Estd. 1962
"A++" Accredited by NAAC (2021)
With CGPA 3.52

**SHIVAJI UNIVERSITY, KOLHAPUR - 416004, MAHARASHTRA**
PHONE:EPABX-2609000, www.unishivaji.ac.in, bos@unishivaji.ac.in
**शिवाजी विद्यापीठ, कोल्हापूर -४१६००४,महाराष्ट्र**
दूरध्वनी-ईपीएबीएक्स -२६०९०००, अभ्याससमंडळे विभाग दुरध्वनी ०२३१—२६०९०९४
०२३१—२६०९४८७

**SU/BOS/Science/09** **Date: 02/01/2024**

**To,**

| | |
|---|---|
| The Principal,<br>All Concerned Affiliated Colleges/Institutions<br>Shivaji University, Kolhapur | The Head/Co-ordinator/Director<br>All Concerned Department (Science)<br>Shivaji University, Kolhapur. |

**Subject:** Regarding syllabi of M.Sc. Part-II (Sem. III & IV) as per NEP-2020 (1.0) degree programme under the Faculty of Science and Technology.

**Sir/Madam,**

With reference to the subject mentioned above, I am directed to inform you that the university authorities have accepted and granted approval to the revised syllabi, nature of question paper and equivalence of M.Sc. Part-II (Sem. III & IV) as per NEP-2020 (1.0) degree programme under the Faculty of Science and Technology.

| **M.Sc.-II (Sem. III & IV) as per NEP-2020 (1.0)** | | | |
|---|---|---|---|
| 1. | Mathematics | 9. | Gen Microbiology |
| 2. | Mathematics (Distance Mode) | 10. | Pharmaceutical Microbiology (HM) |
| 3. | Mathematics (Online Mode) | 11. | Alcohol Technology |
| 4. | MSc.(Mathematics With Computer Application) | 12. | Sugar Technology |
| 5. | Statistics | 13. | Geology |
| 6. | Applied Statistics and Informatics | 14. | AGPM |
| 7. | Electronics | 15. | Geoinformatics |
| 8. | Microbiology (HM) | 16. | Physics |

This syllabus, nature of question and equivalence shall be implemented from the academic year 2024-2025 onwards. A soft copy containing the syllabus is attached herewith and it is also available on university website www.unishivaji.ac.in,NEP-2020 (Online Syllabus).

The question papers on the pre-revised syllabi of above-mentioned course will be set for the examinations to be held in October /November 2024 & March/April 2025. These chances are available for repeater students, if any.

You are, therefore, requested to bring this to the notice of all students and teachers concerned.

Thanking you,

**Dy Registrar**
**Dr. S. M. Kubal**

**Copy to:**

| | | | |
|---|---|---|---|
| 1 | The Dean, Faculty of Science & Technology | 4 | P.G Admission / Eligibility Section |
| 2 | The Chairman, Respective Board of Studies | 5 | Computer Centre/ Eligibility Section |
| 3 | B.Sc. Exam/ Appointment Section | 6 | Affiliation Section (U.G.) (P.G.) |

# SHIVAJI UNIVERSITY, KOLHAPUR

**Established: 1962**

**$A^{++}$ Accredited by NAAC (2021) with CGPA 3.52**

**Structure and Syllabus in Accordance with**

**National Education Policy - 2020**

**with Multiple Entry and Multiple Exit**

## Master of Science Microbiology (H.M.)

## under
## Faculty of Science and Technology

## (To Be Implemented fromAcademic Year 2024-25)

# INDEX

## 1. Preamble:

The two years M. Sc. in Microbiology (H.M.) (NEP) subject under Horizontal Mobility (H.M.)program is formulated for developing competent microbiologists/ biochemists/biotechnologists for which significant job opportunities exist in this country and abroad. The course is based on interdisciplinary nature of Chemistry, Quantitative Biology, Genetics, Microbiology and Biophysics. The program obliges students to read original publications and envisages significant inputs in laboratory work, communication skill, creativity, planning, execution and critical evaluation of the studies undertaken. This program gives common basic knowledge (Biochemistry, Biomolecules, Proteins including Enzymology, Molecular Biology, Tools and Techniques and Basics in Research Methodology which includes Biostatistics and Computers) at first year level to become good microbiologists/biochemists/biotechnologists. The specializations introduced in the course at second year level are in the disciplines of Immunochemistry,Genetic Engineering, Fermentation Technology, Bioinformatics, General Biotechnology, Plant and Animal Cell Biotechnology, Microbiology including Medical Microbiology, Food and Dairy Microbiology and Environmental Microbiology.

## 2. Duration:

Two-Year full-time course with Four semesters.

## 3. Eligibility for Admission:

**i)** B.Sc. Degree (Three years with Six semesters full time course) in Microbiology as principle subject with 50% marks for general category and 45% marks for reservation category.

**ii)** Student have to qualify the entrance examination conducted by Shivaji University for the respective academic year.

## 4. Medium of Instruction:

English

## 5. Program Structure:

### Structure in Accordance with National Education Policy - 2020
### With Multiple Entry and Multiple Exit Options
### M.Sc. Microbiology (H.M.) Part – I (Level-6.0)

| | Course Code | Teaching Scheme | | | Examination Scheme | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | Theory and Practical | | | University Assessment (UA) | | | Internal Assessment (IA) | | |
| | | Lectures (Hours / week) | Practical (Hours / week) | Credit | Maximum Marks | Minimum Marks | Exam. Hours | Maximum Marks | Minimum Marks | Exam. Hours |
| **Semester-I** | | | | | | | | | | |
| **Major Mandatory Theory** | MIC101 | 4 | -- | 4 | 80 | 32 | 3 | 20 | 8 | 0.5 |
| | MIC102 | 4 | -- | 4 | 80 | 32 | 3 | 20 | 8 | 0.5 |
| **Major Elective Theory** | E-MIC 103A **OR** E-MIC 103B **OR** E-MIC 103C | 4 | -- | 4 | 80 | 32 | 3 | 20 | 8 | 0.5 |
| **Major Mandatory Practical** | P-MIC 104 | -- | 8 | 4 | 100 | 40 | 12 | -- | -- | -- |
| | P-MIC 105 | -- | 4 | 2 | 50 | 20 | 6 | -- | -- | -- |
| **Research Methodology** | RM-MIC 106 | 4 | -- | 4 | 80 | 32 | 3 | 20 | 8 | 0.5 |
| **Total** | | | | 22 | 470 | | | 80 | | |
| **Semester-II** | | | | | | | | | | |
| **Major Mandatory Theory** | MIC201 | 4 | -- | 4 | 80 | 32 | 3 | 20 | 8 | 0.5 |
| | MIC202 | 4 | -- | 4 | 80 | 32 | 3 | 20 | 8 | 0.5 |
| **Major Elective Theory** | E-MIC203 | 4 | -- | 4 | 80 | 32 | 3 | 20 | 8 | 0.5 |
| **Major Mandatory Practical** | P-MIC204 | -- | 8 | 4 | 100 | 40 | 12 | -- | -- | -- |
| | P-MIC205 | -- | 4 | 2 | 50 | 20 | 6 | -- | -- | -- |
| **OJT/FP** | OJT-MIC206 | -- | -- | 4 | -- | -- | -- | 100 | 40 | * |

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | **OR** FP-MIC 206 | | | | | | | | | |
| **Total** | | -- | -- | 22 | 390 | -- | -- | 160 | -- | -- |
| **Total (Sem I + Sem II)** | | -- | -- | 44 | 860 | -- | -- | 240 | -- | -- |

| | |
|---|---|
| • MIC –MajorMandatory Theory<br>• P-MIC –MajorMandatory Practical<br>• E-MIC –Major Elective Theory<br>• RM - MIC - Research Methodology<br>• OJT- MIC /FP- MIC - On Job Training/ Field Project | • Total Marks for M.Sc.-I: **1100**<br>• Total Credits for M.Sc.-I (Semester I & II): **44**<br>• Separate passing is mandatory for University and Internal Examinations |
| *Evaluation scheme for OJT/FP shall be decided by concerned BOS | |
| Requirement for Entry at Level 6.0:<br>**B. Sc in Microbiology as principle subject with 50% marks and appeared for entrance examination. (as per eligibility)** | |
| Requirement for Exit after Level 6.0:<br>**Students can exit after completion of Level 6.0 (44 Credits) with Post Graduate Diploma in Microbiology (H.M.)** | |
| Requirement for Entry at Level 6.5:<br>**Completion of Level 6.0** | |

**Structure in Accordance with National Education Policy - 2020**

## With Multiple Entry and Multiple Exit Options
## M.Sc. Microbiology (H.M.) Part – II (Level-6.5)

| | Course Code | Teaching Scheme | | | Examination Scheme | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | Theory and Practical | | | University Assessment (UA) | | | Internal Assessment (IA) | | |
| | | Lectures Hours (Per week) | Practical Hours (Per week) | Credit | Maximum Marks | Minimum Marks | Exam. Hours | Maximum Marks | Minimum Marks | Exam. Hours |
| **Semester-III** | | | | | | | | | | |
| **Major Mandatory Theory** | MIC301 | 4 | -- | 4 | 80 | 32 | 3 | 20 | 8 | 0.5 |
| | MIC302 | 4 | -- | 4 | 80 | 32 | 3 | 20 | 8 | 0.5 |
| | MIC303 | 4 | -- | 4 | 80 | 32 | 3 | 20 | 8 | 0.5 |
| **Major Elective Theory** | E-MIC304 | 4 | -- | 4 | 80 | 32 | 3 | 20 | 8 | 0.5 |
| **Major Mandatory Practical** | P-MIC305 | -- | 4 | 2 | 50 | 20 | 6 | -- | -- | -- |
| **Research Project** | RP-MIC306 | -- | 8 | 4 | 100 | 40 | 12# | -- | -- | -- |
| **Total** | | | | 22 | 470 | | | 80 | | |
| **Semester-IV** | | | | | | | | | | |
| **Major Mandatory Theory** | MIC401 | 4 | -- | 4 | 80 | 32 | 3 | 20 | 8 | 0.5 |
| | MIC402 | 4 | -- | 4 | 80 | 32 | 3 | 20 | 8 | 0.5 |
| | MIC403 | 4 | -- | 4 | 80 | 32 | 3 | 20 | 8 | 0.5 |
| **Major Elective Theory** | E-MIC404 | 4 | -- | 4 | 80 | 32 | 3 | 20 | 8 | 0.5 |
| **Research Project** | RP-MIC405 | -- | 12 | 6 | 150 | 60 | 18## | -- | -- | -- |
| **Total** | | -- | -- | 22 | 470 | -- | -- | 80 | -- | -- |
| **Total (Sem III + Sem IV)** | | -- | -- | 44 | 940 | -- | -- | 160 | -- | -- |

<table>
<tr><td>• MIC –MajorMandatory Theory<br>• P-MIC –MajorMandatory Practical<br>• E-MIC –Major Elective Theory<br>• RP-MIC-Research Project</td><td>• Total Marks for M.Sc.-II: 1100<br>• Total Credits for M.Sc.-II (Semester III & IV): 44<br>• Separate passing is mandatory for University and Internal Examinations</td></tr>
<tr><td colspan="2"># Evaluation Scheme for Research Project shall be decided by concerned BOS</td></tr>
<tr><td colspan="2">## Evaluation Scheme for Research Project shall be decided by concerned BOS</td></tr>
<tr><td colspan="2">Requirement for Exit after Level 6.5:<br>Students can exit after completion of Level 6.5 with Post Graduate in Microbiology (H.M.)</td></tr>
</table>

## Course Code Details: NEP – Microbiology (H.M.) (NEP – 2023)

| Semester I | | Semester II | |
|---|---|---|---|
| MIC 101 | Proteins: Structure and Functions (4 Cr) | MIC 201 | Enzymology (4 Cr) |
| MIC 102 | Biomolecules (4 Cr) | MIC 202 | Molecular Biology (4 Cr) |
| E-MIC 103A<br><br>**OR**<br><br>E-MIC 103B<br><br>**OR**<br><br>E-MIC 103C | Cell Biochemistry and Nucleic Acids (4 Cr)<br><br>Microbial Taxonomy and Molecular Systematics (4 Cr)<br><br>Advances in Drug and Clinical Research (4 Cr) | E-MIC 203 | Tools and Techniques in Biological Sciences (4 Cr) |
| P-MIC 104 | Laboratory Course - I (4 Cr) | P-MIC 204 | Laboratory Course - III (4 Cr) |
| P-MIC 105 | Laboratory Course - II (2 Cr) | P-MIC 205 | Laboratory Course - IV (2 Cr) |
| RM-MIC 106 | Research Methodology (4 Cr) | OJT-MIC 206<br>**OR**<br>FP-MIC 206 | On Job Training (4 Cr)<br>**OR**<br>Field Project (4 Cr) |
| **Semester III** | | **Semester IV** | |
| MIC 301 | Genetic Engineering (4 Cr) | MIC 401 | Bioinformatics (4 Cr) |
| MIC 302 | Immunology (4 Cr) | MIC 402 | Microbial Technology and Bioprocess Design (4 Cr) |
| MIC 303 | Microbial Diversity and Extremophiles (4 Cr) | MIC 403 | Medical Microbiology (4 Cr) |
| E-MIC 304 | Food and Dairy Microbiology (4 Cr) | E-MIC 404 | Environmental Microbiology (4 Cr) |
| P-MIC 305 | Laboratory Course - V (2 Cr) | RP-MIC 405 | Research Project (6 Cr) |
| RP-MIC 306 | Research Project (4 Cr) | | |

## 6. Programme Outcomes (POs):

- Future ready Post Graduate in Microbiology subject
- Well conversant with basic information needed for microbial industries
- Aptitude for knowledge creation by opting for research
- Well equipped with the information needed for scientific competitive examinations
- Aptitude for knowledge transfer to next generation by opting for teaching profession

## 7. Course Codes:

| **M.Sc. Semester–III** | |
|---|---|
| **Major Mandatory** | |
| MIC 301 Genetic Engineering(4Credit**)** | **MSU0325MML931I1** |
| MIC 302 Immunology(4Credit) | **MSU0325MML931I2** |
| MIC 303Microbial Diversity and Extremophiles (4Credit) | **MSU0325MML931I3** |
| P-MIC 305 PracticalCourse–V(2Credit) | **MSU0325MMP931I1** |
| RP-MIC 306 Research Project (4 Credit) | **MSU0325RPP931I** |
| **Major Elective** | |
| E-MIC 304Food and Dairy Microbiology (4 Credit) | **MSU0325MEL931I1** |
| **M.Sc. Semester–IV** | |
| **Major Mandatory** | |
| MIC 401 Bioinformatics(4Credit**)** | **MSU0325MML931J1** |
| MIC 402 Microbial Technology and Bioprocess Design (4Credit**)** | **MSU0325MML931J2** |
| MIC 403Medical Microbiology(4Credit) | **MSU0325MML931J3** |
| RP-MIC 405Research Project(6Credit) | **MSU0325RPP931J** |
| **Major Elective** | |
| E-MIC 404Environmental Microbiology (4 Credits) | **MSU0325MEL931J1** |

**8. Syllabus:**

## SEMESTER III

| MIC 301 | Genetic Engineering | 60 Hrs |
|---|---|---|
| **Credit I** | **Basics of Recombinant DNA Technology:**<br>**Restriction Analysis:** Types of Restriction Enzymes - Type I, II and III, Restriction Modification Systems, Type - II Restriction Endonucleases and Properties, Isoschizomers and Neoschizomers, mcr/mrrGenotypes, Cohesive and Blunt End Ligation, Linkers, Adaptors, HomopolymericTailing.<br>**Labeling of DNA:**Nick Translation, Random Priming, Radioactive and Non-radioactive Probes, Use of KlenowEnzyme/Fragment, T4 DNA Polymerase, Bacterial Alkaline Phosphatase, Polynucleotide Kinase.<br>**Hybridization Techniques:** Northern, Southern, Western and Colony Hybridization, Fluorescence *in situ*Hybridization, Restriction Maps and Mapping Techniques, DNA Fingerprinting, Chromosome Walking &Chromosome Jumping.<br>**DNA-Protein Interactions:** Electromobility Shift Assay, DNase I Foot-printing, Methyl Interference Assay. | **15 Hrs** |
| **Credit II** | **Cloning Vectors:**<br>**Gene Cloning Vectors:** Plasmids (Natural and Synthetic), Bacteriophages, M13, MP Vectors, Phagemids, Lambda vectors; Insertion and Replacement Vectors, EMBL, λDASH, λgt10/11, λZAP etc. CosmidVectors, Artificial Chromosome Vectors (YACs, BACs), Animal Virus Derived Vectors- SV-40, Vaccinia/Bacculo&Retroviral Vectors, Expression Vectors; pMal, GST, pET-based Vectors Baculovirus and *Pichia*Vectors System.<br>**Applications:** His-tag, GST-tag, MBP-tag etc. Restriction Proteases, Intein-based Vectors. Inclusion Bodies, Methodologies to reduce formation of inclusion bodies. | **15 Hrs** |
| **Credit III** | **Cloning Methodologies:**<br>**Insertion of Foreign DNA into Host Cells:** Transformation, Transduction, Conjugation, **Transfection:** Chemical and Physical Methods, Liposomes, Microinjection, Macroinjection, Electroporation, Biolistics, Somatic Cell Fusion, Gene Transfer by Pronuclear Microinjection.<br>**Plant Transformation Technology:** Basis of Tumor Formation, Hairy Root, Features of Ti and Ri Plasmids, Mechanism of DNA Transfer, Role of Virulence Genes, Use of Ti and Ri as Vectors. | **15 Hrs** |

| | | |
|---|---|---|
| | Cloning and Expression in Yeasts (Saccharomyces, Pichia etc.), Animal and Plants Cells, Methods of Selection and Screening, cDNA and Genomic Cloning, Expression Cloning, Yeast two hybrid System, Phage Display.<br>**DNA Libraries:** Construction of cDNA libraries in Plasmids and Screening Methodologies, Construction of cDNA and Genomic DNA Libraries in lambda Vector, Jumping Libraries. Principles in Maximizing Gene Expression. | |
| **Credit IV** | **PCR:**<br>Primer Design, Fidelity of Thermostable Enzymes, DNA Polymerases,<br>**Types of PCR:**Multiplex, Nested, Reverse Transcriptase, Real Time, Touchdown, Hot Start, Colony, Cloning of PCR Products, T-Vectors, Proof -reading Enzymes, PCR in Gene Recombination, Deletion, Addition, Overlap Extension, and SOEing, Site Directed Mutagenesis, PCR in Molecular Diagnostics, Viral and Bacterial Detection, PCR Based Mutagenesis.<br>**Applications:**<br>**Sequencing Methods:** Enzymatic DNA Sequencing, Chemical Sequencing of DNA, Principle of Automated DNA Sequencing, NextGene DNA Sequencing Methods (SOLiD, Ilumina and Pyrosequencing), RNA Sequencing,Chemical Synthesis of Oligonucleotides.<br>**Gene Silencing Techniques:** Introduction to siRNA and siRNA Technology, micro RNA, Construction of siRNA Vectors, Principle and Applications of Gene Silencing. CRISPR, CRISPR/Cas9 Technology.<br>**Gene Knockouts and Gene Therapy:** Creation of Knockout Mice, Disease Model, Somatic and Germ-line Therapy *in vivo* and **ex-vivo**, Suicide Gene Therapy, Gene Replacement, Gene Targeting.<br>**Other Applications:** Transgenics, Genome Projects and their Implications, Application in Global Gene Expression Analysis. Applications of Recombinant DNA Technology in Medicine, Agriculture, Veterinary Sciences and Protein Engineering. | **15 Hrs** |

**Suggested Readings:**


1. Sambrook J, Fritsch E. F. and Maniatis Molecular Cloning, vol. I, II, III, 2nd edition, Cold Spring Harbour Laboratory Press, New York.1989
2. D.M. Glover and D.B. Hames, DNA Cloning: A Practical Approach IRL Press, Oxford, 1995
3. P.B. Kaufman, W. Wu , D. Kim and L.J. Cseke, Molecular and Cellular Methods in Biology and Medicine, CRC Press Florida 1995
4. S.L. Berger and A. R. Kimmel, Methods in Enzymology Guide to Molecular Cloning Techniques, Vol. 152 Academic Press Inc, San Diego, 1996

5. V. Goedel, Methods in Enzymology Gene Expression Technology, Vol. 185D. Academic Press Inc, San Diego, 1990
6. D. A. Mickloss and G. A Freyer,DNA Science: A First Course in Recombinant Technology, Cold Spring Harbour Laboratory Press, New York, 1990
7. S. B. Primrose, Molecular Biotechnology, 2nd Ed. Blackwell Scientific Publishers, Oxford, 1994
8. J. A. Davis and W. S. Reznikoff, Milestones in Biotechnology: Classic Papers on Genetic Engineering, Butterworth-Heinemann Boston 1992
9. M. R. Walker, and R. RapleyRoute Maps in Gene Technology, Blackwell Science, Oxford, 1997
10. S. M. Kingsman, Genetic Engineering: An Introduction to Gene Analysis and Exploitation in Eukaryotes, Blackwell Scientific Publications, Oxford, 1998
11. S. T. Nicholl, An Introduction to Genetic Engineering, 3rd Edition. Desmond Cambridge University Press, 2008.
12. Cristopher Howe, Gene Cloning and Manipulation, 2nded. Cambridge University Press, 2007.

| MIC-302 | Immunology | 60 Hrs |
|---|---|---|
| **Credit I** | **Fundamentals and Anatomy of Immune System**:<br>**Immunity** – Innate and Acquired Immunity, Components of Innate and Acquired Immunity.<br>Antigen, Haptens, Adjuvants, Mitogens, Antibodies – Structure, Functions.<br>**The Anatomy of the Immune Response**: Cells and Organs of Immune System, Regulation of Immune Response – Humoral and Cell Mediated Response. | **15 Hrs** |
| **Credit II** | **Immunity to Infection:**<br>Antigen Processing and Presentation, MHC, Complement System, T & B Cell Activation.<br>Bacterial, Viral, Protozoal and Parasitic Infections with reference to (Diphtheria, Influenza Virus, Malaria and Helminthus) with specific representative examples of each group.<br>**Vaccines** – Active and Passive Immunization, DNA Vaccines, Multivalent Subunit Vaccines, Synthetic Peptide Vaccines. | **15 Hrs** |
| **Credit III** | **Clinical Immunology:**<br>**Hypersensitivity**:Type I, II, III, and IV Reactions. Autoimmunity – Organ Specific and Systemic Autoimmune Diseases. Treatment of Autoimmune Diseases.<br>**Transplantation and Tumor Immunology**: Graft Rejection, Tissue Typing, Immunosuppressive Therapy and Clinical Transplantation. Tumor Antigens, Cancer Immunotherapy.<br>**Immunodeficiency Diseases** - Phagocytic, Humoral, Cell mediated | **15 Hrs** |

| | | |
|---|---|---|
| | Deficiencies and SCID, AIDS- Causes, Syndrome, Diagnostic Tools, Treatment and Development of Vaccine | |
| **Credit IV** | **Immunotechnology:**<br>**Antigen antibody Interactions:** Principles, Types and Applications of Agglutination, Precipitation, Complement Fixation, Viral Neutralization, Immuno-diffusion, Immuno-electrophoresis, ELISA, RIA and Western Blotting<br>**Monoclonal Antibodies:** Hybridoma Technology, Bispecific Monoclonal Antibody, Humanized Monoclonal Antibody,Various Cellular Technologies.<br>**Automation in Immunological Techniques:**Auto Analyzers used in Immunology, FACS etc. | **15 Hrs** |

**Suggested Readings:**


1. R A Goldsby, Thomas J. Kindt, Barbara A. Osborne. Kuby Immunology;
2. Roitt I. M., Brostoff J. and Male D. Gower Immunology Medical Publishing London.
3. Lippencott Raven Paul Fundamentals of Immunology 4th ed., (1999).


| **MIC 303** | **Microbial Diversity and Extremophiles** | **60 Hrs** |
|---|---|---|
| **Credit I** | **Microbial Ecology:**<br>Basic Ecological Principles, Ecosystems, Habitats, EcologicalNiches, Microbial Community, Population Dynamics and EcosystemManagement, Mathematical Definitions and Suitable Examples ofMicrobe – Microbe, Microbe – Plant andMicrobe – Animal Interactions. | **15 Hrs** |
| **Credit II** | **Microbial Taxonomy:**<br>**Brief Study on:**<br>**Algae:** Classification, Distribution, Structure,Nutrition and Metabolism, Reproduction, Importance of Algae.<br>**Fungi;** Classification, Distribution, Structure, Nutrition andMetabolism, Reproduction, Importance of Fungi.<br>**Protozoa;**Classification, Nutrition, Morphology, Reproduction, Importance of Protozoa.<br>**Viruses;** General Properties, Classification and Reproduction ofviruses. Viroids and Virusoids, Prions. | **15 Hrs** |
| **Credit III** | **Study of Types of Microbes with Examples:**<br>**Concept of Autotrophy:** Photosynthetic Bacteria- Green SulphurBacteria, Cyanobacteria,Classification and Characteristics of Each Class,<br>**Methanogens**- Class of ArcheabacteriaMethanogens Types andtheir Classification, Methanotrophs- Concept and Classification, | **15 Hrs** |

| | | |
|---|---|---|
| | **Nitrogen Fixing Bacteria**- Concept of Diazotrophy, Classification ofN2 Fixing Bacteria as Free Living and Symbiotic and theirCharacteristics.<br>**Extremophiles:** Concept, Adaptation, Habitat and Significance ofAcidophilic, Halophilic and ThermophilicBacteria. | |
| **Credit IV** | **Microbial Interactions with Abiotic Components and theirApplications:**<br>Other Microbial Interactions and its Controls with Certain AbioticComponents of Environment like Wood, Plastic, Paints, Rubber,Pesticides, Toxic Heavy Metals, etc. Biodeteriorations, Bioremediations, Biotransformation and Biomagnifications andtheir Significance with respect to Environment and Biodiversity.<br>Role of Microbes in Secondary and Tertiary Recovery of Petroleum. | **15 Hrs** |

**Suggested Readings:**


1. B. N. Johari, Extremophiles Springer Verlag (2000)
2. D. ColwdMicrobial Diversity Academic Press (1999)
3. J.M. Lynch and N. J. Poole Microbial Ecology Blackwell Scientific Publications, Oxford. (1979)
4. N. J. Dimmock and K. N. Leppard eds, Introduction to Modern Virology. Blackwell Scientific Publications, Oxford. (2001)
5. Atlas and Bartha Microbial Ecology: Fundamental and Principles


| **E-MIC 304** | **Food and Dairy Microbiology** | **60 Hrs** |
|---|---|---|
| **Credit I** | **Contamination, Spoilage and Preservation of Different Kinds of Foods:**<br>Food as a substrate for Microorganisms.<br>**Principles of Food Preservation.**<br>**Contamination, Spoilage and Preservation of:**Cereal Products, Sugar Products, Vegetables and Fruits, Meat andMeat Products, Fish, Poultry &Eggs, Milk and Milk Products, HeatedCanned Foods and Fermented Foods-Pickles, Fermented Soya Products, Idli, Dhokla,Sauerkraut. | **15 Hrs** |
| **Credit II** | **Food Poisoning and Infections:**<br>**Food Intoxications:**StaphylococcalIntoxication, Botulinal Poisoning,<br>**Food Infections**: *Salmonella*, *Bacillus cereus*gastroenteritis, *Vibrio*,Streptococcal Infections, Tuberculosis, Shigellosis, Brucellosis,Listeriosis, Enteropathogenic Viral Infections<br>**Mycotoxins:** Patulin, Aflatoxin,Ochratoxin, Luteoskyrin, Sterigmatocystin, ATA etc. | **15 Hrs** |

| | | |
|---|---|---|
| **Credit III** | **Dairy Microbiology:**<br>Introduction, Composition, Physico-Chemical properties and Microbiology of Milk. Fermented Milks, Butter, and other Milk Products-Paneer, Cheese, Dahi, Makkhan, Ghee.Spoilage and Defects of Fermented Dairy Products.<br>**Cheese Fermentation-** Introduction, History and Types of Cheese. | **15 Hrs** |
| **Credit IV** | **Quality Control and Regulations of Food Industry:**<br>**Regulations of Food Industry:** FAO/WHO Regulations, FDA Regulations andAPHA/IDF Regulations, ISO 9001, ISO 22000, FSSAI, BRC, GFSI, FCO, EIC.<br>**Quality Control in the Dairy Industry:**Principles of HACCP in Food Industries, Basic GMP in the Industry Quality Manuals andDocumentations for different Products. | **15 Hrs** |

**Suggested Readings:**


1. Norman and Potter Food Science Fifth Edition (1996)
2. Frazier Food Microbiology
3. J. S. Yadav, S. Grover, and V.K. BatishDairy Microbiology
4. Sukumar Dey Outlines of Dairy Technology
5. Robinson Food MicrobiologyHandbook


## P -MIC 305: Practical Course - V (2 Cr)

| P -MIC 305 | Practical Course – V (30 Hrs) |
|---|---|
| **1.** | **Industrial Microbiology:** Isolation of Industrially Important Microorganism from Soil<br>a) Antibiotic Producers,<br>b) Organic Acid Producers<br>c) Amine Producers<br>d)Amylase, Protease, Lipase Producers |
| **2.** | **Microbial Ecosystem:** Isolation of Extremophiles from Environment<br>Isolation of Thermophiles, Halophiles, Acidophiles, Alkaliphiles, Psychrophiles<br>SPC of Microorganism from different Environmental Sources. |
| **3.** | **Molecular Biology:**<br>Transformation, Conjugation, Transduction and Protoplast Fusion |
| **4.** | Determination of the Effective Concentration of Disinfectant for:<br>Skin, Table and Vessels. |
| **5.** | Widal and ELISA |
| **6.** | Biological Data Analysis using MS- Excel |

**Suggested Readings:**

1. Laboratory Exercise in Microbiology- Harley Prescott, 5th Edition
2. Microbiology A Laboratory Manual - Cappuccino & Sherman, 6th Edition

**RP-MIC 306: Research Project (4 Cr)**

# SEMESTER - IV

| MIC 401 | Bioinformatics | 60 Hrs |
|---|---|---|
| **Credit I** | **Proteomics:**<br>**Protein Sequence Databases and Analysis:**<br>Protein Sequence Information, Primary Protein Sequence Databases, Secondary Protein Sequence Databases, Pair-wise Sequence Alignment, Gaps, Gap-penalties, Scoring Matrices, PAM250, BLOSUM62, Local and Global Sequence Alignment, Multiple Sequence Alignment, Physicochemical Properties using ExPASy, Useful Programme; Clustal W.<br>**Proteomics: Structural Databases, Protein Structure Prediction:**<br>Structural Databases; Protein Data bank (PDB), Nucleic Acid Data Bank (NDB), Molecular Modeling Data Bank (MMDB). Homology Modeling, Three-Dimensional Structure Prediction, Protein Folding and Functional Sites. | **15 Hrs** |
| **Credit II** | **Genomics: Nucleotide Sequence Databases and Analysis:**<br>Human Genome Project (HGP); Rough and Final Draft of HGP, Goals of the HGP, Genomics. Nucleotide Sequence Databases: GenBank, EMBL, DNA Data Bank of Japan (DDBJ). Restriction Enzymes, REBASE, Polymerase Chain Reaction, Primer Designing, Next Generation Sequencing, Application of BioEdit.<br>**Genomics: Gene Identification:**<br>Genome Information and Special Features, Coding Sequences (CDS), Untranslated Regions (UTR's), cDNA Library, Expressed Sequence Tags (EST), 16S rDNA Gene Sequencing. Approaches to Gene Identification; Masking Repetitive DNA, Database Search, Codon-bias Detection, Detecting Functional Sites in the DNA. Internet Resources for Gene Identification. Construction of Maps, Genetic Map, Physical Map, BLAST. | **15 Hrs** |
| **Credit III** | **Structural Biology:**<br>Ribose-ring Puckering, RNA Folding, Ramachandran Plot, Prediction of $\alpha$-helix, $\beta$-sheet, and $3_{10}$-helix, Loop modeling, 3-D Structure Validation, Molecular Docking, Protein-ligand Interactions, Biophysical Aspects of Proteins and Nucleic Acids.<br>**Molecular Modeling:**<br>Functions of Molecular Modeling. Molecular Mechanics, Force Field, Potential Energy Functions, Energy Minimization Methods, Single Point Calculations, Full-geometry Optimization, Conformational Search,MolecularDynamics Simulations, Molecular Modeling Packages. | **15 Hrs** |

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| **Credit IV** | **Microarrays:**<br>Concept of Microarrays; Spotted Arrays, Oligonucleotide Arrays, Applications of Microarray Technology. Tools and Techniques in Proteomics; Isotope Coded Affinity Tags (ICAT), Mass Spectroscopy for Protein Analysis, MALDI-TOF, Electrospray Ionization (EST), Tandem Mass Spectroscopy (MS/MS) Analysis; Tryptic Digestion and Peptide Fingerprinting (PMF), Profiling and Diagnostics, Drug Target Discovery.<br>**Phylogenetic Analysis:**<br>Evolution, Phylogenetic Tree, Methods of Phylogenetic Analysis; Distance Based and Character Based Methods, Phylogenetic Analysis Tool- Phylip. | **15 Hrs** |

**Suggested Readings:**


1. Atwood, T. K. and Parry-Smith, D. J. Introduction to Bioinformatics,
2. C. Stain Tsai, A John An introduction to Computational Biochemistry. Wiley and Sons, Inc., publications.
3. Cynthia Gibas and Per Jambeck Developing Bioinformatics Computer Skills..
4. Rastogi S. C. Mendiratta, and Rastogi P. Bioinformatics Methods and Applications Genomics, Proteomics and Drug Discovery.
5. David Mount Bioinformatics: Sequence and Genome Analysis Cold Spring Harbor Laboratory Press, NY, 2004.
6. NCBI Web site: http://www.ncbi.nlm.nih.gov


| **MIC 402** | **Microbial Technology and Bioprocess Design** | **60 Hrs** |
|---|---|---|
| **Credit I** | **Upstream Fundamentals**:<br>Various Methods for Growth Measurement, Growth Kinetics, Metabolic Pathways for Carbohydrate/Glucose Utilization, Various Strain Improvement Methods, Alternative Carbon and Nitrogen Sources, Processing of Carbon and Nitrogen Sources, Optimization of Media, Preparation of Innoculum, Preservation and Maintenance of Microbes. | **15 Hrs** |
| **Credit II** | **Biochemical Engineering Fundamentals:**<br>Material for Construction, Rheology of Fermenter, Industrial Sterilization Methods for Liquid, Air and Solids, Aeration and Agitation, Auxillary Equipment, Foam, Fermenter Design, Role of Computers in Fermentation Technology, Scale up and Scale down, Types of Fermenters, Process Economics, Fermentation Economics | **15 Hrs** |
| **Credit III** | **Downstream Processing:**<br>Various Unit Operations used for Extraction, Isolation and Characterization of Primary and Secondary metabolites such as – | **15 Hrs** |

| | | |
|---|---|---|
| | Centrifugation, Filtration, Solvent Extraction, Precipitation, Distillation, Chromatography Techniques such as Adsorption, Ion Exchange, Gel filtration, Affinity and Crystallization. | |
| **Credit IV** | **Fermentative Production of:**<br>Alcohol, Various Beverages, Flavor Enhancer as MSG, Citric Acid, Vinegar, Penicillin, Semisynthetic Antibiotics, Bioplastics, Vit. B12, Amino acid as Glutamic acid, Extracellular Polysaccharide as Xanthan, Enzymes, Role of Microbes in Organic Synthesis,<br>Quality Control and IPR | **15 Hrs** |

**Suggested Readings:**


1. M. El-Mansi and C.Bryce Fermentation Microbiology and Biotechnology
2. Whitekar, Stanbury and Hall Principles of Fermentation Technology
3. J.R.Leigh Control of Fermentation Process
4. H.J.Peppler and D.Perlman Microbial Technology Vol. I and II. Academic Press INC
5. Rehm and Reed Biotechnology Vol. I & II


| **MIC 403** | **Medical Microbiology** | **60 Hrs** |
|---|---|---|
| **Credit I** | **Virulence:**<br>Invasion of Pathogens through the Different Immunological Barriers of HumanBody. Establishment of Infection. Role of Portal of Entry of thePathogen. Antigenic Variations and Virulence. Microbial Toxinsand Super Antigens. Carriers of Infections. Epidemiology of CertainDiseases like Urino-genital Infections, Upper RespiratoryTractInfections, Dermatological Infections and Gastero-intestinal TractInfections. Loss of Virulence by many Pathogens on Sub-culturingon Artificial Media. | **15 Hrs** |
| **Credit II** | **Epidemiology:**<br>Spread of Certain Infections in a Population. Concept of Epidemic,Endemic and Pandemic Spread. Role of Socioeconomic Conditionsin Spread of Disease.<br>Epidemiological Methods- Descriptive, Analytical and ExperimentalEpidemiology. Measurement of Infection Rate. | **15 Hrs** |
| **Credit III** | **Chemotherapy:**<br>Development of Drug Resistance Amongst Pathogens – AntibioticResistance Mechanisms. Disease Management Methods. DifferentProphylactic and Therapeutic Methods in Control of Infections. | **15 Hrs** |
| **Credit IV** | **Clinical Microbiology:**<br>Collection and Transportation of Pathological Samples withSpecial Reference to Samples like Cerebro Spinal Fluid (CSF),Sputum | **15 Hrs** |

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|---|---|---|
| | Samples, Urine Samples, CulturalTechniques for Pathogens like Dermatophytes, *Salmonella, Meningococcus, Leptospira, Mycobacterium, Vibrio, Plasmodium spp, Wucheriabancriofti, and Ascaris lumbricoides.*<br>RapidMethods of Identification of Infection like ELISA, FAT, RIA and<br>Western Blot techniques. | |

**Suggested Readings:**


1. Prescott, Harley, Klein Introduction to Microbiology
2. Anant Narayan Medical Microbiology
3. Dey and Dey Medical Microbiology
4. Tortora Medical Microbiology


| E-MIC 404 | Environmental Microbiology | 60 Hrs |
|---|---|---|
| **Credit I** | **Introduction to Environmental Microbiology, Microbial Stress Management and Adaptations:** Definition and Scope Historical Development of Environmental Microbiology, Diversity and Significance of Microorganisms in the Environment, Concept of Microbial Habitat and Niches Response of Microorganism to Environment, Abiotic Stress.<br>**Limited Nutrients:**Leibigs Law of Minimum and Shelfords Law of Tolerance. Tolerance of Stress, Quorum Sensing: Microbial System and Molecules Evolved in Signal Transmittance and Acceptance, Free Radical Concept and Mechanism | **15 Hrs** |
| **Credit II** | **Soil Microbiology, Nutrient cycling, Microbial Biodegradation:**<br>**Introduction of Soil Microbiology:** Soil Microorganism and their Communities. Role of Microbes in Nutrient Cycling Carbon, Nitrogen, Phosphorous, Sulfur etc.<br>**Concept of PGPR:** Rhizosphere, Rhizospheric Microorganisms, and their Interaction with Root System. Microbial Biodegradation of Xenobiotics, Recalcitrant Compounds. Microbial Mineral and Heavy Metal Recovery | **15 Hrs** |
| **Credit III** | **Air and Water Microbiology:**<br>Air as a Habitat for Microorganism, Enumeration of Microorganism from Air, Toxicity<br>**Determination of:** LD50, Tests to Determine Genotoxicity and Toxicant in air.<br>**Introduction and Definition of Limnology:** Microbial Distribution in Natural Water. Concept of: Organic Pollution in Water and BOD: | **15 Hrs** |

| | | |
|---|---|---|
| | N and C BOD, COD, Other Parameters.<br><br>**Waste Water Treatment:** Municipal and Industrial waste Water: Aerobic, Anaerobic Treatments, Activated Sludge, Trickling Filters and Settling etc. | |
| **Credit IV** | **Microbial Biotechnology for Environment and Sustainable Development:**<br>**Commercial:**<br>Concept of MEOR - Microbial Enhanced Oil Recovery, Production of Bio-ethanol from Organic Waste. Bio-composting, Biogas**:** Methane and Hydrogen Production.<br>**Environmental:**<br>**Advanced Microbial Bioremediation:** Concept and Definition of – Detoxification, Deterioration, Degradation, Mineralization, Bioaugmentation and Bio-stimulation. Microbial Transformation of Steroids and Antibiotics. Factors Affecting Bioremediation<br>**Production of Biofertilizers:** Characteristics and Production Technology for $N_2$ fixers, Phosphate Solubilizers, VAM etc.<br>**SCP –** History and Production. | **15 Hrs** |

**Suggested Readings:**


1. Atlas and Bartha Microbial Ecology: Fundamental and Principles
2. H.J. Pepplerand D. Perlman Microbial Technology: Microbial Processes
3. Ian L. Pepper Charles P. Gerba Terry J. Gentry Environmental Microbiology Third edition
4. S.N.JogdandEnvironmental Biotechnology
5. Joanne M. Willey, Linda M. Sherwood, Christopher J. Woolverton Prescott's Principles of Microbiology
6. Stuart Hogg Essential Microbiology
7. Gabriel BittonWaste Water Microbiology


## RP-MIC 405: Research Project (6 Cr)

## 1. Scheme of Teaching:

- Each theory paper will have 4 lectures of 60 min. per week.
- The theory paper will have classroom teaching of 60 hours per paper per semester.
- The classroom teaching will be done by Blackboard Chalk, Power Point Presentation, various ICT Tools, Question Answer way, Debate, Seminars, Quiz etc.
- The practical teaching will be done initially by theoretical explanation of experiment, procedural explanation, allowing the student to perform the experiment individually, discussion of results, possible outcome of the result and documentation of observations in notebook and recording all the details in journal

which will be examined at the of practical examination.

## 10. Examination Pattern:

**Theory:**

- University examination will be of 80 marks for 3 hours as per university time-table and internal examination will be of 20 marks for 30 min.by the respective teacher foreach theory paper.

**Practical:**

- University examination will be conducted for practical after theory examination for 4 days including inspection day from 10:30 am to 05:30 pm. There will be no internal examination.

**On Job Training:**

- The student will submit his/her On Job Training report to the Teacher in Charge after completion of On Job Training. The department will conduct presentation cum viva for all the students. The internal evaluation committee/examiners will assess the On Job Training report and marks will be given.

**Field Project:**

- The student will submit his/her Field Project report to the Teacher in Charge completion of Field Project. The department will conduct presentation cum viva for all the students. The internal evaluation committee/examiners will assess the Field Project report and marks will be given.

**Research Methodology:**

- University examination will be of 80 marks and internal examination will be of 20 marks for Research Methodology theory paper.

## 11. Nature of Question Paper and Scheme of Marking:

### a) University Theory Examination:
### Skeleton of theory question paper:

**M.Sc. Part – II/Sem. – IIIExamination – 2024 (NEP - 2023)**

**Microbiology (H. M.)**

**Title of the Subject**

**(Subject Code)**

**Day & Date:** **Total Marks**: 80

**Time:**

***Instructions:*** 1) Question No. 1 is **COMPULSORY**.

2) All questions carry **EQUAL** marks.

3) Solve any **FOUR** questions such that at least **TWO** questions must be from **EACH** section.

Q. 1 Objective (16 Marks)

16 one line answer type questions

**SECTION-I**

Q.2 Essay type question (16 Marks)

Q.3 Essay type question (16 Marks)

Q.4 Essay type question (16 Marks)

**SECTION-II**

Q.5 Write notes on (2x08Marks)

2 sub questions

Q.6 Write short notes on (4 x04 Marks)

4 sub-questions

Q.7 Write short notes on (4x04 Marks)

4 sub-questions

The theory examination will be conducted by the department as per the university examination time-table. The appointment of Chairman, Paper setters, paper assessment, moderation, appointment of internal/external Sr. Supervisor, Junior supervisor, Clerk and Peon for examination and other theory examination work will carried out as per the university rules and regulations.

## b) Internal Theory Examination:

The internal theory examination of 20 marks will be conducted by Teacher in-charge of the respective subject during the semester. The internal examination theory have 20 questions of 1 mark each. The internal theory paper will be solved on same question paper. Separate answer book will not be given. The examination time will be 30 mins. The internal theory marks will be submitted or uploaded in the university examination portal as per the instruction given by the examination section of the university.

## c) University Practical Examination:

The university practical examination will be conducted in the department immediately after theory examination. The duration of practical examination will be 4 days including inspection day. The examination for both practical papers will be conducted simultaneously. The day, date, nature of question paper, marks distribution and internal/ external examiners will be decided by BOS in consultation with the department. There will be at least one external examiner either from affiliated colleges or from other university amongst the examiner panel approved by BOS/BOE.

## 13.Equivalence of Courses:

### M. Sc. Part II (Semester III and IV)

| Old Course | | | | Equivalent Course | | |
|---|---|---|---|---|---|---|
| **Sem No.** | **Course Code** | **Title of the Old Course** | **Credit** | **Course Code** | **Title of the New Course** | **Credit** |
| III | | Genetic Engineering | 4 | MIC 301 | Genetic Engineering | 4 |
| III | | Microbial Ecology and Extremophiles | 4 | MIC 303 | Microbial Ecology and Extremophiles | 4 |
| III | | Immunology | 4 | MIC 302 | Immunology | 4 |
| III | | Fermentation Technology – I | 4 | | | 4 |
| III | | Laboratory Course – V | 4 | | | |
| III | | Laboratory Course – VI | 4 | | | |
| III | AEC – 306 | | | | | - |
| IV | | Food and Dairy Microbiology | 4 | E-MIC 304 | Food and Dairy Microbiology | 4 |
| IV | | Microbial Fermentation Technology | 4 | MIC 402 | Microbial Technology and Bioprocess Design | 4 |
| IV | | Bioinformatics | 4 | MIC 401 | Bioinformatics | 4 |
| IV | | Medical Microbiology | 4 | E-MIC 403 | Medical Microbiology | 4 |
| IV | | Laboratory Course – VII | 4 | | | |
| IV | CCPR 205 | Laboratory Course – VIII | 4 | - | - | - |
| IV | SEC 206 | - | - | - | - | - |
| IV | GE | | 2 | | | |

Estd. 1962
"A++" Accredited by NAAC(2021) With CGPA 3.52

**SHIVAJI UNIVERSITY, KOLHAPUR - 416004 (MAHARASHTRA)**
DEPARTMENT OF MICROBIOLOGY
**सूक्ष्मजीवशास्त्र अधिविभाग, शिवाजी विद्यापीठ, कोल्हापूर-४१६००४ (महाराष्ट्र)**
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**Dr. P. M. Gurao डॉ. पी. एम. गुरव**
**I/c Head प्र.अधिविभागप्रमुख**
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Mobile: +91 96236 19619 Office Tel: 0231-2609300 / 9326

**Ref. No:** SU/Micro/Micro (NEP-2020)(H.M.)-II/Syllabus**Date:**07/10/2023

**To:**

The Deputy Registrar
(BOS Section)
Shivaji University,
Kolhapur - 416004

**Sub:** NEP Syllabus for M.Sc. Part – II Microbiology (H.M.)(NEP-2020) subject…

Sir / Madam,

Please find enclosed herewith the syllabus for M.Sc. Part II (Sem. III& IV) Microbiology (H.M.) (NEP-2020) subject which has to be implemented from academic year 2024-2025 i.e. from June 2024. This is for your information and further necessary action.

Thanking you,

Sincerely yours,

P. M. Gurao
I/c Head