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<th>Syllabus Ref No</th>
<th>Subject</th>
<th>Credits</th>
<th>Teaching Hours</th>
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<tr>
<td>MB 101</td>
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<tr>
<td>MB 102</td>
<td>Virology (Core)</td>
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<tr>
<td>MB 103</td>
<td>Research Methodology &amp; Techniques (Core)</td>
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<td>MB 104</td>
<td>Microbial Biochemistry (Core)</td>
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<td>MB 153</td>
<td>Research Methodology &amp; Techniques</td>
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<tr>
<td>MB 154</td>
<td>Microbial Biochemistry</td>
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## SEMESTER – II

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<tr>
<th>Syllabus Ref No</th>
<th>Subject</th>
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<th>Teaching Hours</th>
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<td>MB 202</td>
<td>Environmental &amp; Agriculture Microbiology(Core)</td>
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<tr>
<td>MB 203</td>
<td>Immunology (Core)</td>
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<tr>
<td>MB 204</td>
<td>Pharmaceutical Microbiology (Core)</td>
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|                 |                                              |         |                |       |      |
| **PRACTICALS**  |                                              |         |                |       |      |
| MB 251          | Molecular Biology and Microbial Genetics     | 2       | 4              | --    | 50   | 50   |
| MB 252          | Environmental & Agriculture Microbiology     | 2       | 4              | --    | 50   | 50   |
| MB 253          | Immunology                                   | 2       | 4              | --    | 50   | 50   |
| MB 254          | Pharmaceutical Microbiology                  | 2       | 4              | --    | 50   | 50   |
| **Total**       |                                              | 24      | 32             | 80    | 520  | 600  |
### SEMESTER – III

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<thead>
<tr>
<th>Syllabus Ref No</th>
<th>Subject</th>
<th>Credits</th>
<th>Teaching Hours</th>
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<td>MB 302</td>
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<td>MB 303</td>
<td>DSE A. Industrial Microbiology (or)</td>
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<tr>
<td></td>
<td>B. Microbial Proteomics</td>
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<tr>
<td>MB 304</td>
<td>DSE A. Microbial Ecology &amp; Plant Microbe Interactions (or)</td>
<td>4</td>
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</tr>
<tr>
<td></td>
<td>B. Advances in Biotechnology</td>
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|                         |                                              |         |                |          |       |      |
| PRACTICALS             |                                              |         |                |          |       |      |
| MB 351                 | Food Microbial Technology                    | 2       | 4              |          | 50    | 50   |
| MB 352                 | Medical Bacteriology                         | 2       | 4              |          | 50    | 50   |
| MB 353                 | C. Industrial Microbiology (or) Microbial Proteomics | 2 | 4 | - | 50 | 50 |
| MB 354                 | Microbial Ecology & Plant Microbe Interactions (or) Advances in Biotechnology | 2 | 4 | - | 50 | 50 |

**Total**               | 24                                          | 32      | 80             | 520      | 600   |
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<thead>
<tr>
<th>Syllabus Ref No</th>
<th>Subject</th>
<th>Credits</th>
<th>Teaching Hours</th>
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<tr>
<td>MB 401</td>
<td>Cell &amp; Molecular Biotechnology (Core)</td>
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<tr>
<td>MB 402</td>
<td>Medical Virology &amp; Parasitology (Core)</td>
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<td>GE (IDSE)</td>
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<tr>
<td></td>
<td>A. Microbial Biotechnology (or) Bioinformatics and Nanotechnology</td>
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<tr>
<td>MB 404</td>
<td>DSE</td>
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<td>A. Applied Microbiology (or) B. Project work</td>
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<td>Cell &amp; Molecular Biotechnology</td>
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<td>MB 452</td>
<td>Medical Virology &amp; Parasitology</td>
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<tr>
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<td>Microbial Biotechnology (or) Bioinformatics and Nanotechnology</td>
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<tr>
<td>MB 405</td>
<td>Applied Microbiology (or) Project</td>
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<td>GRAND TOTAL</td>
<td>96</td>
<td>128</td>
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</table>
M.Sc. I Semester (CBCS)
Paper I General Microbiology and Microbial Physiology (Core) (CBCS)
(4 HPW-4 Credits)

Unit I
Pioneers of Microbiology.
Microscopy - Principles, working and applications of bright field microscope, fluorescent
microscope, Phase contrast microscope, electron microscope.
Microbial Cell Structure: Prokaryotic cell, Eukaryotic cell, Organization and function of cellular
organelles. Bacterial endospore structure, biochemistry and genetics of sporulation

Unit II
Methods of sterilization and disinfection: Physical methods and chemical methods.
Microbiological media - Autotrophic media, defined synthetic mineral media, heterotrophic
media. The concept of prototrophs and auxotrophs, prototrophic (minimal media) complex
media (undefined media).
Cultivation of Bacteria, Fungi and Algae: Routine and special culture methods.
Isolation of pure cultures.
Preservation and Maintenance of Microbial Cultures: Routine methods and Liquid nitrogen
preservation, freeze-drying (lyophilization), etc.

Unit III
Identification methods and classification of bacteria: -
Microscopic identification characteristics, staining methods. Ecological identification methods,
Nutritional (cultural) identification characters, biochemical identification methods, immunological
characteristics, Molecular and genetic characteristics identification (16s rRNA).
Principles of bacterial taxonomy and classification: - Numerical taxonomy, Bergy’s manual and its
importance, general properties of bacterial groups.
Microbial nutrition and metabolism: autotrophy – Photoautotrophy and bacterial photosynthesis
Chemoautotrophy and heterotrophic metabolism.

Unit IV
Microbial growth: The concept of growth and definition, formation of protoplasm, building of
macromolecules from elemental nutrients, supramolecules, organelles of cell and cellular
components. Cell cycle in microbes and generation time.
Growth phases of bacteria – Lag phase, exponential (logarithmic) phase, stationary (ideo) phase,
decline and survival of microbial cells. Importance of each growth phase.
Synchronous cultures – Methods of synchronous culturing, Continuous culturing methods, factors
effecting growth.
Methods of growth measurement.
I Semester Practical Paper I
General Microbiology & Microbial physiology (CBCS)
(4 HPW-2 Credits)

1. General instructions, Microbiology laboratory and its discipline
2. Handling of microscopes, Calibration and measurement of microscopic objects
3. Staining techniques for bacteria – simple, differential and special stainings
4. Sterilization procedures/methods
5. Preparation of microbiological media. Autotrophic media, minimal media, basic media,
enriched media, enrichment media, differential media.
6. Isolation and cultivation of pure cultures
7. Identification methods of bacteria
8. Isolation and culturing of fungi (yeasts and molds) and algae
9. Culturing methods of microbes – slant and stab cultures, tube culture, flask cultures, shake
   flask cultures
10. Anaerobic culturing methods – anaerobic jar and its use, pyrogallol method,
thioglycollate media culturing, anaerobic glove box and its application
11. Microbial growth experiments – Viable count of growing cultures and generation time
determination
12. Study of bacterial growth curve
13. Factors effecting the microbial growth (pH and temperature)

Recommended books

Microbiology by Pelczar M.J., Ried, RD and Chan, ECS.
Microbiology by Gerard J. Tortora, Berdell Ra. Funke and Christine L. Case. Publ: Pearson
Education Inc.
Text book of Microbiology by M. Burrows
General Microbiology by Stainier, Deudroff and Adelberg
Review of medical microbiology by Jawitz, melnick and Adelberg
Bacterial and Mycotic infections of man. Ed. Dubos and Hirst Lipincott
Principles of Microbiology and Immunology by Davis, Dulbecco, Eison, Ginsberg and Wood.
Structure and Reproduction of Algae, Vol. I & II by Fritsch, F.E.
Introduction to Algae by Morris, I.
Products and Properties of Algae by Zizac.
Fresh water algae of the United States by Smith, GM.
Introductory Mycology by Alexopolus, C.J.
Dispersal in Fungi by Ingold, CT
Microbial Physiology by Moat,
Laboratory Experiments in Microbiology by Gopal Reddy et al
Microbes in Action by Seoley HW and Van-Demark, PJ
Brock’s Biology of microorganisms by Madigan, MT et al
M. Sc. I Semester Microbiology (CBCS)
Paper II Virology (Core) (CBCS)
(4 HPW - 4 Credits)

Unit I

Unit II

Unit –III
Recombination in phages, multiplicity reactivation and phenotypic mixing General account of Tumor virus (RNA and DNA). Viral Interference and Interferons. Nature and source of interferons, Classification of interferons. Induction of interferons. Antiviral agents (chemical and biological) and their mode of actions

Unit –IV
I Semester Practical Paper II
Virology (CBCS) (4 HPW - 2 Credits)

1. Isolation of phage from different soil samples using laboratory bacterial cultures
   (*Staphylococcus, Bacillus*)
2. Isolation of phage from sewage using *Pseudomonas* and *E. coli* as host.
3. Cultivation and preservation of phages.
4. Quantification of phages
5. Growth phages of phage and burst size (Demonstration)
6. Phage induction
7. Cultivation of animal viruses in egg allantoic, amniotic and CAM
8. Symptomatic observations / slides plant viral infections
9. Demonstration of cytopathological changes of animal virus (slides/pictures)

**Recommended Books**
Recent publications: Research papers and review articles
General Virology by Luria and Darnel
Virology and Immunology by Jokli
Text book of Virology by Rhodes and Van Royen
Plant Virology by Smith
Genetics of bacteria and their viruses by W. Hayes
Molecular Biology of the gene by Watson, Roberts, Staitz and Weiner
A laboratory guide in virology by Chjarles H. Lunningham
   Basic lab procedures in diagnostic virology by Marty Cristensen
Review of medical microbiology by Jawitz et al
Medical laboratory manual for tropical countries Vol I & II by Monica Cheesbrough
Text Book of Microbiology by Ananthanarayan and Jayaram Paniker
Viral and Ricketsial infections of Man by Horsfall and Jam
Text book of Virology by Rhodes and Van Royan
Virological Procedures by Mitchal hasking
Virologoy by Wilson and Topley
Unit I
Optical methods:, colourimetry and spectrophotometry, fluorimetry, optical rotation
Circular dichroism, NMR, ESR spectroscopy, x-ray diffraction, types of mass spectrometry.
Electrophoretic techniques and application, counter current distribution.

Unit II
Separation methods: Chromatographic techniques – HPLC, FPLC paper, thin layer, ion exchange,
gel filtration and affinity chromatography.
Diffusion, dialysis, cell disruption methods, centrifugation techniques, cell free extracts and their
use in metabolic studies.
Radio isotopes – detection and measurement of radioactivity – scintillation counters,
autoradiography, stable isotopes and their use. Safety precautions. General method of study of
intermediary metabolism in microbes. Uses of mutants in study of metabolism.

Unit III
Population, samples and sampling procedures, variables, variations and frequency distributions,
measures of central tendency and dispersion, element of probability, gaussian or normal
distribution, binomial distribution, poisson distribution, ‘t’ distribution, ‘F’ distribution and Chi-
square distribution, correlation and linear regression.
Normal curve test, ‘t’ test, ‘F’ test, ANOVA, analysis of covariance, Chi-square test, and
confidence intervals. DMRT and its use in biological experiments. Experimental designs using
statistical tools.

Unit IV
Introduction to Computers
Introduction to disk operating systems (DOS): Sample commands, DIR-CD-RD-DEL-COPY-
MOVE-REN-TYPE-EDIT (Editor) CE-DATE and TIME.
Introduction to Windows: Word Processing: Electronic Spread Sheet
Data collection, Data representation, Manuscript preparation, Plagiarism, Research ethics, QA,
QC, GLP, GMP, Patents & IPR
I Semester Practical Paper III
Research Methodology and Techniques (CBCS)
(4 HPW-2Credits)

1. Creating documents using word processor
2. Usage of spread sheet to biological applications
3. Biochemistry calculations and statistics
4. Absorption maxima of proteins, NA, tyrosine and riboflavin (Determination of molar extinction coefficient, calculations based on Beer Lambert’s Law)
5. Estimation of inorganic and organic phosphate by Fiske-Subbarow method
6. Estimation of protein concentration by UV-vis spectrophotometry and Folin Lowry method
7. Differential centrifugation
8. Paper chromatography of amino acids
9. Dialysis for desalting of proteins
10. Demonstration of Gel filtration technique
11. Demonstration of electrophoresis of proteins and DNA

Recommended books
Biochemistry by Lehninger
Outlines of Biochemistry by Cohn and Stumph
Biological Chemistry by Mullar and Cards
Biochemistry by White, Handler and Smith
Methods in Enzymology series
The Cell – Bratch amd Mirsky series
Laboratory experiments in Microbiology by Gopal Reddy et al
Biochemistry lab manual by Jayaraman
Introduction to the theory of statistics by Alexander, M Mood and Franklin
Fundamentals of Biometry by L.N.Balam
Statistical methods by Snedecor and Cochran
Introduction to computer and its application by Chae C.Chien
Basic Programming language by Bajaraman
M.Sc. Microbiology I Semester (CBCS)
Paper IV Microbial Biochemistry (Core) (CBCS)
(4 HPW - 4Credits)

Unit I
pH and its biological relevance
Determination of pH, preparation of buffers
Concept of entropy, free-energy, free energy changes, high energy compounds. Equilibrium
constants, Redox potentials, Biological redox systems, Biological oxidation, biological
membranes, electron transport, oxidative phosphorylation and mechanism.

Unit II
Lipids classification: Bacterial lipids, prostaglandins, structure, function, Major steroids of
biological importance.
Carbohydrates: Classification, basic chemical structure, monosaccharides, aldoses, and
ketoses, cyclic structure of monosaccharides, stereoisomerism, anomers and epimers.
Sugar derivatives, deoxy sugars, amino sugars, and sugar acids.
Nucleic acids: Structure and properties of purines, pyrimidines, nucleosides and nucleotides.
Metabolism of purines and pyrimidines - Biosynthesis and degradation

Unit III
Proteins and amino acids: Properties of amino acids, structure, confirmation and properties of
proteins, metabolism of amino acids, biosynthesis and degradation – an overview.
Enzymes nomenclature, classification methods for determination of enzyme activity. Isolation
and purification of enzymes. Enzyme kinetics: Effect of pH, substrate concentration, temperature
and inhibitors.

Unit IV
Control of enzymes. Mechanism of enzyme action – Action of Hydrolases, Oxidases and
reductases. Coenzyme catalysis(pyridoxal phosphate and TPP). Isoenzymes. Competitive and
non-competitive inhibition. Methods for increased microbial enzymes production and activity.
Enzyme engineering. Control of enzymes. Regulation of enzyme activity: allosteric enzymes and
feed back mechanisms. Metabolic compartmentalization in relation to enzyme, enzymes and
secondary metabolites
I Semester Practical Paper IV
Microbial Biochemistry (CBCS)
(4 HPW - 2 Credits)

1. Safety and good lab practices
2. Preparation of buffers and adjustment of pH
3. Qualitative tests for carbohydrates and analysis of unknowns
4. Qualitative tests for amino acids and analysis of unknowns
5. Tests for lipids (qualitative)
6. Quantitative estimation of glucose and fructose
7. Determination of saponification value of fats
8. Partial purification of enzymes (β-amylase, urease and catalase)
9. Effect of substrate concentration, pH, time and temperature on enzyme activity
10. Calculation of Km for partially purified enzyme
11. Study for inhibition of enzyme activity

Recommended Books

Biochemistry by Lehninger
Outlines of Biochemistry by Cohn and Stumph
Biochemistry of Nucleic acids by Davidson
Biological Chemistry by Mullar and Cards
Biochemistry by White, Handler and Smith
Methods in Enzymology series
The Cell – Brach and Mirsky series
Biochemistry lab manual by Jayaraman
M.Sc. Microbiology II Semester (CBCS)
Paper I Molecular Biology & Microbial Genetics (Core) (CBCS)
(4 HPW - 4 credits)

Unit I
Detailed structure of DNA, Z-DNA, A & B DNA, Denaturation and melting curves.
Genome organization in prokaryotes and eukaryotes, Enzymes involved in DNA replication,
Modes of DNA replication- Detailed mechanism of Semiconservative replication.
Plasmids: nature, classification, properties and replication.
Eukaryotic telomere and its replication.

Unit II
Prokaryotic and eukaryotic transcription. Structure and processing of m-RNA, r-RNA t-RNA.
Ribozyme, Genetic code and Wobble hypothesis, Translation in Prokaryotes and eukaryotes, Post
translational modifications, Gene regulation and expression – Lac operon, arabinose and
tryptophane operons, Gene regulation in eukaryotic systems, repetitive DNA, gene rearrangement,
promoters, enhancer elements.

Unit III
Types of mutagens, Molecular basis of mutations. Physical and chemical mutagenic agents: UV,
Ethidium Bromide and Nitrous oxide. Detection and analysis of mutations (Replica plating,
Antibiotic enrichment, Ames test etc). DNA damage and repair mechanisms. Global response to
DNA damage. Transposable elements – Types of bacterial transposons and their applications

Unit IV
Bacterial Recombinations-Discovery, gene transfer, molecular mechanism, detection, efficiency
calculation and applications. Bacterial transformation- Competency and resistance.
Bacterial conjugation – Sex factor in bacteria, F and HFR transfer, linkage mapping.
Bacterial transduction – transduction phenomenon, methods of transduction, co-transduction,
generalized, specialized and abortive transduction, sex-ductions.
II Semester Practical Paper I  
Molecular Biology and Microbial Genetics (CBCS)  
(4 HPW - 2 Credits)

1. Isolation of genomic DNA from E.coli and Yeast.  
2. Estimation of DNA and RNA (colorimetry)  
3. Determination of molecular weight of DNA, resolved on agarose gel electrophoresis  
4. Induction of Lac operon  
5. Induction of mutations by physical/chemical mutagens, screening and isolation of mutants, Replica plating technique  
6. Transformation in bacteria  
7. Conjugation in bacteria  
8. Protoplast preparation, Fusion and regeneration

Recommended books
Molecular biology by Robert Weaver  
Molecular Biology By Upadhyay and Upadhyay  
Molecular biology by David and Freifelder  
Microbial genetics by David and Freifelder  
molecular biology malacinski  
Molecular biology of thee gene by Watson et al  
The Lehninger Biochemistry  
Molecular biotechnology by Primrose  
Molecular Biotechnology by Bernard R. Glick and Jack J Pasternak  
Molecular Genetics of Bacteria by Larry Snyder and Wendy Champness
M.Sc. Microbiology II Semester (CBCS)
Paper II Environmental and Agricultural Microbiology (Core) (CBCS)
(4 HPW – 4 Credits)

Unit I
Microorganisms in air and their importance (brief account); Microorganisms and water pollution
Water-borne pathogenic microorganisms and their transmission; Sanitary quality of water; Water pollution due to degradation of organic matter; Aerobic sewage treatment – Oxidation ponds, trickling filters, activated sludge treatment; Anaerobic sewage treatment – Septic tank.

Unit II
Soil properties (physical, chemical and biological), Soil microorganisms, Methods of enumeration and activity of microbes in environment/soil; Microbes and plant interactions – Rhizosphere, Phyllosphere and Mycorrhizae; Strategies for bioremediation technologies, Microbial degradation of organic pollutants with a special emphasis on pesticides like DDT and 2,4-D.

Unit III

Unit IV
Nitrogen fixation – Asymbiotic and symbiotic nitrogen fixation, microorganisms involved, biochemistry and genetics of nitrogen fixation, measurement of nitrogen fixation, ecological and economic importance of nitrogen fixation. Biofertilizers – bacterial fertilizers and production of rhizobial inoculants and blue-green algae, quality control tests.
II Semester Practical Paper II
Environmental and Agricultural Microbiology (CBCS)
(4 HPW-2Credits)

1. Isolation and observation of air microflora
2. Enumeration of soil microorganisms (bacteria, actinomycetes, fungi) by standard plate count
3. Estimation of soil microbial activity by CO₂ evolution
4. Estimation of BOD
5. Testing for microbial sanitary quality of water (coliform test)
6. Bioremediation of organic pollutants and their effect on soil microbial activity
7. Isolation of cellulose decomposing microbes and estimation of cellulase activity
8. Estimation of ammonifiers, nitrifiers and denitrifiers in soil by MPN METHOD
9. Isolation and culturing of Rhizobium sp from root nodules and Azospirillum from grasses (Cyanodon)
10. Isolation and observation of phyllosphere microflora
11. Isolation and observation of rhizosphere microflora
12. Observation for Mycorrhizae

Recommended Books
Recent Published papers on advances in relevant area to be referred
Soil Microbiology by Alexander Martin
Microbial ecology, Fundamentals and Applications Ed. Benjamin-Cummings
Environmental Biotechnology-Fundamentals and applications. By Parihar (Agrobios india – publishers)
Soil Microbiology by Singh, Purohit,Parihar published by student edition.
Soil Biotechnology by JM Lynch
Microbial Ecology: Organisms, Habitats, and Activities by Stolp, H.
Soil Microbiology and Biochemistry by Paul E. and PE Clank
Microbial Ecology: Principles, Methods and Applications by Lavin, Seidler, Rogul
Biological Nitrogen Fixation by Quispel
Soil Microorganisms and Plant Growth by N.S,. Subba Rao.
Laboratory experiments in microbiology by Gopal Reddy et al
Experiments in Microbiology, Plant pathology, Tissue culture and Mushroom production technology by K R Aneja
Biofertilizers for sustainable Agriculture by Arun K. Sharma
Environmental Microbiology by K. Vijaya Ramesh (MJP Publishers)
Brock Biology of Micro organisms by Madigan et al
Waste water microbiology by Bitton, G.
Waste water treatment – Biological and chemical process by Henze, M.
Bioremediation - Principles and Applications by Ronald L Crawford and Don L Crawford , Cambridge University Press
Unit I
History of immunology. Hematopoiesis, Cell lineage, components of immune system, cells and organs of immune system.
Antigens –Nature, properties and types. Haptens
Antibody -Structure , functions and classification. Isotypes, allotypes and idiotypes.
Generation of T cell receptor diversity by genomic rearrangement
Structure of B and T cell receptors

Unit II
Overview of Innate and adaptive immunity
Toll-like receptors, cell-mediated and humoral immune responses, inflammation.
Major Histocompatibility Complex (MHC). Human leucocyte antigen (HLA) restriction
Processing and presentation of antigen by MHC. Transplantation immunity,
Immune response during bacterial (tuberculosis), parasitic (malaria) and viral (HIV) infections,
Congenital and acquired immunodeficiencies.
Immunological tolerance-central and peripheral.

Unit III
Auto immunity and Hypersensitivity - immediate and delayed type hypersensitivity reactions.
Classical and alternate Complement pathways
Antigen and antibody reactions–Agglutination, Precipitation, neutralization, and function. Labeled antigen-antibody reactions- ELISA, RIA, immune blotting, CFT, immunoflourescence. Flow cytometry (Fluorescence activated cell sorter) and its applications in Immunology. Development Of immuno diagnostic kits.

UNIT -IV
Types of conventional vaccines and principles of Immunization.
Modern vaccines; peptide, DNA, recombinant / vector, and anti-idiotypic vaccines
Schedules of common vaccination, Benefits and adverse consequences of vaccination.
Production of polyclonal antibodies; Animals models for production of antibodies
Hybridoma techniques and monoclonal antibody production. Applications of monoclonals in biomedical research, clinical diagnosis and treatment. Chimeric Antibodies.
Immunosuppression and its mechanism of action.
Immune evasion by bacteria and viruses.
Tumor immunology. Immuno diagnosis and immune therapy of cancer
II Semester Practical Paper III
Immunology (CBCS)
(4 HPW- 2 Credits)

1. Agglutination reactions – Widal, VDRL, HA, Blood typing – tube method
   Precipitation test: Ring interphase, single radial diffusion.
2. Ouchterlony double diffusion.
3. Immuno-electrophoresis.
5. WBC and RBC count and differential blood picture.
7. Blot transfer and detection of protein on blot by staining.
8. ELISA
9. Purification of IgG from serum
10. Lymphocyte culture, viable staining and hemocytometer count.
11. Indirect agglutination (Pregnancy hCG Ag)

**Recommended Books**

Kuby Immunology
Cellular and molecular immunology by Abul K. Abbas et al
Test book of Immunology by Barret
Immunology – The science of self-non self discrimination by Jan Klein
Essential Immunology by Roitt, IM
Immunology by Tizard
The elements of Immunology by Fahim Halim Khan
Immunology and immunopathology by Stewart Sell
M.Sc. Microbiology II Semester (CBCS)
Paper IV Pharmaceutical Microbiology (Core) (CBCS)
(4 HPW - 4 Credits)

Unit I
Microorganisms affecting pharmaceutical industry – The atmosphere, water, skin & respiratory flora of personnel, raw-materials, packing, equipments, building, utensils etc. Types of microorganisms occurring in pharmaceutical products.
Microbiological spoilage prevention of pharmaceutical products.
Preservation of pharmaceutical products; antimicrobial agents used as preservatives, evaluation of the microbial stability of formulation
The sterilization in pharmaceutical industry
Good manufacturing practices in pharmaceutical industry

Unit II
History of chemotherapy – plants and arsenicals as therapeutics, Paul Ehrlich and his contributions, selective toxicity and target sites of drug action in microbes. Development of synthetic drugs – Sulphanamides, antitubercular compounds, nitrofurans, nalidixic acid, metronidazole group of drugs.
Antibiotics - The origin, development and definition of antibiotics as drugs, types of antibiotics and their classification. Non-medical uses of antibiotics.
Cosmetics microbiology- testing methods and preservation
Antimicrobial preservation efficacy and microbial content testing

Unit III
Principles of chemotherapy – Clinical and lab diagnosis, sensitivity testing, choice of drug, dosage, route of administration, combined/mixed multi drug therapy, control of antibiotic/drug usage.
Mode of action of important drugs – Cell wall inhibitors (Betalactam – eg. Penicillin), membrane inhibitors (polymyxins), macromolecular synthesis inhibitors (streptomycin), antifungal antibiotics (nystatin)

Unit IV
The drug resistance – The phenomenon, clinical basis of drug resistance, biochemistry of drug resistance, genetics of drug resistance in bacteria.
Microbiological assays: Assays for growth promoting substances, nutritional mutants and their importance, vitamin assay, amino acid assay
Introduction to pharmacokinetics and pharmacogenomics.
II Semester Practical Paper IV  
Pharmaceutical Microbiology (CBCS)  
(4 HPW- 2 Credits)

1. Sterility testing methods for pharmaceutical and cosmetic products
2. Tests for disinfectants (Phenol coefficient/RWC)
3. Determination of antibacterial spectrum of drugs/antibiotics
4. Chemical assays for antimicrobial drugs
5. Testing for antibiotic/drug sensitivity/resistance
6. Determination of MIC valued for antimicrobial chemicals
7. Microbiological assays for antibiotics (Liquid tube assay, agar tube assay, agar plate assays)
8. Efficacy testing of preservatives like parabens

Reference/Recommended Books for MB Pharmaceutical Microbiology

Disinfection, sterilization and preservation. Block, S.S. (ed). Lea and Febigor, Baltimore
Pharmaceutical Microbiology. Huge, W.B. and Russel, AD.Blackwell Scientific, Oxford
Inhibition and destruction of microbial cell by Hugo, WB. (ed). Pub: Academic Press, NY
Microbiological Assays. Hewitt.
Antiviral Drugs. Kargor, S.
The control of antibiotic resistant bacteria. Stuart, Harris and Harris.
Indian Pharmacopea; United States Pharmacopea; British Pharmacopea.
Unit I
Introduction to fermented foods; Health aspects of fermented foods; Fermented vegetables: Processing and fermentation of Sauerkraut and pickles; Cereal and legume based fermented products-bread, Soya Sauce, Tempeh; Microbiology of bread and idly; Production and significance of Silage; Mushrooms – production and cultivation of different types of mushrooms.

Unit II
Dairy Microbiology - Types of microorganisms in milk, significance of microorganisms in milk, Microbial products of milk- Acidophilus Milk, Bifidus Milk, Bulgarian milk, Kefir, Kumiss, Microbiology of cheese, butter, yogurt; microbiological examination of milk, control of microbial flora of milk; Probiotics and Prebiotics: Properties and beneficial effects of probiotics and prebiotics; Screening methods of Probiotics; Genetically Modified Probiotics.

Unit III
Spoilage of foods and factors governing the spoilage; Microbial Food poisoning, risks and hazards; Mycotoxins: Groups of mycotoxins, effects on human and animal health, Detoxification Methods (Physical, Chemical and biological) and Mechanism of toxicity; Food preservation methods and food safety issues.

Unit IV
Food Quality: Importance and functions of quality control. Methods of quality assessment of foods-Sampling, qualitative and quantitative microbiological analysis; Bacteriological examination of fresh and canned foods; Screening and Enumeration of spoilage microorganisms. Detection of pathogens in food.
III Semester Practical Paper I
Food Microbial Technology (CBCS)
(4 HPW-2Credits)

1. Microbiological examination of fresh and canned foods
2. Microbiological examination of spoiled foods and fruits
3. Microbiological examination of milk by Breeds method
4. Microbiological quality testing of milk (MBRT test)
5. Extraction of Mycotoxins from contaminated grains/foods.
6. Detoxification of mycotoxins.
7. Isolation, Screening and Identification of bacterial probiotics like LAB
8. Isolation, Screening and Identification probiotic yeast
9. Microbiological examination of mushrooms

Recommended books
Food Microbiology by Frazier
Biotechnology: Food Fermentation: Microbiology, Biochemistry, and Technology by VK Joshi and Ashok Pandey
Microbial Ecology – A conceptual approach by Lynch and Poole
Basic food microbiology (Abridged edition) by George J. Banwart
Brock’s Biology of Micro organisms by Madigan et al
Probiotics 3 by R. Fuller, G. Perdigon (Kluwer Academic Publishers)
Probiotics and Prebiotics: Scientific Aspects by Gerald W. Tannock University of Otago,
Dunedin, New Zealand (Caister Academic Press)
Biotoxicology by Kamal narayan and Vohra.
Laboratory experiments in microbiology by Gopal Reddy et al
Foodborne Pathogens and Food Safety by Md. Latiful Bari, Dike O. Ukuku (CRC Press)
Recent Published papers on advances in relevant area to be referred
M.Sc. Microbiology III Semester (CBCS)
Paper II Medical Bacteriology (Core) (CBCS)
(4 HPW - 4 Credits)

Unit I
Principles of Medical Microbiology:
Classification of medically important microorganisms. Normal flora of human body – Origin of normal flora, factors that influences normal flora, role of the resident flora, effect of antimicrobial agents on normal flora, characteristics of normal flora
Distribution and occurrence of normal flora (Skin, conjunctiva, nose, nasopharynx, sinuses, mouth, upper respiratory tract, intestinal tract, urogenital tract)
Bacteria in the blood and tissues.

Unit II
Properties of pathogenic microorganisms. Factors that influence pathogenicity
Type of infections, source of infections, different modes/means of infections
Diagnostic microbiology – Types of specimen, specimen collection, transportation of specimen, processing, laboratory investigations, specific lab. Tests, non-specific lab tests, diagnosis and report. Use of lab animals in diagnostic microbiology.

Unit III
Systematic bacteriology – Detailed study of morphology, cultural characteristics, antigenic structure, pathogenesis, diagnostic lab tests (conventional and molecular), epidemiology, prevention and treatment of the following bacterial pathogens.
Bacterial air borne infections – B-Haemolytic streptococco, Pneumococci, Corynebacteium diphtheriae, Mycobacterium tuberculosis, Mycobacterium leprae, Neisseria meningitides, haemophilus influenzae.
Sexually transmitted diseases caused by bacteria, Treponima pallidum, Neisseria gonorrhea.

Unit IV
Systematic bacteriology – Detailed study of morphology, cultural characteristics, antigenic structure, pathogenesis, diagnostic lab tests (conventional and molecular), epidemiology, prevention and treatment of the following pathogenic bacteria:
Water borne infections – E.coli, Salmonella typhi, Shigella dysenteriae, Vibrio cholerae.
Wound infections – Staphylococcus aureus & MRSA, Clostridium tetani, Clostridium welchi, Pseudomonas.
III Semester Practical Paper II  
Medical Bacteriology (CBCS)  
(4 HPW-2 Credits)

1. Preparation of different types of culture media/observation. Blood Agar, Cholate Agar, Mannitol salt agar, Blair Parker medium, MacConkey agar, Lowensten-Jension medium, Wilson Blair Bismuth sulphite medium, Biochemical media.
2. Staining techniques – Gram’s staining, AFB staining, Albert Staining, Capsular staining
3. Isolation and identification of various pathogenic bacteria by microscopic, macroscopic, biochemical, enzymatic and serological tests (Coagulase, catalase, WIDAL, VDRL tests.)
4. Examination of pathogenic bacteria /permanent slides.
5. Bacteriological examination of urine, pus, throat swab etc from patients for diagnosis.
6. PCR based diagnosis.

Recommended Books

Review of Medical Microbiology by Jawitz, Melnick and Adelberg  
Diagnostic Microbiology by Bailey and Scott  
Medical Microbiology by Cruckshanak et al Vol I & II  
Text book of Microbiology by Ananthanarayanan and Jayaram Paniker
M.Sc. III Semester Microbiology (CBCS)
Paper III Industrial Microbiology (Elective-I)
(4 HPW-4Credits)

Unit I
Introduction to industrial microbiology. Definition, scope, history, microorganisms, properties and industrial products
Screening for microbes of industrial importance. Primary screening, screening for amylase, organic acid, antibiotic, amino acid and vitamin producing microorganisms. Secondary screening. Further evaluation of primary isolates
Fermentation equipment and its use. Design of fermenter, type of fermenter, agitation, aeration, antifoam, pH and temperature control.

Unit II
Inoculum media, inoculum preparation
Raw materials Saccharides, starchy and cellulosic materials
Fermentation media and sterilization.
Types of fermentations processes – Solid state, surface and submerged fermentations

Unit III
Batch, fed batch and continuous fermentations. Direct, dual or multiple fermentations.
Scale-up of fermentations.
Fermentation type reactions, alcoholic, lactic acid, mixed acid, propionic acid, butandiol and acetone-butanol types, Product recovery methods.
Detection and assay of fermentation products. Physico-chemical methods and biological assays.

Unit IV
Strain development strategies. Environmental factors and genetic factors for improvement.
Immobilization methods – Absorption, covalent linkage, entrapment and cross linkage, types of carriers, advantage and disadvantages.
III Semester Paper III
Industrial Microbiology (Practicals) (CBCS)

Screening for amylase producing organisms
Screening for organic acid producing microorganisms
Isolation of antibiotic producing microorganisms by crowded plate technique
Isolation and culturing of yeasts
Separation of amino acids by chromatography
Estimation of glucose by DNS method
Estimation of ethanol by dichromate method
Estimation of maltose
Immobilization of microbial cells by entrapment method

Recommended Books
Industrial Microbiology by Casida, LE
Industrial Microbiology by Patel, AH
Industrial Microbiology by Miller, BM and Litsky
Industrial Microbiology by Prescott and Dunn
Microbial Technology by Peppler, JH and Perlman, D.
Biochemistry of Industrial Microorganisms, by Rainbow and Rose
Economic Microbiology by Rose Vol I – V
Microbial Enzymes and Biotechnology by Fogarty WM and Kelly, CT
Comprehensive Biotechnology, All volumes Ed. Murray Moo-Yong
Biotechnology (A text book of industrial Microbiology) Ed. Cruger & Cruger
Advances in Applied Microbiology Ed. Perlman Series of volumes
M.Sc. III Semester Microbiology (CBCS)
Paper III Microbial Proteomics (Elective-II)
(4 HPW-4Credits)

Unit I
Protein structure – Different levels of protein structure, Protein Folding and unfolding, Active sites and effects of pH, temperature, substrate concentrations, inhibitors and activators on activity. Protein functions, e.g. structural, storage, transport, hormonal, receptor, contractile, defensive, enzymatic. Protein interaction in cell signaling neurotransmitters and membrane channel opening and closing.

Unit II
Separation techniques – 2-D gel and polyacrylamide gel electrophoresis (PAGE)
Biological mass spectrometry -MALDI-MS , ESI-MS, LC-MS/MS Finger printing.
Protein identification – Peptide mass fingerprinting (PMF), Electro blotting and sequencing
Determination of 3-D structures by x-ray crystallography ,NMR and homology modeling.

Unit III

Unit IV
Protein-Protein interaction, Protein-DNA interactions. Yeast two hybrid system. Protein micro arrays- Protein Markers, Clinical Proteomics, Small peptides, Personalized medicine, Protein engineering, Drug design. Proteomic strategies in Cancer, Prions.
III Semester Practical Paper III
Microbial Proteomics

1. Protein isolation from E coli, Bacillus and Yeast.
2. Sequence analysis of proteins (by BLAST, ClustalW and Phylip).
3. Protein structure prediction by Homology modeling.
4. *in silico* translation of protein
5. Overexpression of heterologous protein in E.coli.
6. Purification of cloned protein in E.coli.
7. Protein identification by immunoblotting

Reference Books
Principles of Protein structure, Schultz, G. E., and Schirmer, R. H. Dr. Shakti Sahi
Proteomics, Daniel C. Leibler
Microbial Proteomic, Marjo Poutanen
Proteins: Structures and Molecular Principles (2d ed.), TE Creighton
Organic spectroscopy, William Kemp
Proteome Research: Two-Dimensional Gel Electrophoresis and Detection Methods (Principles and Practice), T. Rabilloud (Editor), 2000, Springer Verlag
PGPR: biocontrol and biofertilization by Zaki A. Siddiqui
Plant-bacteria interactions: strategies and techniques to promote plant growth by Iqbal Ahmad, John Pichtel, S. Hayat
Plant Growth and Health Promoting Bacteria by Dinesh K. Maheshwari
Microbes For Sustainable Agriculture by K.V.B.R. Tilak, K.K. Pal, Rinku Dey
Biochemical and genetic mechanisms used by plant growth-promoting bacteria by Bernard R. Glick
Plant-microbe interactions, Volume 1 by Gary Stacey and Noel T. Keen
Biological control of crop diseases Volume 89 of Books in soils, plants, and the environment by S. S. Gnanamanickam
Plant-microbe interactions and biological control Volume 63 of Books in soils, plants, and the environment by Greg J. Boland, L. David Kuykendall
New Perspectives and Approaches in Plant Growth-Promoting Rhizobacteria Research by Philippe Lemanceau, Peter Bakker & Jos Raajimakers
Unit I
Microbial ecology: Concept of habitat and niche. Concept of population and community. Development of microbial communities. Microbial growth curve representing r and k reproductive strategies. Planktonic growth and Biofilm formation. Concept of plant probiotics (Seed endophytes and plant endophytes).

Unit II
Microbial community diversity analysis: Phylogenetic based approach (16s rRNA, Internal transcribed region), Taxon based approach (gene diversity index, Shannon’s diversity index), Sequence based approach (Pyrosequencing, NGS). Plant growth promoting microorganisms (PGPM): Plant growth promoting rhizobacteria (PGPR): Direct and Indirect mechanisms of plant growth promotion. Microbial formulations (peat, lignite, talc) and mode of inoculation in soil conditions. Detection of microbial inoculants by staining, biochemical and molecular methods.

Unit-III

Unit-IV
Cell signaling and Quorum sensing in Gram negative bacteria, acylated homoserine lactones (AHLs), Gram positive bacteria (peptides), yeast (Farnesols), Fungi (Oxylipins). Intra and inter species communication, Inter-kingdom signaling. Host-pathogen interactions. Basic concept of plant immunity (MAMPs, PAMPs). Plant defense mechanisms (induced systemic resistance (ISR); systemic acquired resistance (SAR).
III Semester Practical Paper IV  
Microbial Ecology and Plant Microbe Interactions

1. Isolation of plant growth promoting bacteria (PGPB) from soil, compost, vermicompost
2. Screening PGPB for nitrogen fixation, P-solubilization, Zn solubilisation, Siderophore production on selective medium
3. Isolation of Pseudomonas on Kings B medium and microscopic identification
4. Isolation of actinomycetes on selective medium and microscopic identification
5. Isolation of trichoderma on selective medium and microscopic identification
6. Isolation of bacteria with ability to produce plant growth hormone indole acetic acid (IAA)
7. Quantification of IAA by spectrophotometric method
8. Quantification of phosphate by spectrophotometric method
9. Isolation of antagonistic microbes using two layer method
10. Isolation of antagonistic microbes using dual-culture method
11. Pseudomonas and its metabolites for anti-fungal activity
12. Bacillus and its metabolites for anti-fungal activity
13. Trichoderma and its metabolites for anti-fungal activity
14. Detection of QS compounds in Bacteria.

Reference Books
Research papers and review articles
Principles of Protein structure, Schultz, G. E., and Schirmer, R. H. Dr. Shakti Sahi
Proteomics, Daniel C. Leibler
Microbial Proteomic, Marjo Poutanen
Proteins: Structures and Molecular Principles (2d ed.), TE Creighton
Organic spectroscopy, William Kemp
Proteome Research: Two-Dimensional Gel Electrophoresis and Detection Methods (Principles and Practice), T. Rabilloud (Editor), 2000, Springer Verlag
PGPR: biocontrol and biofertilization by Zaki A. Siddiqui
Plant-bacteria interactions: strategies and techniques to promote plant growth by Iqbal Ahmad, John Pichtel, S. Hayat
Biochemical and genetic mechanisms used by plant growth-promoting bacteria by Bernard R. Glick
Plant-microbe interactions, Volume 1 by Gary Stacey and Noel T. Keen
Biological control of crop diseases Volume 89 of Books in soils, plants, and the environment by S. S. Gnanamanickam
Plant-microbe interactions and biological control Volume 63 of Books in soils, plants, and the environment by Greg J. Boland, L. David Kuykendall
New Perspectives and Approaches in Plant Growth-Promoting Rhizobacteria Research by Philippe Lemanceau, Peter Bakker.
M.Sc. III Semester Microbiology (CBCS)
Paper IV Advances in Biotechnology (Elective-II)
(4 HPW-4Credits)

Unit-I
Transgenic plants, Plants as bioreactors, Biosafety concerns of transgenic plants, Biotic Stress Tolerance- Herbicide resistance, Glyphosate, Insect Resistance, Bt toxin, Disease Resistance, Virus resistance
Abiotic Stress Tolerance-- Drought, Flooding, Salt and temperature.
Manipulation of—Photosynthesis, Nitrogen fixation, Nutrient uptake efficiency.
For quality improvement-Protein, Lipids, carbohydrates, vitamins and minerals.

Unit-II
Animal Tissue Culture: Primary culture, Organ culture, Embryo Culture, Established Cell lines
Scale up, Cryopreservation, Culture Collections, Risks and Safety, Bioethics.
Stem Cell Technology, Cloning techniques Applications.
Transgenics and knockouts: Transgenic cattle, Transgenic birds, Transgenic fish, Transgenic mice: i) Retroviral method ii) DNA microinjection method iii) Engineered Embryonic Stem cell method

Unit-III
Introduction to nanoparticles/nanotechnology, Properties of nanomaterials.
Synthesis of nanostuctures - physical, chemical and biological, micobiological Methods, Biomolecules as nanostructures.

Unit-IV
Gene therapy-concept, vectors, gene targeting and tissue-specific expression, Antisense Technology
Introduction to Pharmacogenetics and toxicogenomics
Genetic counseling, Social- genetic discrimination: insurance and employment, human cloning, foeticide, Sex determination,
Tissue Engineering, Methods of Synthesis, Biomolecular Engineering
III Semester Practical Paper IV
Advances in Biotechnology

1. Terminology, Laboratory design of Animal tissue culture laboratory
2. Preparation of complete medium, Sterilization and sterility checking.
3. Chick embryo fibroblast culture, viable staining.
4. Preparation of Nanosilver By Wet reduction Method (Chemical), using Neem Extract (plants) & Bacteria (Microbiological)
5. Characterisation of Nanosilver by UV spectrometry
6. Characterisation of Nanosilver by microscopic methods

References: Unit I
2. Introduction to Plant Biotechnology (3rd Edtn), H.S. Chawla
4. H.K. Das (ed), Textbook of Biotechnology, Wiley India, 2004
7. Plant Biotechnology and Agriculture: Prospects for the 21st Century, Arie Altman, Paul Michael Hasegawa,

References: Unit II
1. Animal Cell Culture by Ian Freshney
3. Animal Cell Culture Sudha Gangal
4. Principles of biotechnology and applications-Glick and Pasternack

References: Unit III
1. Nanobiotechnology by David Goodsell. John Wiley

References: Unit IV
2. Judit Pongracz, Mary Keen, Medical Biotechnology, Churchill Livingstone, Elsevier (2009)
M.Sc. Microbiology   IV Semester (CBCS)
Paper I Cell and Molecular Biotechnology (Core) (CBCS)
(4 HPW-4 Credits)

Unit I
Signal transduction: G-Protein linked receptors. Concept of second messenger, cAMP & cGMP.
Steroid/peptide hormone regulation, tissue specific regulation.
Protein folding and the roles of Molecular chaperones.

Unit II
Vectors in Molecular Biology, Artificial chromosomes, Enzymes, Polymerase chain reaction, DNA/Protein sequencing, rRNA/Genomic/ cDNA Library construction and screening.

Unit III
Molecular techniques: Analysis of Protein-protein and protein-DNA interactions.
Biochips (DNA chips and Protein chips).
Polymerase chain reaction and Quantitative real time PCR
DNA fingerprinting and DNA markers: RAPD, RFLP, AFLP, Simple sequence repeat (SSR) markers. Site directed mutagenesis, Reverse Genetics, Gene knock out – RNAi and Gene silencing, Gene therapy.
Introduction to Omics techniques: Metagenomics, Transcriptomics and proteomics.

Unit IV
Introduction to Bioinformatics and Molecular Databases, Primary Databanks – NCBI, EMBL, DDBJ; Secondary Databases – UNIPROT; Structural Database – PDB; Database similarity search (FastA, BLAST); Alignment: Pairwise and Multiple sequence alignment; Whole genome sequence; Genome Annotation and Gene Prediction; Primer Designing; Phylogenetics analysis and Tree construction; Protein Sequence Analysis; Approaches for Protein Structure Prediction-Homology modeling of protein; Energy Minimization Methods; Active site identification; Structure Based Drug Design and Ligand Based drug Design; Docking studies; ADMET and Toxicity calculations.
IV Semester Practical Paper I
Cell and Molecular Biotechnology (CBCS)
(4 HPW-2 Credits)

1. Isolation of Plasmid DNA, RNA and Proteins from *E.coli*.
2. Restriction mapping
3. PCR technique.
4. Preparation of competent cells and transformation
5. Gene cloning in bacteria (Demonstration).
6. Recombinant confirmation (Gel shift assays, blue white selection).
7. Southern blotting – demonstration
8. Demonstration of RFLP/AFLP
9. Separations of Proteins by Column chromatography
10. Primer Design
11. Protein Modeling
12. Demonstration of Docking studies

**Recommended Books**

Molecular biology by Robert Weiver  
Molecular biology by David and Freifelder  
Microbial genetics by David and Freifelder  
Molecular biotechnology by Chanarayppa  
Methods in Molecular Cloning by Sambrook.  
Genetics of bacteria and their viruses by William Hayes  
Molecular biology of the gene by Watson et al  
The Biochemistry of nucleic acids by Davidson JN  
Molecular biotechnology by Primerose  
Molecular Biotechnology by Bernard R. Glick and Jack J Pasternak  
DNA Microarrays Ed. M. Schena
M.Sc. IV Semester Microbiology (CBCS)
Paper II Medical Virology and Parasitology (Theory)-CBCS
(4 HPW-4 Credits)

Unit I
Diagnostic virology – Cultivation of pathogenic viruses in lab animals and tissue culture
Identification of pathogenic viruses and establishment of viral etiology
Structure, cultivation, pathogenicity, lab diagnostics, prevention and control of air borne viral
infections – Influenza virus, Rhinovirus, Corona virus, Rubella virus, Adeno virus (type 2),
Mumps virus and Measles virus.

Unit II
Structure, cultivation, pathogenicity, lab diagnostics, prevention and control of viruses transmitted
by water - Hepatitis (HAV), Polio myelitis
Structure, cultivation, pathogenicity, lab diagnostics, prevention and control of viruses transmitted
by Zoonosis – Rabies, Japanese encephalitis

Unit III
Structure, cultivation, pathogenicity, lab diagnostics, prevention and control of contact and
sexually transmitted viral diseases – Small pox, Herpes (Herpes simplex virus), Hepatitis viruses
and their diseases, Acquired immunodeficiency syndrome (AIDS)

Unit IV
Structure, cultivation, pathogenicity, lab diagnostics, prevention and control of Malaria,
Amoebiasis, Trichomoniasis, Helmithic infections (Round worms, Hook worms).
Medical Mycology – Dermatomycosis, Systemic mycosis.
IV Semester Practical Paper II
Medical Virology and Parasitology (CBCS)
(4 HPW-2Credits)

1. Tissue culture techniques
2. Microscopic studies of virus infected materials (demonstration)
3. Preparation and observation of monolayer culture
4. Examination of pathogenic fungi
5. Examination of stool for Hookworm, Round worm
6. Examination of stool for Entamoeba histolytica
7. Examination of blood smear by Leishman stain for Malarial parasites
8. Immunodiagnosis - Tridot test for HIV, Hepstic test for HBV, ELISA.

Recommended Books

Review of medical microbiology by Jawitz et al
Medical laboratory Manual for tropical countries Vol I & II by Monica Cheesbrough
Text Book of Microbiology by Ananthanarayanan and Jayaram Paniker
Viral and Rickettsial infections of Man by Horsfall and Jam
Text book of Virology by Rhodes and Van Royan
Virological Procedures by Mitchal hasking
Virology by Wilson and Topley
M.Sc. IV Semester Microbiology (CBCS)
Paper III Microbial Biotechnology (Elective-I)
(4 HPW-4Credits)

Unit I
Fermentative production of industrial alcohol, uses, raw materials, microorganisms, inoculum preparation, preparation of wort, fermentation and recovery.
Fermentative production of beer – Medium components, malt, malt adjuncts, hops, water. Preparation of wort, mashing, wort boiling, microorganism, inoculum preparation, fermentation, cold storage maturation, carbonation, packing and preservation.
Principles of wine making – Fruit selection, picking, crushing, sulphite addition, processing, fermentation, aging and bottling.

Unit II
Fermentative production of citric acid, uses, microorganism, inoculum preparation, medium preparation, fermentation, recovery and mechanism of citric acid production.
Fermentative production of vitamin B12 – Uses, structure of vit-B12, microorganisms, inoculum preparation, medium preparation, fermentation and recovery.
Fermentative production of glutamic acid – Uses, microorganism, inoculum preparation, production medium, fermentation and down stream processing.

Unit III
Antibiotics – Commercial production of benzyl penicillin, uses, microorganism, inoculum preparation, production medium, fermentation, recovery and semi-synthetic penicillins.
Fermentative production of tetracyclines – uses, chlortetracycline, oxy-tetracycline, tetracycline and semisynthetic tetracyclines, structures, microorganisms, inoculum preparation, production medium, fermentation and recovery methods.

Unit IV
Production and application of microbial enzymes. – Amylases and proteases, uses, microorganisms, inoculum preparation, production medium, fermentation and recovery
Steroid transformations – Substrates, typical structures, microorganisms, inoculum preparation, 11-hydroxylation, process and recovery.
Principles of vaccine production and types of vaccines
Microbial biopesticides
Microbial products from genetically modified (cloned) organisms eg. Insulin.
IV Semester Paper III
Microbial Biotechnology (Practicals) (CBCS)

Production of ethanol by flask fermentation, recovery of ethanol by distillation and calculation of fermentation efficiency
Preparation of wine from grapes/fruits by fermentation
Production of citric acid by fungal fermentation, recovery and estimation
Production of amino acid (Glutamic acid/lysine) by fermentation
Production of amylase by fermentation, recovery and estimation
Production and estimation of penicillin by flask fermentation
Immobilized bacteria/yeast/enzyme in fermentation
Scale up of fermentation.

Recommended Books

Industrial Microbiology by Casida, LE
Industrial Microbiology by Patel, AH
Industrial Microbiology by Miller, BM and Litsky
Industrial Microbiology by Prescott and Dunn
Microbial Technology by Peppler, JH and Perlman, D.
Biochemistry of Industrial Microorganisms, by Rainbow and Rose
Economic Microbiology by Rose Vol I – V
Microbial Enzymes and Biotechnology by Fogarty WM and Kelly, CT
Comprehensive Biotechnology, All volumes Ed. Murray Moo-Yong
Biotechnology (A text book of industrial Microbiology) Ed. Cruger & Cruger
Advances in Applied Microbiology Ed. Perlman Series of volumes
M.Sc. IV Semester  
Paper III Bioinformatics and Nanotechnology (Elective-II)  
(4 HPW-4Credits)

Unit 1

- Introduction to Bioinformatics and Molecular Databases
- Primary Databanks – NCBI, EMBL, DDBJ; Secondary Databases – UNIPROT; Structural Database – PDB
- Database similarity search (FastA, BLAST); Alignment: Pairwise and Multiple sequence alignment, Phylogenetics analysis and Tree construction
- Primer Designing

Unit 2

- Transcriptomics and sequencing a transcriptome, microarrays
- Proteomics and sequencing a proteome
- Protein folding \textit{in vivo} and the roles of Molecular chaperones.
- Protein Sequence Analysis; Approaches for Protein Structure Prediction (folding \textit{in silico})- Homology modeling of protein; Energy Minimization Methods; Active site identification;
- Protein engineering
- Structure Based Drug Design and Ligand-based drug Design; Docking studies;

Unit 3 – Basic concepts of Nanobiotechnology
1. Nanoparticles -Origin and their classification, Nanoscale systems

Unit 4 - Nano particles: Synthesis and Characterization
1. Synthesis of nanострукtures – physical, chemical and biological
3. Characterization techniques for nanomaterials
   - Optical- UV–Visible spectroscopy, X-ray diffraction
   - Imaging and Size- Scanning Electron Microscope (SEM), Transmission Electron Microscopy (TEM), Atomic Fluorescence Microscopy (AFM),
IV Semester Practical Paper III
Bioinformatics and Nanotechnology (CBCS)
(4 HPW-2 Credits)

1. Database searching
2. BLAST and MSA
3. Primer Design
4. Protein Modeling
5. Chemical Synthesis of Nano Biomaterials:
6. Microbiological Synthesis of Nano Biomaterials
7. Green synthesis of metal nanoparticles - Copper, Zinc and Silver using plants extracts
8. Characterization of Nanoparticles by UV spectrometry

Recommended Books

5. Bionanotechnology: Lessons from Nature by David S. Goodsell
6. Handbook of Nanostructured Biomaterials and Their Applications in Nanobiotechnology - Hari Singh Nalwa
M.Sc. IV Semester  
Paper IV Applied Microbiology (Elective-I)  
(4 HPW-4 Credits)

Unit I  
Respiration (Aerobic and anaerobic). Glycolysis (EMP, HMP and ED) pathways. TCA Cycle and its integration. Exploitation of metabolic pathways in fermentation technology and strain improvement.

Unit II  
Production of Microbial products-Bacteriocins and Bioemulsifiers. Production of Microbial Enzymes-Lipases and Protease. Rapid detection techniques for pathogenic microorganisms–Total ATP measurement, PCR and Immunological based assays.

Unit III  
Plant Pathology and pests. Introduction to Phytiatary science and its importance.  
Plant Disease Triangle. Diseases caused by fungi: *Sclerotium rolfsii* and *Macrophomina phaseolina* (collar rot disease, charcoal rot), bacteria: *Xanthomonas campestris* (black rot), actinomycetes: *Streptomyces scabies* (common scab).  
Infections caused by pest: *Helicoverpa armigera* and *Spodoptera litura*  
Biological and chemical control methods for plant diseases and pest management.

Unit IV  
IV Semester Practical Paper IV
Applied Microbiology (CBCS)
(4 HPW-2Credits)

1. Isolation of Bacteriocin from Lactic Acid Bacteria
2. Isolation of Proteolytic bacteria
3. Isolation of Lipolytic bacteria
4. Estimation of Protease activity
5. Estimation of Lipase activity
6. Isolation of plant pathogenic fungi S. rolfsi, M. phaseolina, Fusarium spp. etc. on specific media
7. Antimicrobial effect of Ionic silver and Nanosilver prepared by above methods.
8. Study of Nanosilver coated Gauze/textiles for antimicrobial effect on different bacteria.
9. Characterisation of Nanosilver by UV spectrometry

References:
1. Microbiology by Prescott
2. Medical Microbiology by Ananthnarayan
3. Text book of Microbiology by Pelczar
4. Industrial Microbiology by A.H.Patel
5. Food Microbiology by Frazier
6. Food Microbiology by Casida
7. Handbook of Nanostructured Biomaterials and Their Applications in Nanobiotechnology - Hari Singh Nalwa
13. Biological control of crop diseases Volume 89 of Books in soils, plants, and the environment by S. S. Gnanamanickam
IV Semester
PMB 405: Project Work (CBCS)
(8 HPW-6 Credits)

1. Number of students who will be offered project work will vary batch to batch depending upon the infrastructural facilities and may vary each year (Not exceeding 5 students per group).

2. Project work will involve experimental work and the student will have to complete this in stipulated time.

3. The final evaluation of the project work will be through a Panel involving internal and external examiners.

4. Guidelines provided for executing and evaluation of project work will be final.

5. Students will be asked their choice for Project work at the beginning of IV semester and all formalities of topic and mentor selection will be completed.

Project work will be offered in lieu of expertise and infrastructural facilities of the department and will be evaluated for 6 credits.

6. The distribution of marks for project work will be:

Project work in lieu of one theory paper: 100 Marks (80 marks for dissertation + 20 marks for internal assessment for research skills) and 50 marks for research work presentation.