BHARATHIDASAN UNIVERSITY
TIRUCHIRAPPALLI – 620 024
INDIA

M.Sc. MICROBIOLOGY
(AUTONOMOUS)

CURRICULUM
(Revised with effect from 2007-2009 batch)

DEPARTMENT OF MICROBIOLOGY
REGULATIONS FOR
M.Sc. MICROBIOLOGY (2 YEARS)
(UNDER AUTONOMY)

Name of the Course:
M.Sc. Microbiology

Department offering the Course:
The Department of Microbiology, School of Life Sciences will be offering the course since 1994.

Eligibility for admission:
A degree in Science with one or more branches of biology at the major or ancillary (subsidiary) levels.

Duration of the course:
2 Academic years consisting of two semesters each.

Course Fees:
Each student admitted to the M.Sc. Microbiology degree course will pay a Tuition, Lab, Special, Stationery, Chemical and computer and other fees as decided by the University from time to time. The student will have to pay additionally the fees prescribed by the University for recognition, matriculation etc. In addition, the student has to pay a sum of Rs.1, 000/- as Laboratory Caution Deposit, which would be refunded depending upon breakages etc., at the end of the course.

Board of Studies:
The Board of Studies for academic programmes, syllabi etc., will consist of all the members of the faculty of the Department of Microbiology and two outside experts. The Head of the Department of Microbiology will be the Chairman.

Syllabus:
The Syllabi for the various courses are designed keeping in view the usefulness of the course to the students for (1) continuation of academic activity
leading to research, (2) employability in microbiology related vocations and (3) self-employment.

Academic visits to institutions and or industries related to the courses during the semesters of study will form part of the curriculum. The students depending on their performance and choice would either have to carry out a project or undergo training or submit a report at the end of the final semester in an area of microbiology.

From the academic year (2002-2004) Choice Based Credit System (CBCS) is introduced in all departments of the University. According to this system the M.Sc., Microbiology Course requires a student to earn 90 credits in four semesters. The basic course structure and the scheme of examinations are given in tables that follow.

A student has to take four core courses including practical and two elective courses in the first and second semesters and six core courses including practical and a self study review paper in third semester. The fourth semester would be entirely devoted to the project work.

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M.Sc., MICROBIOLOGY

COURSE STRUCTURE

The two year M.Sc, Microbiology program will have four semesters.

The Course structure will be as given below:

<table>
<thead>
<tr>
<th>Semester</th>
<th>Course</th>
<th>Hours per week</th>
<th>Total credits per course</th>
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<tbody>
<tr>
<td>I</td>
<td>Four core courses</td>
<td>22</td>
<td>17</td>
<td>25</td>
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<tr>
<td>I</td>
<td>Two Elective course</td>
<td>8</td>
<td>8</td>
<td></td>
</tr>
<tr>
<td>II</td>
<td>Four core courses</td>
<td>22</td>
<td>17</td>
<td>25</td>
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<tr>
<td>II</td>
<td>Two Elective course</td>
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<td>8</td>
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<tr>
<td>III</td>
<td>Six core courses</td>
<td>30</td>
<td>25</td>
<td>25</td>
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<tr>
<td>IV</td>
<td>Project work</td>
<td>--</td>
<td>15</td>
<td>15</td>
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<tr>
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<td><strong>Total</strong></td>
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<td>Inst Hrs/Week</td>
<td>Credits</td>
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<td>---------------</td>
<td>---------</td>
</tr>
<tr>
<td>I</td>
<td>CC I</td>
<td>Biological macromolecules (T)</td>
<td>4 4 3</td>
<td>25</td>
</tr>
<tr>
<td></td>
<td>CC II</td>
<td>Microbial Cell Biology(T)</td>
<td>4 4 3</td>
<td>25</td>
</tr>
<tr>
<td></td>
<td>CC III</td>
<td>Molecular Biology &amp; Microbial Genetics (T)</td>
<td>4 4 3</td>
<td>25</td>
</tr>
<tr>
<td></td>
<td>CC IV</td>
<td>Practical CCI, CCII, CCIII (lab)</td>
<td>10 5 6</td>
<td>60</td>
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<tr>
<td></td>
<td>EC I</td>
<td>Biological Techniques (T)</td>
<td>4 4 3</td>
<td>25</td>
</tr>
<tr>
<td></td>
<td>EC II</td>
<td>Molecular taxonomy and phylogeny(T)</td>
<td>4 4 3</td>
<td>25</td>
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<td>CC V</td>
<td>Immunotechnology (T)</td>
<td>4 4 3</td>
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<td>CCVI</td>
<td>Medical Microbiology (T)</td>
<td>4 4 3</td>
<td>25</td>
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<tr>
<td></td>
<td>CC VII</td>
<td>Virology (T)</td>
<td>4 4 3</td>
<td>25</td>
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<tr>
<td></td>
<td>CC VIII</td>
<td>Practical CCV , CCVI, CCVII</td>
<td>10 5 6</td>
<td>60</td>
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<tr>
<td></td>
<td>EC III</td>
<td>Commercial Biotechnology &amp; IPR (T)</td>
<td>4 4 3</td>
<td>25</td>
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<td>EC IV</td>
<td>Bio-Informatics and Bio-Statistics. (T)</td>
<td>4 4 3</td>
<td>25</td>
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<td>III</td>
<td>CC IX</td>
<td>Food &amp; Dairy Microbiology (T)</td>
<td>4 4 3</td>
<td>25</td>
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<tr>
<td></td>
<td>CC X</td>
<td>Recombinant DNA Technology (T)</td>
<td>4 4 3</td>
<td>25</td>
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<td></td>
<td>CC XI</td>
<td>Microbial Biotechnology (T)</td>
<td>4 4 3</td>
<td>25</td>
</tr>
<tr>
<td></td>
<td>CC XII</td>
<td>Environmental &amp; Agriculture Microbiology(T)</td>
<td>4 4 3</td>
<td>25</td>
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<td></td>
<td>CC XIII</td>
<td>Self Study Review</td>
<td>4 4 3</td>
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<td>CC XIV</td>
<td>Practical CC IX, CC X, CC XI</td>
<td>10 5 6</td>
<td>60</td>
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<tr>
<td>IV</td>
<td>CC XIX</td>
<td>Project</td>
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<td>90</td>
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</table>
Continuous Internal Assessment:

The internal assessment component for theory for each student will include attendance, weekly tests, model exams, seminars and/or assignments.

The internal assessment component for the lab course for each student will consist of attendance, performance in the laboratory, observation notebook, monthly tests and model tests. The Internal assessment component for each course will be 40% of the marks allotted to the course. This applies to theory as well as lab courses. In the case of core course CC XIII - self-study review in the III semester 100% internal assessment will be done and there will be no external component.

There will be no passing minimum for internal assessment. However, if a student wishes to improve his/her internal assessment performance, he/she has to rejoin the course in the concerned semester after completing the four semesters.

External Examination:

The question paper setters for the external examinations in theory will be from out of a panel of examiners suggested by the course teachers and the board of studies. There will be a double valuation of the theory papers and one of them will be the course teacher. If the marks awarded by the two examiners differ by 10 or more, there will be a third valuation by a person appointed by the chairman and the average of the nearest two marks will be taken final irrespective of the difference in percentage.

There will be two examiners for each lab course external examination of whom one will be internal. There will be combined evaluation of the students by the two examiners. Each lab course examination will include a viva-voce component, the marks for which should not exceed 20% of the marks allotted.

A student has to obtain at least 50% of the marks allotted for the external component and at least 50% in the internal plus external aggregate to pass the theory or lab course component of each course passing minimum in the University examinations will be 40% and the candidate in aggregate should score 50%. Successful completion of a course requires a minimum of ‘C’ grade or 4 grade points. Grading pattern is given below.
## GRADING OF THE COURSES

<table>
<thead>
<tr>
<th>Marks</th>
<th>Grade point</th>
<th>Letter Grade</th>
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<tr>
<td>96 and above</td>
<td>10</td>
<td>S+</td>
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<td>91-95</td>
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<td>86-90</td>
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<td>81-85</td>
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<td>76-80</td>
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<td>71-75</td>
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<td>66-70</td>
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<td>61-65</td>
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<td>56-60</td>
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<tr>
<td>50-55</td>
<td>5.5</td>
<td>C</td>
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<tr>
<td>Below 50</td>
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## FINAL RESULT

<table>
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<tr>
<th>CGPA</th>
<th>Grade Point</th>
<th>Classification of Final Result</th>
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<tr>
<td>9.51 and above</td>
<td>S+</td>
<td>First Class – Exemplary</td>
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<tr>
<td>9.01 - 9.50</td>
<td>S</td>
<td>First Class - Distinction</td>
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<tr>
<td>8.51 - 9.00</td>
<td>D++</td>
<td>First Class</td>
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<td>8.01 - 8.50</td>
<td>D+</td>
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<tr>
<td>7.51 - 8.00</td>
<td>D</td>
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<tr>
<td>7.01 - 7.50</td>
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<td>6.51 - 7.00</td>
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<td>5.51 - 6.00</td>
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<td>Second Class</td>
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<td>5.00 - 5.50</td>
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<tr>
<td>Below 5.00</td>
<td>F</td>
<td>Fail</td>
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</table>
Unit - I: Types of Macromolecules
Classification of macromolecules - polysaccharides, fats, proteins & nucleic acids
structure and properties of:
- Mono, di, oligo and polysaccharides, Complex carbohydrates,
- Aminoacids, peptides & proteins
- Fatty acids, Glycerolipids, phospholipids, glycolipids and steroids
- Pigments – chlorophyll

Unit - II: Biosynthesis
Gluconeogenesis - Synthesis of amylase, glycogen, levan and dextran.
Biosynthesis of:
- Fatty acids, triglycerols, membrane phospholipids & cholesterol synthesis
- Nucleotides, Purines, pyrimidines, and nucleotides
- Chlorophyll
- Amino acids

Unit - III: Nucleic acids
Structure & types of - DNA & RNA - their topology and functions. Chromosome
organization in microbes. Artificial nucleic acid – PNA. Structure of tRNA, rRNA
and mRNA.

Unit - IV: Proteins
Primary, secondary and tertiary structure – structure determination –
Ramachandran plot – Purification of proteins

Unit – V: Vitamins and hormones
Structure and properties of vitamins and hormones – Definition and nomenclature
– biological availability – assessment of vitamins in nutritional status – vitamins B₁,
B₁₂, K, E and niacin – Protein and peptide hormones – auxine, gibberellins, abscisic
acid.
References

Unit – I: Morphology and ultra structure of microorganisms

Unit – II: Classification of microorganisms

Unit – III: Techniques in Microbiology

Unit – IV: Nutritional types and carbohydrate metabolism

**Unit – V: Growth and metabolism of nitrogenous compounds**


**References:**

8. Neidhardt FC. (1996) *Escherichia coli* and *Salmonella typhimurium* – Cellular and Molecular Biology (Vol I & II)
CC III - Molecular Biology & Microbial Genetics - (Theory)

Unit - I: DNA replication and repair

Unit – II: Transcription and translation

Unit – III: Concept of Gene & Gene regulation

Unit - IV: Gene transfer mechanisms
Transformation – competence cells, regulation, general process; Transduction – general and specialized; Conjugation – Hfr, triparental mating, self transmissible and mobilizable plasmids, pil.

Unit – V: Transposable elements
Introduction - Discovery insertion sequences, complex and compound transposons – T10, T5, and retroposon – Nomenclature- Insertion sequences – Mechanism – Transposons of E.coli, Bacteriophage and Yeast.
References:

First Year - Semester- I

CC IV – Practical (CC I, CC II & CC III)

CC I – Biological Macromolecules - (Lab Course)

Quantification of Macromolecules - Isolation and Colorimetric estimation of:
1. Amino acids - Ninhydrin method
2. Protein - Biuret method/Lowry’s method
4. Cholesterol estimation - Acetic anhydride method
5. DNA - Diphenylamine method
6. RNA - Orcinol method
7. Determination of Phosphorous content of nucleic acids - perchloric acid test.
8. Pigments (chlorophyll - carotenoids – phycobiliproteins)
9. Estimation of lipid

References
CC II - Microbial Cell Biology - (Lab Course)

1. Preparation and use of glassware cleaning solutions, sterilization.
3. Isolation of anaerobic and aerobic bacteria – cyanobacteria, actinomycetes and fungi.
4. Pure and axenic culture techniques – serial dilution – pour plate, spread plate, streak plate methods and stab culture techniques.
5. Bacterial Staining methods – simple, Gram’s, acid fast, flagella, capsule and spore.
9. Effect of physical and chemical factors on the growth of bacteria and Cyanobacteria – temperature, pH, oxygen, radiation, water activity, macro and micro nutrients and chelators.
10. Fixation of nitrogen by acetylene reduction assay using gas chromatography
11. Assay of glutamine synthetase, nitrite reductase and nitrate reductase by colorimetry

References:
1. Isolation of antibiotic resistant microbes.
2. Induction of mutation by ultra-violet radiation and chemical mutagens – NTG, MNNG.
3. Transformation (competent cell preparation) and Transduction using P1.
4. Isolation of microbial genomic DNA
5. Isolation of plasmid DNA from \textit{E.coli} (mini preparation).
6. Isolation of plasmid DNA from Gram Negative (bacteria) and cyanobacteria (mini preparation)
7. Quantification of plasmid by spectrophotometric methods.
9. Conjugation - \textit{Hfr}

\textbf{References:}
First Year – Semester I

EC I – Biological Techniques - (Theory)

Unit – I: Microscopy and Related Techniques

Unit – II: Analytical Techniques

Unit – III: Principles & Applications of Chromatographic Techniques
Adsorption – Ion exchange and gel permeation – affinity chromatography for separation of compounds including GC and HPLC methods.

Unit – IV: Electrophoresis Techniques

Unit – V: Molecular Biological Techniques
Isolation of chromosomal and plasmid DNA. Polymerase chain reaction – isolation of specific genes using PCR. Restriction digestion and Phosphatase treatment of cloning vectors. Cloning techniques – separation and quantification of DNA by spectrophotometric and electrophoretic techniques, gene transfer mechanisms – chemical and electroporation.
Methods of detection of clones – Nucleic acid transfer by blotting, Hybridization - plaque, colony hybridization. Histochemical detection of β-galactosidase, antibody screening including colour development reaction.

References:
First Year – Semester I

EC II – Molecular Taxonomy & Phylogeny - (Theory)

Unit – I: Microbial Taxonomy

UNIT- II: Biochemical & molecular taxonomy

Unit – III: 16S rRNA based finger printing
Types of rRNA - 23s rRNA, 16S rRNA & 5S rRNA. Importance of 16SrRNA in microbial identification and taxonomy. Methods of 16S rRNA / rDNA fingerprinting - Isolation of rRNA, RT- PCR, Isolation of DNA, amplification of 16S rDNA using PCR, Cloning, transformation, Blue-white screening, Plasmid isolation, Dot blot/Southern blot hybridization using specific probes Sequencing of 16S rDNA using chain-termination method.

UNIT – IV: Sequence analysis.

UNIT – V: Molecular phylogeny.
Introduction to Molecular phylogeny – tree terminology, software programs for making phylogenetic trees – MEGA, Phylib, RAPDistance. Cladogram, additive trees and ultrametric trees, rooted, unrooted trees and tree shapes.
References:
4. Genome Mapping and Sequencing by Ian Dunham (Hardcover - Sep 1, 2003).
7. First Year – Semester - II

CC V – Immunotechnology - (Theory)

Unit I: Immune System
Historical perspective – Discovery, early theories, Immunodeficiency conditions, Lymphocyte Traffic, Hematopoiesis, Innate and adoptive immune response in protection.

Unit II: Antigen and Antibody Molecules
Antigen engineering for better immunogenicity, Use for vaccine development, whole-organism vaccines, recombinant vaccines, DNA vaccines, synthetic peptide, multivalent subunit and anti-idiotype vaccines. Antibody engineering, Antibody for diagnosis, Antibody for therapy, Hybridoma Technology.

Unit III: MHC, Cytokines and Complements
Structure of MHC molecules, Antigen presentation, Antigen presentation by non MHC molecules, Cytokine structure and their receptors, Cytokine therapy, Complements, Lymphocyte Migration and Inflammation, Hypersensitivity reactions, auto immunity.

Unit IV: B and T Cell Activation
B cell receptor complex, B cell maturation, Generation of antibody diversity, Understanding self-nonself discrimination, T\textsubscript{H} Cell subpopulation, Organisation of T cell receptor, Cell mediated effector responses.

Unit V: Immunotechnology and its applications
Precipitation techniques, agglutination techniques, radiology in immunotechniques, Enzyme-Linked immunosorbent assay (ELISA), Western blotting, immunofluorescence, Flowcytometry and immunoelectron microscopy. Infectious diseases - immune system in AIDS, transplantation immunology, cancer and the immune system.
References:

3. Chapel H and Halbey M (1986) Essentials of Clinical Immunology
Unit-I: Introduction of Medical Microbiology:
History, Koach & River’s postulates, Role of Microbiology in Medicine, Classification of medically important microbes, Normal Microbial flora, Infections-Source, Mode of transmission, Prevention of medically important microbes.

Unit-II: Systematic Medical Bacteriology:

Unit-III: Mycology & Parasitology:

Unit-IV: Viral diseases:
Influenza viruses, Measels, Mumps, Chicken Pox, Hepatitis A,B,C, D & E, Poliomyelitis, AIDS, Human Papilloma Virus (HPV), Rabies, Yellow fever, Dengue and Japanese Enchepalitis.

Unit-V: Laboratory Diagnosis:
Laboratory diagnosis of bacterial diseases, Laboratory diagnosis of mycological and Parasitological diseases, Laboratory diagnosis of viral diseases, Antibiotic sensitivity test. Molecular diagnosis.
References:

1. Medical Microbiology (2001) by Jawetz, Melnick and Adelberg’s 22nd edition
   McGraw Hill Medical Publication division
   Peutherer 15th edition, Church Hill Living stone Publication.
3. Medical Microbiology by Anathanarayanan.
5. Foundations in Microbiology (2005) by Cathleen park Talaro 6th edition,
   McGraw Hill Medical Publication division.
   Medical Publication division.
   Medical Publication division.
Unit – I: Brief outline of virology
Discovery of virus; early development of virology – nomenclature - classification and taxonomy of viruses - based on host, nucleic acids and structure; Evolution of viruses

Unit - II: Bacterial viruses
φ X 174; T4; M 13; Lambda and Mu; P1 phages. Structural organization - life cycle - transcription - DNA replication and phage production - lysogenic cycle wherever applicable, and genetics of each phage.

Unit - III: Plant viruses
TMV - general characters – morphology – structure – replication - RNA as the initiator of infection; Cauliflower Mosaic Virus - a brief account. Transmission of plant viruses - transmission by vectors - transmission without vectors. Common viral diseases of crop plants - names of diseases, pathogens and symptoms only - paddy, cotton, tomato and sugar cane.

Unit - IV: Animal viruses
General characters, chemical and physical nature, life cycle, epidemiology, pathogenicity, disease caused and immunologic response of the following viruses: Myxo virus: Orthomyxo virus, Paramyxvo virus; Herpes virus - HSV 1 & 2; Adeno virus and Adeno Associated Viruses; Tumour viruses of human.

Unit - V: Other viral types
**References:**

CC VIII – Practical (CC V, CC VI & CC VII)

CC V - Immunotechnology - (Lab Course)

1. Collection of venous blood from human and separation and preservation of serum/plasma
2. Agar gel diffusion – Ouchterlony’s method
3. Counter immuno electrophoresis
4. Electrophoresis – serum proteins
5. Blood grouping
6. Latex agglutination test
7. Widal tube and slide agglutination technique
8. Enzyme Linked Immunosorbent Assay (ELISA)
9. Western blotting
10. Immunization of protocols and raising antibody
11. Dissection of primary and secondary lymphoid organs in a selected animal

References:

CC VI – Medical Microbiology - (Lab Course)

1. Collection and transport of clinical specimens for microbiological examinations
2. Laboratory diagnosis of upper respiratory tract infection
3. Laboratory diagnosis of lower respiratory tract infection
4. Laboratory diagnosis of gastrointestinal infection
5. Laboratory diagnosis of urinary tract infection (UTI)
6. Laboratory diagnosis of Typhoid fever
7. Laboratory diagnosis of Leptospirosis
8. Laboratory diagnosis of Dengue fever
9. Laboratory diagnosis of skin diseases
10. Laboratory diagnosis of Parasitic infection

References:
3. A Photographic Atlas for the Microbiology Laboratory by Michael J Leboffe, Burton E. Pierce 3rd Edition Benjamin Cummings Publisher.

CC VII – Virology - (Lab Course)

1. Isolation and characterization of bacteriophage from natural sources.
2. preparation of bacteriophage stock - Lambda & T4
3. Phage Titration - T4 and M13
4. Burst size determination - A one step growth curve of bacteriophage T4
5. Determination of lysogeny by using Lambda phage
6. Isolation of cyanophage
7. Study of virus infected plant samples
8. Transmission methods of plant viruses - Southern Sunhemp Mosaic Virus (SSMV) - local and systemic plants
9. Thermal characterization, Longevity *invitro* - Dilution end point.
10. Animal Virus Propagation - Egg inoculation

**References:**

Unit - I: Industrial microbes
Biology of industrial microorganisms such as *Streptomyces*, yeasts, *Spirulina* and *Penicillium* – Strain improvement – Culture preservation - Stock culture collection centres – Criteria used for the selection of microorganisms for fermentation.

Unit - II: Large-scale cultivation
Fermentation media - Desired qualities - media formulation strategies - economic means of providing energy, carbon - nitrogen - vitamin and mineral sources - role of buffers, precursors, inhibitors, inducers and antifoams, types of fermentation. Fermenters - Basic functions, design and components - asepsis and containment requirements - body construction and temperature control - aeration and agitation systems - sterilization of fermenter, air supply, and medium; aseptic inoculation methods - sampling methods, valve systems - a brief idea on monitoring and control devices and types of fermenters.

Unit - III: Microbial products

Unit – IV: Commercialization
Objectives - market potential - economic measures in plant and equipment - media, heating and cooling; productivity of culturing, recovery costs.

Unit – V: Legal protection & IPR
GATT and IPR, forms of IPR, IPR in India, WTO Act, Convention on Biodiversity (CBD), Patent Co-operation Treaty (PCT), forms of patents and patentability, process of patenting, Indian and international agencies involved in IPR & patenting, Global scenario of patents and India’s position, patenting of biological material, GLP, GMP.
References:
Unit I: Biology in the computer age

Unit II: Genomics

Unit III: Proteomics
Protein Data Bank, Swiss-prot - biochemical pathway databases - Predicting Protein structure and function from sequence – Determination of structure – feature detection – secondary structure prediction – predicting 3 D structure - protein modeling.

Unit IV: Biostatistics I

Unit V: Biostatistics II
Inferential statistics – Probability and distributions – Poisson, Binomial and Normal distribution – Chi-square test – Hypothesis test - Student’s t-test – Correlation and Regression – ANOVA.
References:

Unit – I: Food Microbiology
Introduction- Importance of food microbiology- Types of microorganisms in food spoilage, Source of contamination- Factors influencing microbial growth in food. Food preservations: principles- methods of preservations-Physical and chemical methods.

Unit – II: Microbiology of food and food products
Contamination, spoilage and preservation of cereals and cereals products, sugar and sugar products, Vegetables and fruits, meat and meat products – fish and other sea foods, egg and poultry.

Unit – III: Food borne diseases
Food borne diseases, intoxication and food poisoning – bacterial and non-bacterial food borne diseases: Staphylococcus, Clostridium, Escherichia coli and Salmonella infections, Mycotoxins, Protozoan and Viral food borne diseases.

Unit – IV: Food fermentations
Methods of fermentations and organisms used -bread, wine, beer. Fermented vegetables, Food and enzymes from microorganisms-single cell protein. Production of amylase and protease.

Unit – V: Dairy Microbiology
References:

Unit – I: Introduction to Basics of genetic engineering

Unit – II: Tools of genetic engineering
Enzymes in Genetic Engineering - DNA Polymerase, Polynucleotide kinase, T4 DNA ligase, Nick translation system, Terminal deoxynucleotidyl transferase, Reverse transcriptase Restriction endonucleases Type I & II. Vectors – plasmid, bacteriophage and other viral vectors, cosmids, Ti plasmid, yeast artificial chromosome.

Unit – III: Techniques of Genetic Engineering I
Strategy of recombinant DNA technology; Gene library - Genomic library, cDNA library – Cloning strategies - Use of linkers, adoptors, homopolymer tails - Nucleic acid hybridization - Colony hybridization, plaque hybridization; Blotting techniques - Southern, Northern, Western and dot blotting.

Unit – IV: Techniques of Genetic Engineering II
PCR – principles, techniques and applications. Gene isolation, cloning and expression, DNA sequencing, oligonucleotide synthesis, Southern and Northern hybridization, FISH, RAPD, PCR-RFLP, STRR, LTRR. DNA fingerprinting and their applications for diagnosis of disease, site-directed mutagenesis, Gene silencing, Gene transfer technologies.

Unit-V: Functional genomics and Applications of Genetic Engineering
DNA chips and microarray gene screen technology; site directed mutagenesis, transgenic animals and gene knockout techniques, cell culture based techniques Genetic diagnosis. Applications in medical field, biology, transgenic plants, transgenic animals, Recombinant vaccines development. Gene therapy; Molecular basis of genetic diseases, genetic counseling.
References:

5. Application of rDNA Technology by Glick & Pasteneuk.
Second Year – Semester - III

CC XI – Microbial Biotechnology - (Theory)

Unit - I: Algal Biotechnology

Unit-II: Microbial Pesticides
Basic principle – antagonism, amensalism, siderophores, parasitism, nematophagy. Microbial herbicides, microbial insecticides - bacterial insecticide *Pseudomonas*, *Bacillus* sp. - *Bacillus thrungiensis* - toxins - BT cotton - viral insecticide - entomopathogenic fungi.

Unit- III: Industrial Processes and Products

Unit – IV: Microbial Metagenomics

Unit – V: Bioremediation
Microbes in abatement of heavy metal pollution - heavy metal tolerant microbes - Mechanism of heavy metal and antibiotic resistance - role of biosorption - biotransformation of Xenobiotics - Superbug - rDNA application. Biodegradation of oil and petroleum products. Microbial leaching - Copper - Uranium.
References:

   Washington, D.C
7. Alexander Hillisch and Rolf Hilgenfeld. Modern Methods of Drug Discovery, Birkhauser, Switzerland
CC XII – Environmental & Agricultural Microbiology - (Theory)

Unit – I: Environmental Microbiology
Characteristic features of environmental microflora: Important uses and harmful effects of virus, protozoa, Bacteria, actinomycetes, fungi, algae and nematodes. Microorganisms and their environment: Temperature, oxygen, desiccation, extreme cold, ionic effect, electricity, osmotic pressures, radiant energy, hydrostatic pressures, mechanical Impact, vibration, and surface forces.

Unit – II: Air and Aquatic Microbiology

Unit – III: Waste treatment
Types of wastes - characterization of solid and liquid wastes. Bioremediation: Types of bioremediation, basics of bioremediation of surface soil and sludges. Principles and applications of bioaccumulation, biomagnification, biodegradation: Degradation of Biopolymers: Xylan, lignin and polyhydroxy alkanoates (bioplastics); Microbial degradation of hydrocarbons: Methane alkanes; Microbial degradation of halogenated and sulfonated compounds and Biodegradation of pesticides.

Unit – IV: Agroecosystems
Agroecosystems - Populations in agroecosystems, diversification of agroecosystems. Interaction between agroecosystems and natural ecosystems. Agrobiodiversity assessment and management, outline of the threats to agrobiodiversity and the need for conservation management: Impact of genetically modified crops. Microbial interactions: Plant & microbe, microbe & microbe interactions - Mutualism, commensalisms, amensalism, synergism, parasitism,
predation and competition. Outline of biogeochemical cycles: transformation, fixation and mobilization of nutrients, R: S ratio.

**Unit – V: Sustainable agriculture**


**References:**

CC XIV Practical (CC IX, CC X CC XI & CC XII)

CC IX – Food and Dairy Microbiology - (Lab Course)

1. Microbial analysis of food products – bacterial and fungal
2. Microbial spoilage of refrigerated food
3. Extracellular enzyme activities – cellulase, protease, lipase and phosphatase
4. Milk microbiology – direct microscopic count – standard plate count
5. Reductase test (resazurin/methylene blue)
6. Isolation of microbes from yoghurt, curd
7. Field trip to dairy, food industries, sewage treatment plants

References:

CC X – Recombinant DNA Technology - (Lab Course)

1. Genomic DNA isolation
2. Plasmid DNA isolation
3. Restriction digestion
4. Transformation
5. PCR
6. Western Blotting
7. RAPD Fingerprinting
8. Competent cell preparation and ligation
9. Southern and Northern Blotting
References:

12. Application of rDNA Technology by Glick & Pasteneuk.

CC XI – Microbial Biotechnology - (Lab Course)

1. Separation of proteins by coloum chromatography ion exchange – gel exclusion - adsorption
3. Production, quantification, extraction and characterization of followings
   i) Alcohol, ii) Citric acid, iii) Amylase, iv) Lipase, v) protease, vi) penicillin and vii) Biofertilizers
4. Antibiotic assays- MIC – antibiotic resistance
5. Lipid separation using TLC, and fatty acids by gas chromatographic technique
6. Hydrogen production assay by gas Chromatographic technique

References:


**CC XII – Environmental & Agricultural Microbiology - (Lab Course)**

1. Quantification of microorganisms in air – solid – liquid impingement techniques.
2. Physical, Chemical & Microbial assessment of water. Colour, pH, alkalinity, acidity, COD, BOD, anions, cations, MPN index – presumptive, completed and confirmative tests.
3. Isolation of microflora from different industrial waste.
5. Microflora from different soil types & habitats. Isolation of N\textsubscript{2} fixing, phosphate solubilizing / mobilizing microbes.
6. Localization of AMF.

**References:**

## CC XIII- SELF STUDY REVIEW

### SELF STUDY REVIEW TOPICS - 2008 Batch

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