication mechanism used by viruses.

**CO6.** Understand different types of vaccines and antiviral agents.

**CO7.** To comprehend and appreciate the major and varried laboratory techniques and research approaches employed in the field of virology.

**UNIT 1: Structure and Replication of viruses Structure of Viruses (15L)**

- Enveloped and Non enveloped viruses
- Capsid symmetries – Icosohedral, Polyhedral and Helical
- Structural components of virus – Protein - Envelope proteins, Matrix proteins and Lipoproteins, Genome – dsDNA, ssDNA, dsRNA, ssRNA (positive sense, negative sense and ambisense), linear, circular, segmented
- Virus related structures – Viroids and Prions
- **Replication of viruses**

Mechanism of virus adsorption and entry into host cell
Genome replication
Post transcriptional processing
Translation of viral proteins
Protein nucleic acid interactions and genome packaging
Assembly, exit and maturation of progeny virions

**UNIT 2: Cultivation and Detection methods for viruses Cultivation of viruses (15L)**

- *In ovo*: using embryonated chicken eggs

- *In vivo*: using experimental animals
- *Ex vivo / In vitro:* using various cell cultures - primary and secondary cell lines, suspension cell cultures and monolayer cell culture

**Diagnostic and detection methods for viruses:**

- Direct methods of detection – Light microscopy (inclusion bodies), Electron microscopy and Fluorescence microscopy
- Immnuodiagnosis, Hemagglutination and Hemagglutinationinhibition tests, Complement fixation, Neutralization, Western blot, Radioactive Immuno Precipitation Assay (RIPA), Flow Cytometry and Immunohistochemistry
- Nucleic acid based diagnosis: Nucleic acid hybridization, Polymerase Chain Reaction (PCR), Microarray and Nucleotide sequencing, LINE probe assay
- Infectivity assay for animal and bacterial viruses – Plaque method, Pock counting, End point methods, LD50, ID50, EID50, TCID50
- Infectivity assays of plant viruses

**UNIT 3: Bacteriophages** **(15L)**

Bacteriophage ecology

Morphology, Genome organization and Life cycles

- T (odd and even phages)
- Lambda phage
- M13 phage
- Phi X 174 phage
- MS2 phage

Bacteriophage therapy for control of bacterial diseases

**UNIT 4: Viral Therapeutics** **(15L)**

Vaccines

Conventional vaccines: Killed and attenuated

Modern vaccines: Concepts and examples (DNA vaccines, Recombinant DNA/protein vaccines, Subunits vaccines, Peptide vaccines, Anti-idiotype vaccines, Edible vaccines, Vaccine formulations and delivery: Adjuvants, immunomodulators, cytokines)

Antivirals:

- Designing and screening
- Mechanism of action (e.g. Nucleoside analogues, Nucleotide analogues, Antisense, Topical immune modulator, neuraminidase inhibitors, Ion channel function inhibitors of M2 proteins, Pyrimidines)
- Antiretrovirls
- Mechanism of action
- Mechanism of resistance

Modern approaches of virus control

- Small interfering RNA (siRNA)
- Ribozymes

**Text / Reference Books:**


- Cann A.J, (2005), Principles of Molecular Virology, 4th Ed. Elsevier Academic Press.
- Dimmock N. J., Easton A. J. and K. N. Leppard, (2007), Introduction to Modern Virology, 6th Ed. Blackwell Publishing.
- Edward K. Wagner, Martinez J. Hewlett, (2004), *Basic Virology*, Blackwell Publishing

• Flint S. J., V. R. Racaniello, L. W. Enquist, V. R. Rancaniello, A. M. Skalka, (2003), *Principles of Virology: Molecular Biology, Pathogenesis, and Control of Animal Viruses*, American Society Microbiology.
• Haaheim L. R., J. R. Pattison and R. J. Whitley, (2002), *A Practical Guide toClinical Virology. 2nd Ed.* Edited by, John Wiley & Sons, Ltd.
• Knipe David M., Peter M. Howley, Diane E. Griffin, Robert A. Lamb, Malcolm A. Martin, Bernard Roizman, Stephen E. Straus, (2007), *Field's Virology,* 5th Ed. Lippincott Williams & Wilkins
• Luria S. E. et.al. (1978) *General virology*, 3rd Ed, New York. John Wiley and Sons.
• Straus J. H. and Straus E.S. (1998) *Evolution of RNA Viruses* Ann. Rev. Microbiol. 42: 657 – 83
• Mahy B. WJ. And Kangro H.O., (1996), Virology Methods Manual, Academic Press.
• Shors T. (2011), Understanding Viruses, 2nd Ed., Jones & Bartlett Publishers LLC, Canada.
• Stephenson J. R. and Warnes A., (1998), Diagnostic Virology Protocols: Methods in Molecular Medicine, Humana Press.
• Wiedbrauk D. L. and Farkas D.H., (1995) Molecular Methods For Virus Detectin, Academic Press.
• Calendar R. and Abedon S. T. (2006), The Bacteriophages, 2nd Ed. Oxford University Press.
• Douglas John, (1975), *Bacteriophages*, Chapman and Hall, London.
• Guttman Burton S. and Elizabeth M. Kutter, (2002), *Bacteriophage Genetics*, Uldis N. Streips and Ronald E. Yasbin, Editors, Modern Microbial Genetics, 2nd Ed., Wiley- Liss Inc.
• Colmon M. P. (2009) New New antivirals and drug resistance, Annual Review of Biochemistry, 78, 95 – 118.

**Mapping of Program Outcomes with Course Outcomes**

**Weightage**:1=weak or low relation,2=moderate or partial relation,3=strong or direct relation

| | **Programme Outcomes(POs)** | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| **CourseOutcoms** | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 |
| CO1 | 2 | | | | 2 | | | | 2 |
| CO2 | | 3 | | | 3 | | | 3 | |
| CO3 | | 2 | | 3 | 2 | 3 | | | 3 |
| CO4 | 2 | 3 | | 2 | | 3 | | 3 | 3 |
| CO5 | 3 | 3 | | | | | | | |
| CO6 | 2 | 2 | | 3 | 3 | 2 | | 3 | 2 |
| CO7 | 3 | 3 | | 3 | 2 | 3 | | | 3 |

**Justification for the mapping**

**PO1: Disciplinary Knowledge**

CO1:Student get basic knowledge of viruses

CO4:Acquired knowledge regarding bacteriophages therapy to control bacterial diseases

CO5:Students will understand strategies and mechanism of viruses replication.

CO6:Student get knowledge of different types of vaccines and antiviral agents

CO7:Students get familiar to different laboratory techniques and research approaches employed in the field of virology

**PO2: Critical Thinking and Problem Solving**

CO2:Students will apply learned knowledge to understand virus pathogenesis.

CO3:Students get basic knowledge of virus cultivation and detection methods

CO4:Overall understanding about bacteriophages therapy for control bacterial diseases

CO5: Students will apply learned knowledge to compare replication mechanism used by viruses.

CO6:Students understand the mode of action of vaccines and antiviral agents

CO7:To comprehend techniques and research approaches employed in the field of virology

**PO4: Research related skill and Scientific temper.**

CO3:Understand basic knowledge of virus cultivation and detection methods

CO4:Students acquired knowledge to use bacteriophages therapy to control bacteria diseases

CO6:Student able to apply and analyze the inference of effect of different types of vaccines and antiviral agents

CO7:To comprehend and appreciate the major and varied laboratory techniques and research approaches employed in the field of virology

**PO5: Trans-disciplinary Knowledge**

CO1:Understand basic structures of viruses

CO2:Student will aware about different virus infections.

CO3:Understand basic knowledge of virus cultivation and detection methods

CO6:Understand different types of vaccines and antiviral agents

CO7:Students explore and employed the knowledge in the field of virology

**PO6:Personal and Professional Competence**

CO3:Understand virus cultivation

CO4:Student shall use bacteriophages therapy for control bacterial diseases

CO6:Understand different types of vaccines and antiviral agents

CO7:To comprehend and appreciate the major and varied laboratory techniques and research.approaches employed in the field of virology

**PO8: Environment and Sustainability**

CO2:Student will aware to virus pathogenesis

CO4:Overall understanding about bacteriophages therapy for control bacterial diseases

CO6: Student will aware about the action of vaccines and antiviral agent

**PO9:Self-directedandLife-longLearning**

Students will understand over all knowledge related to virology subject

# SYLLABUS (CBCS) FOR M.Sc. I.
# Microbiology (w. e. from June, 2019)
# Academic Year 2019-2020

| | |
|---|---|
| Class | : M. Sc. I (Semester- II) |
| Paper Code | : MICRO4202 |
| Paper | : II |
| Title of Paper | : Instrumentation |
| Credit | : 4 |
| No. of lectures | : 60 |

**Course Objectives:**

1. To Define and understand fundamental concepts in instrumentation, including sensors, transducers, actuators, and signal conditioning.
2. To Identify and explain the functions of various instrumentation components, such as amplifiers, filters, and signal processors
3. To understand, analyze and design measurement systems for different physical parameters, considering accuracy, precision, and reliability.
4. Gain practical experience through laboratory exercises, projects, or case studies that involve the use and implementation of instrumentation
5. To explore different sensor technologies and their applications, including but not limited to temperature sensors, pressure sensors, and displacement sensors.
6. To enrich Knowledge about the ability to calibrate instruments and assess their accuracy, precision, and reliability.
7. Explore the application of instrumentation in various industries, such as manufacturing, healthcare, and environmental monitoring.
8. Develop skills in troubleshooting instrumentation systems and perform routine maintenance to ensure proper functionality.
9. Develop project management skills, including planning, execution, and documentation, in the context of instrumentation projects.

**Course Outcome:**

CO1. Gain a fundamental understanding of the principles of instrumentation, including sensors, transducers, signal conditioning, and measurement techniques.

CO2. Learn about various measurement devices used in instrumentation, such as pressure gauges, temperature sensors, flow meters, and level detectors.

CO3. Develop the ability to design instrumentation systems for specific applications, considering factors such as accuracy, precision, and reliability.

CO4. Gain practical, hands-on experience with instrumentation devices and systems through laboratory exercises, projects, or internships.

CO5. Understand the role of instrumentation in control systems and learn about feedback control mechanisms.

CO6. Gain knowledge of safety standards and regulations related to instrumentation, ensuring that instrumentation systems comply with industry and safety guidelines.

CO7. Develop skills in troubleshooting instrumentation systems and performing routine maintenance to ensure optimal performance.

**UNIT 1: Chromatography** **(15L)**

Partition Coefficient, Selectivity, Resolution, Column Efficiency, Van Deemter equation, Interpretation of chromatograms

Principle, components of instrument, operation and application of:

A. Gel filtration chromatography

B. Ion-exchangeChromatography

C. Affinity chromatography

D. Gas chromatography

E. High Performance Liquid Chromatography

**UNIT 2 Spectroscopy** **(15L)**

Electromagnetic spectrum, Atomic orbitals, Molecular orbitals, Electronic, Rotational and Vibrational transitions in spectroscopy, Interpretation of spectra.

A. UV/Visible spectroscopy- Instrumentation, Molar Absorptivities, Beer and Lamberts Law, Bathochromic and hypsochromic shifts.

B. Fluorescence spectroscopy- Instrumentation, Quantum Yield, Quenching, FRET, Binding and Folding studies

C. Infrared spectroscopy- Principle , Instrumentation, Absorption bands, FTIR and its advantages

D. Circular Dichroism (CD) – Instrumentation, Circular polarization, Delta absorbance, Cotton Effect.

**UNIT 3: Electrophoresis and Centrifugation** **(15L)**

Electrophoresis – AGE, NATIVE PAGE, SDS-PAGE, Isoelectric focusing.

Ultra centrifugation, Differential centrifugation, Isopycnic and Rate zonal centrifugation

**UNIT 4: Microscopy** **(15L)**

Electron microscopy, Immunoelectron microscopy, and Confocal microscopy, Atomic Force Microscopy, Phase contrast Microscopy, Fluorescence Microscopy

**Text / Reference Books:**


- Clive Dennison (2002) *A guide to protein isolation*, Kluwer Academic Publishers
- Pattabhi, V. and Gautham, N. (2002) *Biophysics.* Kluwer Academic Publishers, New York and Narosa Publishing House, Delhi.
- David J Holme, Hazel Peck (1998 ) *Analytical Biochemistry,* 3rd ed ., Prentice Hall, Pearson Education Limited, Harlow England.
- Rodney F. Boyer (2000*) Modern Experimental Biochemistry* 3d edition., Benjamin Cummings.
- Nölting, B. (2006) *Methods in modern biophysics.* Second Edition. Springer, Germany.
- Wilson Keith and Walker John (2005) *Principles and Techniques of Biochemistry and Molecular Biology,* 6th Ed. Cambridge University Press, New York.
- Rolf Ekman, Jerzy Silberring, Ann Westman- Brinkmalm, Agnieszka Kraj (2009) *Mass spectrometry : instrumentation, interpretation, and applications*, John Wiley & Sons, Inc.,Canada.
- Irwin H. Segel (1976) *Biochemical Calculations: How to Solve Mathematical Problems in General Biochemistry,* 2nd Edition. John Wiley & Sons.
- Harvey Lodish, Arnold Berk, S. Lawrence Zipursky, Paul Matsudaira, David Baltimore, and

- James Darnell (2000) Molecular Cell Biology, 4th edition, W. H. Freeman & co., New York.

**Mapping of Program Outcomes with Course Outcomes**

**Weightage**: 1=weakorlowrelation,2=moderateorpartialrelation,3=strongordirectrelation

| | Programme Outcomes(POs) | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| **CourseOutcomes** | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 |
| CO1 | 3 | 2 | 1 | | | | | | |
| CO2 | 1 | 3 | 2 | | 2 | | 2 | | |
| CO3 | 2 | 1 | 3 | 2 | | | 2 | | |
| CO4 | 3 | 2 | 2 | 3 | | | | | |
| CO5 | 2 | | 1 | | 3 | 3 | | | |
| CO6 | | | | 2 | 2 | 2 | 3 | | |
| CO7 | | | | | | 2 | | | 2 |

**Justification for the mapping**

**PO1: Disciplinary Knowledge**

CO1: Students will understand the basic principles of instrumentation, including sensors, transducers, signal conditioning, and measurement techniques.

CO2: Students will develop a deep understanding ofvarious measurement devices used in instrumentation, such as pressure gauges, temperature sensors, flow meters, and level detectors.

CO3: Students will master and developing the ability to design instrumentation systems for specific applications, considering factors such as accuracy, precision, and reliability.

CO4: Students will develop competence in various aspects of practical, hands-on experience with instrumentation devices and systems through laboratory exercises, projects, or internships.

CO5: Students will able to understand the role of instrumentation in control systems and learn about feedback control mechanisms.

**PO2: Critical Thinking and Problem Solving**

CO1: Students will apply their knowledge of instrumentation, including sensors, transducers, signal conditioning, and measurement techniques.

CO2: Students will use their understanding of various measurement devices used in instrumentation, such as pressure gauges, temperature sensors, flow meters, and level detectors.

CO3: Students will apply their knowledge of interpreting ability to design instrumentation systems

CO4: Students will use their understanding of hands-on experience with instrumentation devices and systems

**PO3: Social competence**

CO1: Students will explore to the knowledge of instrumentation in control systems and learn about feedback control mechanisms.

CO2: Students will learn about various measurement devices used in instrumentation, such as pressure gauges, temperature sensors, flow meters, and level detectors.

CO3: Students will gain knowledge to design instrumentation systems for specific applications, considering factors such as accuracy, precision, and reliability.

CO4: Students will develop competence in various practical skills.
CO5: Students will explore the role of instrumentation in control systems and learn about feedback control mechanisms.

**PO4: Research-related skills and Scientific temper**
CO3: Students will able to understand anddevelop the ability to design instrumentation systems for specific applications, considering factors such as accuracy, precision, and reliability.
CO4: Students will apply their knowledge of instrumentation devices and systems through laboratory exercises, projects, or internships.
CO6: Students will be able to comprehend knowledge of safety standards and regulations related to instrumentation, ensuring that instrumentation systems comply with industry and safety guidelines.

**PO5: Trans-disciplinary Knowledge**
CO2: Students will apply of instrumentation, such as pressure gauges, temperature sensors, flow meters, and level detectors.
CO5: Students will employ control systems and learn about feedback control mechanisms of instruments.
CO6: Students will put into practicein safety standards and regulations related to instrumentation, ensuring that instrumentation systems comply with industry and safety guidelines.

**PO6: Personal and Professional Competence**
CO3: Students will demonstrate the ability to interpret to design instrumentation systems for specific applications
CO6: Students will showcase their proficiency in interpreting knowledge of safety standards and regulations related to instrumentation, ensuring that instrumentation systems comply with industry and safety guidelines.
CO7: Students will showcase their capacity for interpretation skills in troubleshooting instrumentation systems and performing routine maintenance to ensure optimal performance.

**PO7: Self-directed and Life-long Learning**
CO2: Students will acquire the skill of learning various measurement devices used in instrumentation, such as pressure gauges, temperature sensors, flow meters, and level detectors.
CO3: Students will develop the ability to design instrumentation systems

**PO9: Self-directed and Life-long learning**
CO7: Students will develop skills in troubleshooting instrumentation systems and performing routine maintenance to ensure optimal performance.

**SYLLABUS (CBCS) FOR M.Sc. I.**
**Microbiology (w. e. from June, 2019)**
**Academic Year 2019-2020**

| | |
|---|---|
| Class | : M. Sc. I (Semester- II) |
| Paper Code | : MICRO4203 |
| Paper | : III |
| Title of Paper | : Metabolism |
| Credit | : 4 |
| No. of lectures | : 60 |

**Course Objectives**

1. Student will able to understand the Basics of Metabolism:
2. Student will able Understand the function of enzymes in metabolic pathways.
3. Student will able Explain enzyme kinetics and regulation.
4. Describe the process of photosynthesis and its significance in energy capture.
5. Understand the light-dependent and light-independent reactions.
6. Describe the role of ATP synthase in oxidative phosphorylation and ATP production.
7. Discuss the role of oxygen as the final electron acceptor in aerobic respiration.

**Course Outcomes**

CO1. Students should demonstrate a thorough understanding of major metabolic pathways, including glycolysis, the citric acid cycle, oxidative phosphorylation, photosynthesis, and various biosynthetic pathways.

CO2. Students should be able to explain the principles of enzyme kinetics and describe how enzymes are regulated in metabolic pathways.

CO3. Understand how cells generate and transfer energy through ATP synthesis and utilization.

CO4. Demonstrate the ability to integrate different metabolic processes and understand how they are interconnected within the cell.

CO5. Gain practical skills in using biochemical techniques to study metabolic processes in the laboratory.

CO6. Apply knowledge of metabolism to real-world scenarios, demonstrating the ability to relate theoretical concepts to practical situations

**UNIT 1: Photosynthesis** **(15L)**

Structure of chloroplast, energy consideration in photosynthesis, light and dark reaction, electron carriers in photosynthesis, Hill reaction, photolysis of water, C3, C4 CAM plants, Photorespiration, Regulation of photosynthesis,

Bacterial photosynthesis: scope, electron carriers, Photosynthetic reaction center, cyclic flow of electrons, bacterial photophosphorylation in various groups of phototrophic bacteria, electron donors other than water in anoxygenic photosynthetic bacteria

**UNIT 2: Nitrogen metabolism** **(15L)**

Biochemistry of biological nitrogen fixation, properties of nitrogenase and its regulation, ammonia assimilation with respect to glutamine synthetase, glutamate dehydrogenase, glutamate synthetase, their properties and regulation, Biosynthesis of five families of amino acids and histidine, Biosynthesis of purine and pyrimidine bases

**UNIT 3: Anaerobic respiration** **(15L)**

Concept of anaerobic respiration, Concept of Assimilation and Dissimilative metabolism, components of electron transfer system and energy generation of bacteria where nitrate, sulfate and co2 acts as terminal electron acceptors

**UNIT 4: Enzyme Kinetics** **(15L)**

King Altman approach to derive – two substrate enzyme catalyzed reactions, types of two substrate enzyme catalyzed reactions, concept of allosterism, positive and negative co-operativity, models of allosteric enzymes (Monod, Wyamann and Changuax model, Koshland, Nemethy and Filmer model), kinetics of allosteric enzyme, Hill plot, examples of allosteric enzymes and their significance in allosteric regulation

**Text / Reference Books:**


- Nelson D. L. and Cox M. M. (2005) *Lehninger's Principles of Biochemistry*, Fourth edition, W. H. Freeman & Co. New York
- Hall D. D. and Rao K. K. (1996) *Photosynthesis* 5th Ed.,Cambridge University Press
- Michael T. Madigan, John M. Martinko, David A. Stahl, David P. Clark (2012) *Brock Biology of Microorganisms*, Thirteenth edition, Benjamin Cummings, San Francisco.
- White David (2000) *Physiology and Biochemistry of Prokaryotes.* 2nd Ed. Oxford
University Press, New York.
- Mandelstam Joel and McQuillen Kenneth (1976) *Biochemistry of Bacterial Growth*, Blackwell Scientific Publication London.
- Moat Albert G. and Foster John W. (1988) *Microbial Physiology* 2nd Ed. John Wiley and Sons New York.
- Palmer Trevor (2001) *Enzymes: Biochemistry, Biotechnology and Clinical chemistry*, Horwood Pub. Co. Chinchester, England.
- Segel Irvin H. (1997) *Biochemical Calculations* 2nd Ed., John Wiley and Sons, New York


**Mapping of Program Outcomes with Course Outcomes**

**Weightage**: 1= weak or low relation, 2= moderate or partial relation, 3= strong or direct relation

| | **Programme Outcomes (POs)** | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| **Course Outcomes** | PO 1 | PO 2 | PO 3 | PO 4 | PO 5 | PO 6 | PO 7 | PO 8 | PO 9 | PO 10 |
| CO 1 | 2 | | | | | | | | 2 | |
| CO 2 | 2 | | | | | | 2 | | 2 | |
| CO 3 | 2 | | | | | | | | 2 | |
| CO 4 | 2 | 2 | | | 2 | | | | 2 | |
| CO 5 | 2 | | | 3 | | | | 3 | 2 | |
| CO 6 | 2 | 6 | 2 | | 2 | 2 | 2 | | 2 | |

**Justification for the mapping**

**PO1.Disciplinary Knowledge:**

CO1: Demonstrating a thorough understanding of major metabolic pathways aligns with disciplinary knowledge. Students are acquiring specialized knowledge in biochemistry and cellular metabolism, which is fundamental to the discipline.

CO2: Explaining the principles of enzyme kinetics and describing enzyme regulation in metabolic pathways contributes to disciplinary knowledge by focusing on the specific mechanisms and intricacies of biochemical processes.
CO3: Understanding how cells generate and transfer energy through ATP synthesis and utilization reinforces disciplinary knowledge in cellular bioenergetics.
CO4: Integrating different metabolic processes and understanding their interconnections within the cell emphasizes a comprehensive grasp of the discipline, showcasing the complexity and interrelatedness of metabolic pathways.
CO5: Gaining practical skills in using biochemical techniques to study metabolic processes in the laboratory enhances disciplinary knowledge through hands-on experience and application of theoretical concepts.
CO6: Applying knowledge of metabolism to real-world scenarios demonstrates the practical relevance of disciplinary knowledge, showcasing its applicability in professional settings.

**PO2.Critical Thinking and Problem Solving:**

CO4: The ability to integrate different metabolic processes requires critical thinking skills to analyze complex interactions and solve problems related to cellular metabolism.
CO6: Applying knowledge of metabolism to real-world scenarios involves critical thinking to bridge theoretical concepts with practical situations**.**

**PO3. Social Competence:**

CO6: Applying knowledge of metabolism to real-world scenarios may involve understanding societal implications of metabolic processes, fostering social competence.

**PO4. Research-related Skill:**

CO5: Gaining practical skills in using biochemical techniques to study metabolic processes in the laboratory aligns with research-related skills, as it involves hands-on experimentation and data collection.

**PO5.Transdisciplinary Knowledge:**

CO4: Demonstrating the ability to integrate different metabolic processes emphasizes transdisciplinary knowledge, as it involves understanding connections between different biological processes.
CO6: Applying knowledge of metabolism to real-world scenarios involves integrating biochemical knowledge with broader contexts, showcasing transdisciplinary thinking**.**

**PO6.Personal and Professional Competence:**

CO6: Applying knowledge of metabolism to real-world scenarios not only demonstrates academic competence but also showcases the ability to apply this knowledge in a professional context, contributing to personal and professional competence**.**

**PO7.Effective Citizenship and Ethics:**

CO2: Describing how enzymes are regulated in metabolic pathways may involve discussing ethical considerations in manipulating biochemical processes, promoting effective citizenship and ethical awareness.
CO6: Applying knowledge of metabolism to real-world scenarios may also involve considering ethical implications, emphasizing the importance of effective citizenship and ethical decision-making.

**PO8.Environment and Sustainability:**

CO5: Gaining practical skills in using biochemical techniques may involve considering environmental aspects, such as sustainable lab practices, promoting awareness of environmental responsibility.

**PO9. Self-directed and Lifelong Learning:**

All COs: Inherent in the entire course outcomes is the promotion of self-directed and lifelong learning, as students are acquiring foundational knowledge and skills that are essential for continuous learning and adaptation in the field of biochemistry and related disciplines.

**SYLLABUS (CBCS) FOR M.Sc. I.**
**Microbiology (w. e. from June, 2019)**
**Academic Year 2019-2020**

| | |
|---|---|
| Class | : M. Sc. I (Semester- II) |
| Paper Code | : MICRO4204 |
| Paper | : IV |
| Title of Paper | : Evolution and Ecology |
| Credit | : 4 |
| No. of lectures | : 60 |

**Course Objectives:**

1. To introduce the concepts of biological basis of evolution and ecology.
2. To enrich students' knowledge about the diversity and complexity of major lineages of life on earth.
3. Recognize the major lineages of life on earth and understand the major characteristics of each lineage.
4. To develop the understanding of ecological interactions among living organisms.
5. To acquaint students with basic properties of populations and interactions among different types of organisms within an ecosystem.
6. To develop the understanding how changes to biogeochemical processes may change ecosystems.
7. To inculcate students how the environment affects species and species distribution.

**Course Outcome:**

CO1. Understand how the major principles of evolution and ecology and to determine the functioning of all life on earth.
CO2. Students will be able to learn the main lines of life's origin and evolution on earth, including the evolution of man.
CO3. Students will be able to acquire knowledge and understanding of the processes of evolution, including natural selection, adaptation and speciation.
CO4. Students will be able to understand how selection pressure arises in ecological interaction and competition between individual and species.
CO5. Students will be able to do simple arithmetic problems and calculations in population dynamics using spreadsheets.
CO6. Understand how biological knowledge is developed, and apply this framework to critically engage with new biological scenarios.
CO7. Students will be able to gain knowledge of key concepts, theories in ecology, life history, population dynamics, and of evolution.

**UNIT 1: Theories of Evolution (30L)**

- History and development of evolutionary theories.
- Neo-Darwinism and its importance in prokaryote evolution.
- Spontaneous mutation controversy, evolution of rates of mutation.
- Types and levels of selection
- Neutral evolution and molecular clocks, phylogeny and molecular distances
- Co-evolution.
- Molecular evolution
- Speciation in sexual and asexual organisms, origin and stability of diversity, diversity of secondary metabolites.

- evolutionary stability of cooperation, sociality and multicellularity in microorganisms
- Game Theory

**UNIT 2: Ecology** **(30L)**

- The Environment: Physical environment; biotic environment; biotic and abiotic interactions. Concept of habitat and niche; niche width and overlap; fundamental and realized niche; resource partitioning; character displacement.
- Population Ecology: Characteristics of a population; population growth curves; population regulation;
- Species Interactions: Types of interactions, interspecific competition, herbivory, carnivory, pollination, symbiosis.
- Community Ecology: Nature of communities; community structure and attributes; levels of species diversity and its measurement; edges and ecotones.
- Ecological Succession: Types; mechanisms; changes involved in succession; concept of climax.
- Ecosystem Ecology: Ecosystem structure; ecosystem function; energy flow; Iceland Geography, primary production and

**Text / Reference Books:**


- Anders Gorm Pedersen, Molecular Evolution: Lecture Notes,February 2005.
- Lindell Bromham and David Penny (2003). The Modern MolecularClock.www.nature.com/reviews/genetics. MARCH 2003 | VOLUME 4, **Page. 216.** Nature Publishing Group.
- Lively Curtis, M. (1996). Host-parasite coevolution and sex. Bioscience **46**, 2, 107.
- Leo C. Vining (1992). Roles of secondary metabolites from microbes.Edited by Derek J. Chadwick, Julie. Whelm Copyright.
- Macan, T. T. (1974). Freshwater Ecology. Longman Group Ltd., London,
- Meadows, P. S. and J. I. Campbell. (1978). An introduction to Marine Science. Blackie &
Son Ltd., Glasgow.
- Richards, B.N. (1987). Microbiology of Terrestrial Ecosystems. Longman Scientific & Technical, New York.


**Mapping of course outcomes and programme outcomes:**

Weightage: 1= weak or low relation, 2= Moderate or partial relation, 3= Strong or direct relation

| | Programme Outcomes (POs) | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Course outcomes (COs) | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 |
| CO1 | 3 | 3 | | | 3 | | | 3 | 3 |
| CO2 | 3 | | | 2 | | | | | 2 |
| CO3 | 3 | | 3 | | | 3 | | | |
| CO4 | 3 | 2 | | 3 | | | | | |
| CO5 | 3 | | | | 3 | 2 | | 2 | |
| CO6 | 3 | 3 | 2 | 2 | | | | | |
| CO7 | 3 | | | | 2 | | | | 3 |

**Justification for the mapping**

***PO1*** **Disciplinary Knowledge:**

CO1: It help to understande major principles in the fields of evolution and ecology, contributing to a comprehensive grasp of life sciences.

CO2: It focuses on the main lines of life's origin and evolution, including the evolution of humans, within the broader context of evolutionary biology.

CO3: It specify the acquisition of knowledge and understanding related to key processes in evolutionary biology, such as natural selection, adaptation, and speciation.

CO5:It incorporate quantitative skills students in the context of population dynamics, emphasizing the application of mathematical concepts within the discipline..

CO7: It specify the acquisition of knowledge in key concepts and theories within the disciplines of ecology, life history, population dynamics, and evolution.

***PO2*** **Critical Thinking and Problem Solving:**

CO1: Students will be able to analyze and comprehend complex principles in evolution and ecology to understand the functioning of life on earth.

CO4: Students will be able to solve problem to analyze and address ecological challenges and competition between individuals and species..

CO6: Students will be able to understand the process of developing biological knowledge and to critically engage with new scenarios.

***PO3*** **Social Competence**

CO3 Understanding evolutionary processes can enhance social competence by providing a foundation for discussions on biodiversity, human origins, and related topics in social settings.

CO6 It enhance social competence in students by promoting adaptability, open-mindedness, and the ability to engage in informed discussions.

***PO4*** **Research-related skills and Scientific temper:**

CO2: Learning the main lines of life's origin involves research-related skills as students engage with scientific literature and concepts.

CO4: Understanding selection pressure involves research-related skills which is require by students to engage with ecological research and literature.

CO6: Encourages a scientific temper by promoting critical engagement and evidence-based thinking in new biological scenarios.

***PO5*** **Trans-disciplinary knowledge:**

CO1: It has potential connections to other disciplines such as environmental science, anthropology, and even philosophy, as it involves understanding life's functioning on a broad scale

CO5: Population dynamics, while rooted in biology, involves mathematical modeling, which can have connections to disciplines like mathematics, statistics, and computer science

CO7: It involve insights from various disciplines such as genetics, environmental science, and even ethics, highlighting the interconnected nature of knowledge.

***PO6*** **Personal and professional competence:**

CO3: Acquiring knowledge in evolutionary processes contributes to personal competence by promoting critical thinking and a deeper understanding of the mechanisms that drive biodiversity.

CO5: Proficiency in quantitative analysis contributes to personal competence in problem-solving and analytical skills.

***PO8*** **Environment and Sustainability:**

CO1: Understanding the major principles of evolution and ecology contributes to environmental awareness.

CO5: Quantitative analysis of populations contributes to informed decision-making for sustainable resource management..

***PO9*** **Self-directed and Life-long learning:**

CO1: Fundamental principles in evolution and ecology are evergreen, encouraging a lifelong interest in understanding the functioning of life on earth.

CO2: The history of life on earth is a continuous and evolving field, fostering a sense of curiosity and interest that extends beyond formal education.

CO7:It Involves gaining knowledge in various key concepts, promoting self-directed learning as students explore these fundamental aspects

**SYLLABUS (CBCS) FOR M.Sc. I.**
**Microbiology (w. e. from June, 2019)**
**Academic Year 2019-2020**

| | |
|---|---|
| Class | : M. Sc. I (Semester- II) |
| Paper Code | : MICRO4205 |
| Paper | : V |
| Title of Paper | : Practical Course: Biophysics & Virology |
| Credit | : 4 |
| No. of lectures | : 60 |

**Course Objectives:**

1. To study qualitative and quantitative determination of bacteriophage.
2. To study animal virus titration by Hemagglutination inhibition test.
3. Interpretation of Ramachandran plot and study of confirmation of protein.
4. To learn the technique of chromatographic separation of a mixture biomolecule.
5. To study the Biological synthesis of nanoparticles and their characterization in laboratory level.
6. To study Calibration of analytical instruments.
7. To study the process of gel filtration chromatography.

**Course Outcome:**

CO1. Students will apply their knowledge regarding to qualitative and quantitative determination of bacteriophage in laboratory.
CO2. Students will understand different virus titration technique in laboratory.
CO3. Students will understand interpretation of Ramachandran plots for study of confirmation of protein.
CO4. Students will get master’s in Calibration of analytical instruments- colorimeter, spectrophotometer.
CO5. Student will know the Biological synthesis of nanoparticles and their characterization in laboratory level.
CO6. Student will understand protein electrophoresis by Native PAGE and SDS PAGE.
CO7. Students will get over all knowledge of gel filtration chromatography.

A. Qualitative and quantitative detection of bacteriophage
B. Animal virus titration by Hemagglutination test
C. Biological synthesis of nanoparticles (actinomycetes /fungi /yeast) and their characterization by UV-Vis spectroscopy.
D. Interpretation of Ramchandran Plot and study of Conformations of protein molecule using Molecular Graphics Visualization Tool.
E. Calibration of analytical instruments – Colorimeter and Spectrophotometer by estimation of biomolecules and Statistical analysis of data generated.
F. Determination of molar extinction coefficient of biological molecule.
G. To determine the ion-exchange capacity and nature of given resin using anion exchange chromatography.
H. Protein electrophoresis by PAGE and SDS PAGE
I. Agarose Gel Electrophoresis

**Text / Reference Books:**

- Nelson D. L. and Cox M. M. (2005) *Lehninger's Principles of Biochemistry*, Fourth edition, W. H. Freeman & Co. New York
- Wilson Keith and Walker John (2005) *Principles and Techniques of Biochemistry and Molecular Biology*, 6th Ed. Cambridge University Press, New York.
- Palmer Trevor (2001) *Enzymes: Biochemistry, Biotechnology and Clinical chemistry*, Horwood Pub. Co. Chinchester, England.
- Segel Irvin H. (1997) *Biochemical Calculations* 2nd Ed., John Wiley and Sons, New York

**Mapping of Program Outcomes with Course Outcomes**

**Weightage**:1=weak or low relation,2=moderate or partial relation,3=strong or direct relation

| | Programme Outcomes (POs) | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| **Course Outcomes** | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 |
| CO1 | 3 | 3 | | 3 | 2 | 3 | | 3 | 2 |
| CO2 | | | | | 3 | 2 | | | 3 |
| CO3 | 2 | 2 | | | 3 | | | | 3 |
| CO4 | 3 | 2 | | 2 | | 2 | | | 3 |
| CO5 | 3 | 3 | | | | 3 | | | 3 |
| CO6 | 2 | | | | | 2 | | | 2 |
| CO7 | 3 | 3 | | 3 | 3 | 3 | | | 3 |

**Justification for the mapping**

**PO1: Disciplinary Knowledge**

CO1: Student get basic knowledge of bacteriophage cultivation in laboratory.

CO3:Students will understand interpretation of Ramachandran plots for study of confirmation of protein.

CO4:Acquired knowledge regarding Calibration of analytical instruments- colorimeter, spectrophotometer

CO5:Students get knowledge of biological nanoparticles synthesis in laboratory.

CO6andCO7:Student get knowledge about agarose gel electrophoresis Native PAGE and SDS PAGE gel filtration chromatography.

**PO2: Critical Thinking and Problem Solving**

CO1:Students will apply learned knowledge to qualitative and quantitative determination of bacteriophage in laboratory.

CO3:Students will understand interpretation of Ramachandran plots for study of confirmation of protein.

CO4:Students will get master's in Calibration of analytical instruments- colorimeter, spectrophotometer.

CO5:Overall understanding about nanoparticles.

CO7:To comprehend techniques and research approaches employed in the field of Biophysics and virology.

**PO4: Research related skill and Scientific temper**.

CO1:Students acquired knowledge of bacteriophage cultivation in laboratory.

CO4:Students will get master's in Calibration of analytical instruments- colorimeter, spectrophotometer.
CO7:To comprehend and appreciate the major and varied laboratory techniques and research.approaches employed in the field of Biophysics and virology.

**PO5: Trans-disciplinary Knowledge**
CO1:Understand basic knowledge regarding to virus and bacteriophage.
CO2:Student will aware about different virus infections.
CO3:Understand basic knowledge of bacteriophage cultivation and detection methods.
CO7:Students explore and employed the knowledge in the field of Biophysics and Virology.

**PO6:Personal and Professional Competence**
CO1andCO2: Student get basic knowledge of bacteriophage cultivation and its titration technique in laboratory.
CO4:Acquired knowledge regarding Calibration of analytical instruments- colorimeter, spectrophotometer.
CO5:Students get knowledge of biological nanoparticles synthesis in laboratory.
CO6andCO7:Student get knowledge about agarose gel electrophoresis Native PAGE and SDS PAGE and Gel filtration chromatography.

**PO8: Environment and Sustainability**
CO1:Student will aware about virus pathogenesis.

**PO9:Self-directedandLife-longLearning**
Students will understand over all practical knowledge related to Biophysics and virology subject.

**SYLLABUS (CBCS) FOR M.Sc. I.**
**Microbiology (w. e. from June, 2019)**
**Academic Year 2019-2020**

| | |
|---|---|
| Class | : M. Sc. I (Semester- II) |
| Paper Code | : MICRO4206 |
| Paper | : VI |
| Title of Paper | : Practical Course: Enzymology & Microbial Metabolism |
| Credit | : 4 |
| No. of lectures | : 60 |

**Course Objectives:**

1. Interpret enzyme kinetic data and calculate kinetic parameters.
2. Students should be able to explain the principles of enzyme kinetics
3. Understand the biosynthesis of siderophores and their role in microbial iron acquisition.
4. Develop practical skills in conducting immunological experiments.

**Course Outcome:**

CO1. Demonstrate knowledge of enzyme kinetics, including concepts such as Michaelis-Menten kinetics and enzyme inhibition.
CO2. Calculate and interpret kinetic parameters like Vmax, Km, and Kcat.
CO3. Understand the implications of enzyme research in fields like medicine, biochemistry, and biotechnology.
CO4. Develop critical thinking skills to analyze experimental data related to enzyme activity.
CO5. Learn and apply laboratory techniques for the quantitative and qualitative detection of IAA.
CO6. Explore the diversity of siderophores produced by different microorganisms.

A. Purification of enzyme from natural sources like animal, plant, bacterial/fungal by ammonium sulfate precipitation, organic solvent precipitation, gel filtration, etc.
B. Establishment of enzyme purification chart
C. Determination of Km and Vm values of any hydrolytic enzyme
D. Isolation and characterization of (as nitrogen fixers) *Azospirillum*
E. Detection of IAA by *Azospirillum*
F. Detection of siderophore production by *Azospirillum* and *Pseudomonas*
G. Isolation and characterization of phosphate solublizing bacteria
H. Isolation and characterization of chitin, cellulose and pesticide degrading bacteria
I. Isolation of Aflatoxin producing organism
J. Detection of Aflatoxin in food / culture

**Text / Reference Books:**


• Nelson D. L. and Cox M. M. (2005) *Lehninger's Principles of Biochemistry*, Fourth edition, W. H. Freeman & Co. New York
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| | Programme Outcomes (POs) | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| **Course Outcomes** | PO 1 | PO 2 | PO 3 | PO 4 | PO 5 | PO 6 | PO 7 | PO 8 | PO 9 | PO 10 |
| CO 1 | 3 | | | | | 1 | | | | |
| CO 2 | 2 | | | | | 2 | | | | |
| CO 3 | | | 3 | | 3 | | 2 | | | |
| CO 4 | | 2 | | 3 | | | | | | |
| CO 5 | | | | | | | | | 5 | |
| CO 6 | 2 | | | | | | | | | |

**Justification for the mapping**

**PO1.Disciplinary Knowledge:**

CO1, CO2,CO6: Justification: These outcomes align with disciplinary knowledge as they focus on understanding fundamental concepts and techniques within biochemistry, specifically enzyme kinetics and the diversity of siderophores. Students will gain in-depth knowledge in these areas, establishing a strong foundation in their field.

**PO2.Critical Thinking and Problem Solving:**

CO4: Justification: Analyzing experimental data requires critical thinking skills. Students will need to assess and interpret results, identify patterns, and draw conclusions, contributing to their critical thinking and problem-solving abilities.

**PO3.Social Competence:**

CO3:.Justification: This outcome connects enzyme research to broader societal contexts, emphasizing the social relevance of biochemistry in fields such as medicine and biotechnology. Understanding these implications fosters social competence.

**PO4.Research-Related Skills:**

CO4: Develop critical thinking skills to analyze experimental data related to enzyme activity. Justification: Analyzing experimental data is a fundamental aspect of research-related skills. Students will learn to assess the validity of data, draw conclusions, and contribute to the research process.

**PO5.Transdisciplinary Knowledge:**

CO3: Understand the implications of enzyme research in fields like medicine, biochemistry, and biotechnology.Justification: The implications of enzyme research extend beyond the boundaries of biochemistry, reaching into medicine and biotechnology. This outcome reflects the transdisciplinary nature of knowledge in these fields.

**PO6.Personal and Professional Competence:**

CO1: Demonstrate knowledge of enzyme kinetics, including concepts such as Michaelis-Menten kinetics and enzyme inhibition.
CO2: Calculate and interpret kinetic parameters like Vmax, Km, and Kcat.
Justification: Mastering enzyme kinetics and related calculations enhances personal and professional competence, as these are foundational skills essential for success in biochemistry and related professions.

**PO7.Effective Citizenship and Ethics:**
CO3: Understand the implications of enzyme research in fields like medicine, biochemistry, and biotechnology. Justification: Considering the broader implications of enzyme research in medicine and biotechnology encourages an understanding of ethical considerations. This outcome contributes to effective citizenship by fostering awareness of the ethical dimensions of scientific research.

**PO8.Environment and Sustainability**:
(No direct alignment in the provided outcomes)
Justification: The provided outcomes do not explicitly address environmental or sustainability aspects. However, if the curriculum includes discussions on sustainable practices in biotechnology or the environmental impact of enzyme-related processes, it could contribute to this category.

**PO9.Self-Directed and Lifelong Learning:**
CO5: Learn and apply laboratory techniques for the quantitative and qualitative detection of IAA.Justification: Learning and applying laboratory techniques contribute to self-directed and lifelong learning. Students acquire skills that can be applied independently, fostering a mindset of continuous learning and adaptation.