

**SU/BOS/Science/497**

**Date: 10/07/2023**

**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 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 degree programme under the Faculty of Science and Technology.

| <b>M.Sc.Part-II (Sem. III &amp; IV) as per NEP-2020</b> |                                  |     |                                |
|---|----------------------------------|-----|--------------------------------|
| 1.  | Microbiology (HM)                | 8.  | Food Science & Nutrition       |
| 2.  | Pharmaceutical Microbiology (HM) | 9.  | Food Science & Technology      |
| 3.  | Microbiology                     | 10. | Biochemistry                   |
| 4.  | Computer Science                 | 11. | Biotechnology                  |
| 5.  | Computer Science (Online Mode)   | 12. | Medical Information Management |
| 6.  | Data Science                     | 13. | Environmental Science          |
| 7.  | Information Technology (Entire)  | 14. | Physics                        |

This syllabus, nature of question and equivalence shall be implemented from the academic year 2023-2024 onwards. A soft copy containing the syllabus is attached herewith and it is also available on university website [www.unishivaji.ac.in](http://www.unishivaji.ac.in)

The question papers on the pre-revised syllabi of above-mentioned course will be set for the examinations to be held in October /November 2023 & March/April 2024. 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      | 8  | P.G. Admission/Seminar Section       |
| 2 | Director, Board of Examinations and Evaluation | 9  | Computer Centre/ Eligibility Section |
| 3 | The Chairman, Respective Board of Studies      | 10 | Affiliation Section (U.G.) (P.G.)    |
| 4 | B.Sc. Exam/ Appointment Section                | 11 | Centre for Distance Education        |

**Choice Based Credit System with Multiple Entry and Multiple Exit Option (NEP-2020)**  
**M.Sc. Programme Structure**  
**M.Sc. Part – II (Level-9)**  
**M.Sc. Microbiology (Horizontal Mobility) CBCS Pattern**

| SEMESTER-III (Duration- Six month) |         |   |  |                  |        |                            |               |             |                          |               |             |
|------------------------------------|---------|---|--|------------------|--------|----------------------------|---------------|-------------|--------------------------|---------------|-------------|
|                                    | Sr. No. | Course code   | Teaching Scheme  |                  |        | Examination Scheme         |               |             |                          |               |             |
|                                    |         |   | Theory and Practical   |                  |        | University Assessment (UA) |               |             | Internal Assessment (IA) |               |             |
|                                    |         |   | Lectures (per week)  | Hours (per week) | Credit | Maximum Marks              | Minimum Marks | Exam. Hours | Maximum Marks            | Minimum Marks | Exam. Hours |
| CGPA                               | 1       | CC-301: Genetic Engineering                           | 4  | 4                | 4      | 80\$                       | 32            | 3           | 20                       | 8             | 1           |
|                                    | 2       | CCS-302: Microbial Diversity and Extremophiles        | 4  | 4                | 4      | 80\$                       | 32            | 3           | 20                       | 8             | 1           |
|                                    | 3       | CCS-303: Fermentation Technology-I                    | 4  | 4                | 4      | 80\$                       | 32            | 3           | 20                       | 8             | 1           |
|                                    | 4       | DSE-304: Immunology                                   | 4  | 4                | 4      | 80\$                       | 32            | 3           | 20                       | 8             | 1           |
|                                    | 5       | CCPR-305: Laboratory Course                           | 16   | 16               | 8      | 200*                       | 80            | -           | -                        | -             | #           |
| Total (C)                          |         |   | -  | -                | 24     | 520                        | -             | -           | 80                       | -             | -           |
| Non-CGPA                           | 1       | AEC-306   | 2  | 2                | 2      | -                          | -             | -           | 50                       | 20            | 2           |
|                                    | 2       | EC (SWMMOOC)-307<br>Food Microbiology and Food Safety | Number of lectures and credit shall be as specified on SWAYAM MOOC |                  |        |                            |               |             |                          |               |             |
| SEMESTER-IV (Duration- Six month)  |         |   |  |                  |        |                            |               |             |                          |               |             |
| CGPA                               | 1       | CC-401: Food and Dairy Microbiology                   | 4  | 4                | 4      | 80\$                       | 32            | 3           | 20                       | 8             | 1           |
|                                    | 2       | CCS-402: Microbial Fermentation Technology            | 4  | 4                | 4      | 80\$                       | 32            | 3           | 20                       | 8             | 1           |
|                                    | 3       | CCS-403: Bioinformatics                               | 4  | 4                | 4      | 80\$                       | 32            | 3           | 20                       | 8             | 1           |
|                                    | 4       | DSE-404: Medical Microbiology                         | 4  | 4                | 4      | 80\$                       | 32            | 3           | 20                       | 8             | 1           |
|                                    | 5       | CCPR-405:Laboratory Course and Project                | 16   | 16               | 8      | 200*                       | 80            | -           | -                        | -             | #           |
| Total (D)                          |         |   | -  | -                | 24     | 520                        | -             | -           | 80                       | -             | -           |
| Non-CGPA                           | 1       | SEC-406   | 2  | 2                | 2      | -                          | -             | -           | 50                       | 20            | 2           |
|                                    | 2       | GE-407: Basics of Microbiology                        | 2  | 2                | 2      | -                          | -             | -           | 50                       | 20            | 2           |
| Total (C + D)                      |         |   | -  | -                | 48     | 1040                       | -             | -           | 160                      | -             | -           |

1. \*Practical Examination will be internal/external as per department choice
2. \$ Question no. 1 of each question paper will be subjective (short answer question instead of objective)
3. # Duration of Practical Examination will be 5 days (1 inspection day and 4 Practical days)

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|--|--|
| <ul style="list-style-type: none"> <li>• Student contact hours per week : <b>32 Hours (Min.)</b></li> </ul>  | <ul style="list-style-type: none"> <li>• Total Marks for M.Sc.-II : <b>1200</b></li> </ul>   |
| <ul style="list-style-type: none"> <li>• Theory and Practical Lectures : <b>60 Minutes Each</b></li> </ul>   | <ul style="list-style-type: none"> <li>• Total Credits for M.Sc.-II (Semester III &amp; IV) : <b>48</b></li> </ul>   |
| <ul style="list-style-type: none"> <li>• CC-Core Course</li> <li>• CCS- Core Course Specialization</li> <li>• CCPR-Core Course Practical and Project</li> <li>• DSE-Discipline Specific Elective</li> <li>• AEC-Mandatory Non-CGPA compulsory Ability Enhancement Course</li> <li>• SEC- Mandatory Non-CGPA compulsory Skill Enhancement Course</li> <li>• EC (SWM MOOC) - Non-CGPA Elective Course</li> <li>• GE- Multidisciplinary Generic Elective</li> </ul> | <ul style="list-style-type: none"> <li>• Practical Examination is annual.</li> <li>• Examination for CCPR-305 shall be based on Semester III Practical's.</li> <li>• Examination for CCPR-405 shall be based on Semester IV Practical's.</li> <li>• *Duration of Practical Examination as per respective BOS guidelines</li> <li>• <b><i>Separate passing is mandatory for Theory, Internal and Practical Examination</i></b></li> </ul> |
| <ul style="list-style-type: none"> <li>• <b>Requirement for Entry at Level 9:</b><br/><b>Completed all requirements of the relevant Post Graduate Diploma (Level 8) in Diploma in Microbiology (HM)</b></li> </ul>   |  |
| <ul style="list-style-type: none"> <li>• <b>Exit at Level 9:</b> Students will exit after Level 9 with <b>Master's Degree in Microbiology (HM)</b> if he/she completes the courses equivalent to minimum of 96 credits.</li> </ul>   |  |

|                | <b>M.Sc.-I</b> | <b>M.Sc.-II</b> | <b>Total</b> |
|----------------|----------------|-----------------|--------------|
| <b>Marks</b>   | <b>1200</b>    | <b>1200</b>     | <b>2400</b>  |
| <b>Credits</b> | <b>48</b>      | <b>48</b>       | <b>96</b>    |

#### **I. CGPA course:**

1. There shall be 10 Core Courses (CC)per programme.
2. There shall be 04 Core Course Practical's (CCPR) per programme.
3. There shall be 04 Core Course Specialization (CCS)of 16 credits per programme.
4. There shall be 02 Discipline Specific Elective (DSE) courses of 08 credits per programme
5. Total credits for CGPA courses shall be of 96 credits per programme

#### **II. Mandatory Non-CGPA Courses:**

1. There shall be 02 Mandatory Non-CGPA compulsory Ability Enhancement Courses (AEC I and II) of 02 credits each per programme.
2. There shall be 02 Mandatory Non-CGPA compulsory Skill Enhancement Course (SEC I and II) of 02 credits per program.
3. There shall be one Elective Course (EC) (SWAYAM MOOC). The credits of this course shall be as specified on SWAYAM MOOC.
4. There shall be one Generic Elective (GE) course of 02 credits per programme. Each student has to take generic elective from the department other than parent department.
5. The total credits for Non-CGPA course shall be of 08 credits + 2-4 credits of EC as per availability.
6. The credits assigned to the course and the programme are to be earned by the students and shall not have any relevance with the work load of the teacher.

# Shivaji University, Kolhapur



**Accredited By NAAC with 'A++' grade with CGPA 3.52**

**Syllabus for**

**Master of Science (M.Sc.)**

**In**

**Microbiology (NEP-2020) (HM)**

**(Under Faculty of Science and Technology)**

**Part II**

**(Subject to modifications to be made time to time)**

**Syllabus to be implemented from 2023-2024**

# **M.Sc. Microbiology (NEP-2020) (HM)**

## **Part – II Syllabus**

| <b>SEMESTER III</b>         |   |
|-----------------------------|---|
| <b>CC-301</b>               | : Genetic Engineering   |
| <b>CCS-302</b>              | : Microbial Diversity and Extremophiles                       |
| <b>CCS-303</b>              | : Fermentation Technology-I                                   |
| <b>DSE-304</b>              | : Immunology  |
| <b>CCPR-305</b>             | : Laboratory Course   |
| <b>AEC-306</b>              | : Mandatory Non-CGPA compulsory: Ability Enhancement Course   |
| <b>EC-307<br/>(SWMMOOC)</b> | : Non-CGPA Elective Course: Food Microbiology and Food Safety |
| <b>SEMESTER IV</b>          |   |
| <b>CC-401</b>               | : Food and Dairy Microbiology                                 |
| <b>CCS-402</b>              | : Microbial Fermentation Technology                           |
| <b>CCS-403</b>              | : Bioinformatics  |
| <b>DSE-404</b>              | : Medical Microbiology  |
| <b>CCPR-405</b>             | : Laboratory Course and Dissertation (Project)                |
| <b>SEC-406</b>              | : Mandatory Non-CGPA compulsory Skill Enhancement Course      |
| <b>GE-407</b>               | : Generic Elective: Basics of Microbiology                    |

## SEMESTER III

|                   |   |               |
|-------------------|---|---------------|
|                   | <b>CC-301: Genetic Engineering</b>  | <b>60 Hrs</b> |
| <b>Credit I</b>   | <p><b>Basics Of Recombinant DNA Technology</b></p> <p>Restriction analysis: Types of restriction enzyme, Type I, II and III, restriction modification systems, type II restriction endonucleases and properties, isoschizomers and neoschizomers, mcr/mrr genotypes, Cohesive and blunt end ligation, linkers, adaptors, homopolymeric tailing.</p> <p>Labeling of DNA: Nick translation, random priming, radioactive and non-radioactive probes, use of Klenow enzyme, T4 DNA polymerase, bacterial alkaline phosphatase, polynucleotide kinase. Hybridization techniques: Northern, Southern, Western and Colony hybridization, Fluorescence in situ hybridization, Restriction maps and mapping techniques, DNA fingerprinting, chromosome walking &amp; chromosome jumping.</p> <p>DNA-Protein Interactions: Electro mobility shift assay, DNase I footprinting, methyl interference assay.</p>   | <b>15 Hrs</b> |
| <b>Credit II</b>  | <p><b>Cloning Vectors</b></p> <p>Gene Cloning Vectors: Plasmids (Natural and synthetic), bacteriophages, M13, MP vectors, phagemids, Lambda vectors; insertion and replacement vectors, EMBL, <math>\lambda</math>DASH, <math>\lambda</math>gt10/11, <math>\lambda</math>ZAP etc. Cosmid vectors. Artificial chromosome vectors (YACs, BACs), Animal Virus derived vectors- SV-40, vaccinia/baculo&amp; retroviral vectors. Expression vectors; pMal, GST, pET-based vectors Baculovirus and <i>Pichia</i> vectors system.</p> <p>Applications: His-tag, GST-tag, MBP-tag etc. Restriction proteases, intein-based vectors. Inclusion bodies, methodologies to reduce formation of inclusion bodies.</p>  | <b>15 Hrs</b> |
| <b>Credit III</b> | <p><b>Cloning Methodologies</b></p> <p>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.</p> <p>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.</p> <p>Cloning and expression in yeasts (<i>Saccharomyces</i>, <i>Pichia</i> etc.), animal and plants cells, methods of selection and screening, cDNA and genomic cloning, expression cloning, yeast two hybrid system, phage display.</p> <p>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.</p> | <b>15 Hrs</b> |

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|------------------|--|---------------|
| <b>Credit IV</b> | <p><b>PCR</b><br/> Primer design, Fidelity of thermostable enzymes, DNA polymerases, 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.</p> <p><b>Applications</b><br/> Sequencing methods: Enzymatic DNA sequencing, Chemical sequencing of DNA, principle of automated DNA sequencing, NextGene DNA sequencing Methods (SOLiD, Illumina and pyrosequencing), RNA sequencing, Chemical Synthesis of oligonucleotides.</p> <p>Gene silencing techniques: Introduction to siRNA and siRNA technology, micro RNA, construction of siRNA vectors, principle and application of gene silencing. CRISPR, CRISPR/Cas9 technology.</p> <p>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.</p> <p>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.</p> | <b>15 Hrs</b> |
|------------------|--|---------------|

#### **Suggested readings:**

1. Sambrook J, Fritsch E. F. and Maniatis (1989) Molecular cloning, vol. I, II, III, II nd edition, Cold spring harbor laboratory press, New York.
2. DNA Cloning : A practical approach D.M. Glover and D.B. Hames, RL Press, Oxford, 1995
3. Molecular and cellular methods in Biology and Medicine, P.B. Kaufman, W. Wu , D. Kim and L.J. Cseke, CRC Press Florida 1995
4. Methods in Enzymology Guide to Molecular Cloning Techniques, Vol. 152 S.L. Berger and A. R. Kimmel, Academic Press Inc, San Diego, 1996
5. Methods in Enzymology Gene Expression Technology, Vol. 185D. V. Goedel, Academic Press Inc, San Diego, 1990
6. DNA Science: A First Course in Recombinant Technology, D. A. Mickloss and G. A Freyer, Cold Spring Harbor Laboratory Press, New York, 1990
7. Molecular Biotechnology, 2nd Ed. S. B. Primrose, Blackwell Scientific publishers, Oxford, 1994
8. Milestones in Biotechnology, Classic Papers on Genetic Engineering, J. A. Davis and W. S. Reznikoff, Butterworth-Heinemann Boston 1992
9. Route Maps in Gene Technology, M. R. Walker, and R. Rapley, Blakwell Science, Oxford, 1997
10. Genetic Engineering : An Introduction to Gene Analysis and Exploitation in Eukaryotes, S. M. Kingsman, Blackwell Scientific Publications, Oxford, 1998

11. An Introduction to Genetic Engineering, 3<sup>rd</sup> Edition. Desmond S. T. Nicholl, Cambridge University press, 2008.
12. Gene Cloning and Manipulation, 2<sup>nd</sup> Ed. Cristopher Howe, Cambridge University Press, 2007.

|                   |  |               |
|-------------------|--|---------------|
|                   | <b>CCS-302: Microbial Diversity and Extremophiles</b>  | <b>60 Hrs</b> |
| <b>Credit I</b>   | <b>Microbial Ecology:</b><br>Basic ecological principles, Ecosystems, Habitats, Ecological niches, microbial community, Population dynamics and ecosystem management, mathematical definitions and suitable examples of microbe-microbe interactions, microbe-plant interactions and microbe – animal interactions.  | <b>15 Hrs</b> |
| <b>Credit II</b>  | <b>Microbial taxonomy:</b><br>Brief study on: Algae: Classification, distribution, structure, nutrition and metabolism, reproduction, importance of Algae.<br>Fungi; Classification, distribution, structure, nutrition and metabolism, reproduction, importance of Fungi.<br>Protozoa ; Classification, nutrition, morphology, reproduction, of protozoa.<br>Viruses; .General properties, classification and reproduction of viruses.<br>Viroids and virusoids, Prions.  | <b>15 Hrs</b> |
| <b>Credit III</b> | <b>Study of types of Microbes with examples:</b><br>Concept of autotrophy, Photosynthetic bacteria- Green sulphur bacteria, cyanobacteria classification characteristics of each class,<br>Methanogens- class of Archeabacteria methanogens types and their classification, Methanotrophs- concept and classification,<br>Nitrogen fixing bacteria- Concept of diazotrophy, Classification of N <sub>2</sub> fixing bacteria as free living and symbiotic and their characteristics.<br>Extremophiles: Concept, adaptation, habitat and significance of Acidophilic bacteria, Halophilic bacteria and Thermophilic bacteria. | <b>15 Hrs</b> |
| <b>Credit IV</b>  | <b>Microbial interactions with abiotic components and their applications:</b><br>Other microbial interactions and its controls, with certain abiotic components of environment like wood, plastic, paints, rubber, pesticides, toxic heavy metals, etc.: Biodeteriorations, Bioremediations, Biotransformations and Biomagnifications and their significance with respect to environment and biodiversity.<br>Role of microbes in secondary and tertiary recovery of petroleum.  | <b>15 Hrs</b> |

### **Suggested Readings:**

1. Extremophiles (2000) By B.N.Johari, Springer Verlag
2. Microbial Diversity (1999) By D. Colwd, Academic press
3. Microbial Ecology (1979) By J.M. Lynch and N.J.Poole, Blackwell Scientific Publications, Oxford.



4. Introduction to Modern Virology (2001) eds.: N.J.Dimmock and K.N.Leppard, Blackwell Scientific Publications, Oxford.

|                   |   |               |
|-------------------|---|---------------|
|                   | <b>CCS-303 : Fermentation Technology-I</b>  | <b>60 Hrs</b> |
| <b>Credit I</b>   | <b>Upstream Processing</b><br>Microbial cell growth, kinetics and stoichiometry, various methods for growth measurement, strain improvement by mutation, genetic engineering, etc. Overproduction of metabolites, alternative carbon and nitrogen sources and their composition. Development of inocula for industrial fermentation, design of industrial production media. Alternate metabolic routines for utilization of carbon sources with their regulation and inter-linkage especially for glucose and hydrocarbons, preservation and maintenance of microbes. | <b>15 Hrs</b> |
| <b>Credit II</b>  | <b>Fermentation</b><br>Design of fermenter, construction materials, various sterilization techniques for solid, liquid and gases, aeration and agitation, foam, auxiliary equipments. Control of various parameters – online and offline monitoring, rheological properties of fermenter, role of computer in fermenter operation.  | <b>15 Hrs</b> |
| <b>Credit III</b> | Batch, fed-batch, continuous fermentation and solid state fermentation. Effluent treatment, scale up and scale down. Types of fermenters, process economics, fermentation economics.  | <b>15 Hrs</b> |
| <b>Credit IV</b>  | <b>Downstream Processing</b><br>Principle, methodology, instrumentation and applications of cell homogenization techniques liquid-liquid extraction centrifugation, filtration, , distillation, ultrafiltration, precipitation, adsorption chromatography, ion exchange chromatography, gel filtration and affinity chromatography in clarification, concentration, isolation and purification of various metabolites from fermented media  | <b>15 Hrs</b> |

#### **Suggested Readings:**

1. Moo-Young M. ed. ( 1985 ) Comprehensive Biotechnology vol: I & II, Pergamon Press N.Y.
2. Ratledge C and Kristiansen B. eds. ( 2001 ) Basic Biotechnology 2<sup>nd</sup> ed. Cambridge Univ Press Cambridge.
3. Old R.W and Primose S.D ( 1995 ) Principles of Gene Manipulation 5<sup>th</sup> ed. Blackwell Scientific Pub. Oxford.
4. Bailey J.E and Ollis D.F. ( 1986 ) Biochemical Engineering Fundamentals 2<sup>nd</sup> ed. McGraw Hill Book Company, N. Delhi.
5. Aiba S, Humphrey A. E. and N. F. Millis (1973) Biochemical Engineering, 2<sup>nd</sup> Edition University of Tokyo Press, Tokyo, Japan.
6. Stanbury P.F., Whitaker A, and Hall S.J. ( 1997 ) Principles of Fermentation Technology 2<sup>nd</sup> ed. Aditya Books Pvt. Ltd, N.Delhi.
7. Mukhopadhyaya S.N. ( 2001 ) Process Biotechnology Fundamentals. Viva Books Pvt. Ltd. N.Delhi.

8. Rehm H.J and Reed G. ( 1985 ) Biotechnology vol. I & II. VCH, Basel.
9. Stainer R. Y. Ingraham J. L., Wheelis M. L. and Painter P. R. (1987) General Microbiology 5<sup>th</sup> Edition, Macmillan Press Ltd. London.

|                   |  |               |
|-------------------|--|---------------|
|                   | <b>DSE-304 : Immunology</b>  | <b>60 Hrs</b> |
| <b>Credit I</b>   | <b>Immunology</b> – fundamentals and anatomy of immune system<br>A) ImmCredity – Innate and acquired immunity. Components of innate and acquired immunity.<br>B) Antigen, Haptens, adjuvants, mitogens. Antibodies – structure, functions.<br>C) The anatomy of the immune response: - Cells and organs of immune system. Regulation of immune response – Humoral and Cell mediated response.  | <b>15 Hrs</b> |
| <b>Credit II</b>  | <b>Immunity to infection</b><br>A) Antigen processing and presentation, MHC, complement system, T & B cell activation.<br>B) Bacterial, viral, protozoal and parasitic infections with reference to (Diphtheria, influenza virus, malaria and helminthes) with specific representative examples of each group.<br>C) Vaccines – Active and passive immunization, DNA vaccines, multivalent subunit vaccines, synthetic peptide vaccines.   | <b>15 Hrs</b> |
| <b>Credit III</b> | <b>Clinical Immunology</b><br>A) Hypersensitivity: - Type I, II, III, and IV reactions. Autoimmunity – organ specific and systemic autoimmune diseases. Treatment of autoimmune diseases.<br>B) Transplantation and tumor immunology: - Graft rejection, tissue typing, immunosuppressive therapy and clinical transplantation. Tumor antigens, cancer immunotherapy.<br>C) Immunodeficiency diseases - Phagocytic, humoral, cell mediated deficiencies and SCID. AIDS- causes, syndrome, diagnostic tools, treatment and development of vaccine | <b>15 Hrs</b> |
| <b>Credit IV</b>  | <b>Immunotechnology</b><br>A) Antigen antibody interactions – Principles, types and applications of agglutination, precipitation, complement fixation, viral neutralization, immunodiffusion, immunoelectrophoresis, ELISA and RIA.<br>B) Monoclonal antibodies – Hybridoma technology and various cellular technologies.<br>C) Automation in immunological techniques – auto analyzers used in immunology, FACS etc.  | <b>15 Hrs</b> |

#### **Suggested readings:**

1. Kuby : Immunology; RA Goldsby, Thomas J. Kindt, Barbara A. Osborne.
2. Immunology by Roitt I. M., Brostoff J. and Male D. Gower medical publishing London.
3. Fundamentals of immunology 4th ed., Paul 1999, Lippencott Raven.

|               |  |
|---------------|--|
|               | <b>CCPR-305: Laboratory Course</b> <b>(120 hrs) 200 Marks</b>  |
| <b>Part A</b> | 1. Screening of antibiotic producers- crowded plate technique<br>2. Screening of organic acid producers & amine producers<br>3. Screening of Amylase, Protease & Lipase producers<br>4. Screening of Vitamin producers<br>5. Enrichment and isolation of pesticide resistant bacteria from soil<br>6. Isolation of thermophilic bacteria from soil<br>7. Isolation of acidophilic and alkalophilic bacteria from soil<br>8. Isolation of psychrophilic bacteria from soil<br>9. Isolation of halophilic and halotolerant bacteria<br>10. Determination of effective dilution of the given disinfectant to disinfect tables & vessels<br>11. Determination of effective dilution of the given disinfectant for effective disinfection of skin.<br>12. Determination of preservative effect of the given preservative<br>13. Determination of potability of the given water<br>14. Estimation of heterotrophic bacterial count of the given sample.<br>15. Isolation of lysozyme from egg. |

|               |   |
|---------------|---|
| <b>Part B</b> | 1. Production and Estimation of citric acid by <i>Aspergillus niger</i><br>2. Transformation<br>3. Conjugation<br>4. ELISA and Widal test<br>5. Western blot.<br>6. Transduction<br>7. Protoplast fusion<br>8. Gene expression<br>9. Preparation of plant tissue culture, formulation of media.<br>10. Isolation of cell wall and study of cell wall polysaccharide by chromatographic technique.<br>11. Laboratory Production of <i>Bacillus thuringiensis</i> insecticide and testing of its efficiency.<br>12. Production of biomass <i>Azotobacter</i> , <i>Rhizobium</i> , <i>Azolla</i> and preparation of biofertilizer from it. |
|---------------|---|

|                  |   |               |
|------------------|---|---------------|
|                  | <b>AEC-306 : Mandatory Non-CGPA compulsory Ability Enhancement Course</b> | <b>30 Hrs</b> |
| <b>Credit I</b>  | Syllabus and nature of paper will be opted as per committee decision.     | <b>15 Hrs</b> |
| <b>Credit II</b> |   | <b>15 Hrs</b> |

|                  |  |  |
|------------------|--|--|
|                  | <b>EC (SWMMOOC) 307 : Non-CGPA Elective Course</b><br><b>Food Microbiology and Food Safety</b> |  |
| <b>Credit I</b>  | Syllabus and nature of paper will be opted as per swayam portal.                               |  |
| <b>Credit II</b> |  |  |

## SEMESTER IV

|                   |   |               |
|-------------------|---|---------------|
|                   | <b>CC-401: Food and Dairy Microbiology</b>  | <b>60 Hrs</b> |
| <b>Credit I</b>   | <b>Contamination, Preservation and Spoilage of different kinds of foods:</b><br>Cereal products, Sugar products, Vegetables and fruits, Meat and Meat products, Fish, Eggs, Milk and Milk products, Heated canned foods and other Miscellaneous foods.<br>Fermented Foods: Pickles, Fermented soya products, Fermented products like Idli, Dhokla etc.<br>Fermented vegetables -sauerkraut fermentation. Fermented bakery products. | <b>15 Hrs</b> |
| <b>Credit II</b>  | <b>Food poisoning and infections:</b><br>Staphylococcal poisoning, botulinal poisoning, Salmonella, Vibrio, Bacillus cereus poisoning.<br>Mycotoxins: Patulin, Aflatoxin, Ochratoxin, Luteoskyrin, Sterigmatocystin, ATA etc.<br>Food borne infections: Study of food borne diseases Streptococcal infections, Tuberculosis, Shigellosis, Brucellosis, Enteropathogenic viral infections, preventive measures.                      | <b>15 Hrs</b> |
| <b>Credit III</b> | <b>Dairy Microbiology:</b><br>Cheese fermentation, Fermented Milks, Butter, and other milk products. Indicator organisms. Spoilage and defects of fermented dairy products.   | <b>15 Hrs</b> |
| <b>Credit IV</b>  | <b>Quality control and Regulations of food industry:</b><br>Microbiological quality control of milk and milk products: ISI standards, FAO/WHO regulations, FDA regulations and APHA/IDF regulations.<br>Principles of HACCP in Food industries, Quality Manuals and documentations for different products, Basic GMP in the industry.   | <b>15 Hrs</b> |

### Suggested Readings:

1. Food Science (1996) Fifth Edition by Norman and Potter
2. Food Microbiology Frazier
3. Dairy Microbiology by J.S.Yadav, S. Grover, and V.K. Batish

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|-----------------|---|---------------|
|                 | <b>CCS-402: Microbial Fermentation Technology)</b>  | <b>60 Hrs</b> |
| <b>Credit I</b> | <b>Fermentation media:</b><br>Functions of media components, media rheology and Newton's law of viscosity, Optimization of medium.<br>Gas diffusion: Oxygen and Mass Balance Transfer relationship, Factors affecting gas diffusion | <b>15 Hrs</b> |

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|                   | Types of fermentations: Solid Surface culture type, Liquid surface culture, submerged fermentations.   |               |
| <b>Credit II</b>  | <b>Cultures:</b><br>Isolation, Screening, Yield improvement by changing culture techniques, Strain improvement and preservation. Growth kinetics and yield kinetics.<br>Controls of fermentation: Principles of control system design, Flux control analysis, Command controls, Biosensors. Fermentation control options- Knowledge based system (KBS), Artificial neural networks (ANN) and Genetic algorithm (GA).   | <b>15 Hrs</b> |
| <b>Credit III</b> | <b>Modeling of fermentation processes:</b><br>Techniques of mathematical modeling.<br>Process validation and quality assurance: bioprocesses, Approaches and Modeling<br>a) Installation Qualification (IQ), Operational Qualification (OQ), and Performance Qualification (PQ) for laboratory instruments<br>b) Methods of validation and calibration of equipments<br>c) Documentation-importance and significance<br>d) Current Good Manufacturing Practices (CGMP) and Currents Good Laboratory Practices (CGLP) | <b>15 Hrs</b> |
| <b>Credit IV</b>  | <b>Typical fermentation processes:</b><br>Industrial production of<br>i) Microbial enzymes<br>ii) Bacitracin<br>iii) Streptomycin<br>vi) Riboflavin<br>v) B-Carotene<br>vi) Gibberellins<br>vii) Surfactants   | <b>15 Hrs</b> |

#### Suggested Readings:

1. Fermentation Microbiology and Biotechnology by M. El-Mansi and C.Bryce
2. Principles of fermentation technology by Whitekar, Stanbury and Hall Modelling
3. Control of fermentation process by J.R.Leigh
4. Microbial Technology Vol. I and II by H.J.Peppler and D.Pearlman. Academic Press INC

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|-----------------|--|---------------|
|                 | <b>CCS-403: Bioinformatics</b>   | <b>60 Hrs</b> |
| <b>Credit I</b> | <b>Proteomics: Protein Sequence Databases and Analysis</b><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. | <b>15 Hrs</b> |

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|                   | <b>Proteomics; Strutural Databases, Protein Structure Prediction</b><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.  |               |
| <b>Credit II</b>  | <b>Genomics: Nucleotide Sequence Databases And Analysis</b><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><b>Genomics: Gene Identification</b><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. | <b>15 Hrs</b> |
| <b>Credit III</b> | <b>Structural Biology</b><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><b>Molecular Modeling</b><br>Functions of molecular modeling. Molecular mechanics, force field, potential energy functions, energy minimization methods, single point calculations, full-geometry optimization, conformational search, , molecular dynamics simulations, molecular modeling packages.  | <b>15 Hrs</b> |
| <b>Credit IV</b>  | <b>Microarrays</b><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 (ESI), Tandem mass spectroscopy (MS/MS) analysis; tryptic digestion and peptide fingerprinting (PMF), profiling and diagnostics, drug target discovery.<br><b>Phylogenetic Analysis</b><br>Evolution, phylogenetic tree, methods of phylogenetic analysis; distance based and character based methods, phylogenetic analysis tool-Phylip.   | <b>15 Hrs</b> |

#### **Suggested Readings:**

1. Introduction to Bioinformatics, (Atwood, T. K. and Parry-Smith, D. J).
2. An introduction to Computational Biochemistry. (C. Stain Tsai, A John Wiley and Sons, Inc., publications).
3. Developing Bioinformatics Computer Skills. (Cynthia Gibas and Per Jambeck).

4. Bioinformatics Methods and Applications Genomics, Proteomics and Drug Discovery. (Rastogi S. C. Mendiratta, and Rastogi P.)
5. Bioinformatics, Sequence and Genome Analysis by David Mount, Cold Spring Harbor Laboratory Press, NY, 2004.
6. NCBI Web site: <http://www.ncbi.nlm.nih.gov>

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|                   | <b>DSE-404: Medical Microbiology</b>  | <b>60 Hrs</b> |
| <b>Credit I</b>   | <b>Virulence:</b><br>Invasion of pathogens through the different immunological barriers of human body. Establishment of infection. Role of portal of entry of the pathogen. Antigenic variations and virulence. Microbial toxins and super antigens. Carriers of infections. Epidemiology of certain diseases like urino-genital infections, upper respiratory tract infections, dermatological infections and gastro intestinal tract infections. Loss of virulence by many pathogens on subculturing on artificial media. | <b>15 Hrs</b> |
| <b>Credit II</b>  | <b>Epidemiology:</b><br>Spread of certain infections in a population. Concept of epidemic, endemic and pandemic spread. Role of socioeconomic conditions in spread of disease.<br>Epidemiological methods- descriptive, analytical and experimental epidemiology. Measurement of infection rate.  | <b>15 Hrs</b> |
| <b>Credit III</b> | <b>Chemotherapy:</b><br>Development of drug resistance amongst pathogens – antibiotic resistance mechanisms. Disease management methods. Different prophylactic and therapeutic methods in control of infections.   | <b>15 Hrs</b> |
| <b>Credit IV</b>  | <b>Clinical Microbiology:</b><br>Collection and transportation of pathological samples with specialreference to samples like Cerebro Spinal Fluid (CSF), Sputum samples, Urine samples and swabs. Certain cultural techniques for pathogens like Dermatophytes, Salmonella, Meningococcus, Leptospira, Mycobacterium, Vibrio, Plasmodium spp, Wucheria bancrionti, and Ascaris lumbricoides.<br>Rapid methods of identification of infection like ELISA, FAT, RIA and Western Blot techniques.                              | <b>15 Hrs</b> |

**Suggested reading:**

1. Introduction to Microbiology by Prescott, Harley, Klein
2. Medical Microbiology by Ananthanaryan
3. Medical Microbiology by Dey and Dey

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|               | <b>CCPR- 405: Laboratory Course and Project (120 Hrs)</b><br><b>(200 Marks)</b>  |
| <b>Part A</b> | 1. Fermentative production of gluconic acid.<br>2. Bioassay of streptomycin.<br>3. Fermentative production of wine.<br>4. Detection of adulteration in common food.<br>5. Detection of afla toxin in food and feed.<br>6. Chemical analysis of food – pH, benzoate, sorbate and colour.<br>7. Microbiological –MPN, Resazurin. Chemical – pH, fat, protein, sugar and ash, Physical – sp. gravity, different solid, test for grading of milk.<br>8. Platform test in dairy industry – COB, alcohol precipitation, titrable acidity test, quantitative phosphatase test.<br>9. Using RasMol through command line.<br>10. Pair-wise sequence alignment.<br>11. Multiple sequence alignment.<br>12. Introduction of BioEdit.<br>13. Construction of three-dimensional model by using SPARTAN<br>14. Model Building and Energy minimization.<br>15. Molecular Docking and Drug designing.<br>16. Production of amylase |
| <b>Part B</b> | Research Project <b>(100 Marks)</b>  |

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|                  | <b>SEC-406: Mandatory Non-CGPA compulsory Skill Enhancement Course</b> | <b>30 Hrs</b> |
| <b>Credit I</b>  | Syllabus and nature of paper will be opted as per committee decision.  | <b>15 Hrs</b> |
| <b>Credit II</b> |  | <b>15 Hrs</b> |

### **GE-407: Mandatory Non-CGPA Generic Elective Course**

| <b>Sr. No.</b> | <b>Generic Elective Title of the paper</b> | <b>Credits assigned to the paper</b> | <b>Semester for which course is offered</b> | <b>Eligibility</b>    |
|----------------|--|--------------------------------------|---|-----------------------|
| 1.             | Basics of Microbiology                     | 2                                    | IV  | Masters in any stream |



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|------------------|---|---------------|
|                  | <b>GE-407: Basics of Microbiology</b>   | <b>30 Hrs</b> |
| <b>Credit I</b>  | <b>Introduction to Microbiology:</b><br>Origins of Microorganisms, differences between eukaryotic and prokaryotic cells,<br>Types of microorganisms, Beneficial and harmful activities of microorganisms.<br>Bacterial cell structure and its physiology.<br>Microbial growth: growth curves, Bacterial nutrition, Culture media  | <b>15</b>     |
| <b>Credit II</b> | <b>Techniques in Microbiology:</b><br>Pure culture techniques: streak plate, pour plate, spread plate, Microscopy.<br>Isolation of aerobic and anaerobic bacteria,<br>Control of microorganisms: different methods such as physical and chemical, disinfection, antimicrobial test.<br>Stains and staining techniques: definition and types of stains, monochrome and Gram staining | <b>15</b>     |

**Suggested readings:**

1. Introduction to Microbiology by Prescott, Harley and Keim
2. Microbiology by Pelczar