MASTER OF SCIENCE (MICROBIOLOGY)

MASTER OF SCIENCE (MICROBIOLOGY)

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| Eligibility | : | Graduate in related fields Program |
| Duration | : | 2 Years |
| Program Objectives | : | The aim of this course is to provide a detailed understanding about the concepts of immune recognition, vaccine design–infectious diseases, methods of control – microbial biotechnology, and parasitological study. The course has been developed by experts in the field to develop an understanding of the importance of microbiology in environmental, agricultural and industrial settings.  The programme further provides in depth knowledge of various significant topics, such as:  Microbiology and Immunology  Bacteriology  Mycology and Virology  Molecular Biology  Bioinformatics and Biostatistics  Medical, Food and Diary Microbiology  Environmental Microbiology  Microbiology is a discipline of enormous importance and research. This discipline has been revolutionized by new and exciting technologies such as proteomics, genomics, bioinformatics and genetic engineering. This exciting field has numerous sub branches where the growth options are numerous. |
| Job Prospects | : | Our M.Sc. in Microbiology degree is one of the most versatile degrees you can obtain because of the fundamental nature of the discipline, and also because it can be combined with so many other sciences, leading to powerful and sought-after skills. After the completion of our program, you will find a challenging career in medical, public health and environmental microbiology. Exciting career possibilities exist as research work is strongly gaining importance in laboratories in universities, biotechnology companies and agricultural, medical and veterinary institutes. Common job profiles of students after completing M.Sc. in Microbiology include: Research Microbiologists, Industrial Microbiologists, Clinical Microbiologists, Environment  Microbiologists, and Academic Faculty Positions. |

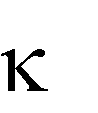
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| --- | --- | --- | --- | --- |
| **Course Code** | **Course Title** | **Theory/ Practical** | **Continuous Assessment (Internals)** | **Credits** |
| BIO16102 | Cell Biology | 70 | 30 | 3 |
| MBL16108 | Microbiology | 70 | 30 | 3 |
| MBL16109 | Immunology | 70 | 30 | 3 |
| MBL16112 | Bacteriology | 70 | 30 | 4 |
| MBL16113 | Mycology | 70 | 30 | 4 |
| MBL16114 | Virology | 70 | 30 | 4 |
| MBL16111 | Molecular Biology | 70 | 30 | 3 |
| BIO16102P | Cell Biology (P) | 35 | 15 | 2 |
| MBL16109P | Immunology (P) | 35 | 15 | 2 |
| BML16112P | Bacteriology (P) | 35 | 15 | 2 |
| MBL16111P | Molecular Biology (P) | 35 | 15 | 2 |
|  | **Total** | **900** | | **32** |

## YEAR II

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| **Course Code** | **Course Title** | **Theory/ Practical** | **Continuous Assessment (Internals)** | **Credits** |
| BOX16202 | Bioinformatics and Biostatistics | 70 | 30 | 4 |
| MBL16209 | Medical Microbiology | 70 | 30 | 4 |
| MBL16210 | Fermentation Technology | 70 | 30 | 4 |
| MBL16211 | Food and Dairy Microbiology | 70 | 30 | 4 |
| MBL16212 | Environmental Microbiology | 70 | 30 | 4 |
| BOX16202P | Bioinformatics and Biostatistics (P) | 35 | 15 | 4 |
| MBL16209P | Medical Microbiology (P) | 35 | 15 | 2 |
| MBL16210P | Fermentation Technology (P) | 35 | 15 | 2 |
| DSR16201 | Dissertation | 200 | | 4 |
|  | **Total** | **850** | | **32** |

**CELL BIOLOGY – BIO16102**

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| **UNIT** | **CONTENT** |
| 1 | **Introduction to Cell Biology:** Cell theory; Classification of Cells; Structure of Prokaryotic Cells, Cell Organelles; Structure of Eukaryotic Cells, Cell Organelles; Prokaryotes versus  Eukaryotes. |
| 2 | **Cell Membrane:** Cell Membrane; Cell Membrane/Plasma Structure, Theories, Lipid Bilayer, Membrane Polarity, Membrane Structure, Cytoskeleton, Functions; biochemistry of the Cell Membrane, Membrane Lipids; Role of Lipid Molecules in Maintaining Fluid Property of Membrane, Types of Movements of Lipid Molecules, Role of Unsaturated Fats in Increasing  Membrane Fluidity, Role of Cholesterol in Maintaining Fluidity of Membrane; Membrane Proteins. |
| 3 | **Cell Motility:** Cell Motility, Elements of Cell Movement, Cilia and Flagella, Occurrence of Cilia and Flagella, Structure of Cilia and Flagella, Movement of Cilia and Flagella, The Overall Structure of Bacterial Flagella; Molecular Events and Model, Amoeboid Movement, Pseudopodia, The Sliding-Filament Model of Bending, The Primary Cilium; Cellular Responses to Environmental Signals in Plants and Animals, Cell Signaling can be divided into three stages; Signal Transduction; Signal Amplification; Rhizobium Legume Symbiosis, The Role of Nod Signal Structures in the Determination of Host Specificity in the Rhizobium-  legume Symbiosis. |
| 4 | **Cell cycle and regulation:** Review of cell cycle, Divisional Control; Regulatory Proteins; Cell Cycle Regulation; Cyclin / Cdk complexes, positive and negative regulation; The Restriction Point, A Knot of Mitogen and Inhibitory Signaling, cis-Acting Regulatory Sequences:  Promoters and Enhancers. |
| 5 | **Cell communication I:** General Principles of Cell Communication; Extracellular signals and their receptors; Autocrine signaling; Role of gap junctions; Types of cell receptors; Relay of Signals; Intracellular signal proteins; Regulated proteolysis dependent signaling pathways, The Pathway mediated by the receptor protein notch, The pathway activated by secreted WNT Proteins, The Pathway activated by Secreted Hedgehog Proteins, The Pathway Activated by  Latent Gene Regulatory Protein NF- B. |
| 6 | **Cell communication II:** Informational transactions in eukaryotic cells; Cyclic AMP facet, Functions of cAMP; Study of G-proteins, Types of G-protein, Conformational Changes Occur in G-protein during Nucleotide Exchange, Role of G-protein in signal Transduction, G-protein linked cell surface receptor, Role of G-protein Coupled receptor; Signaling through Enzyme- linked cell-surface receptor; Calcium Messenger System-Calcium Ion Flux, Role of Calcium in  cell signaling, Properties of Calcium Ion (Ca2+), Function of Ca2+ in cell, Signaling via GMP. |
| 7 | **Stem Cell:** Properties of stem cell, self renewal, Totipotent, Pluripotent; Introduction and  applications of embryonic stem cells, fetal cells, adult stem cells, muse stem cells, amniotic stem cells. |
| 8 | **Stem Cell Therapy:** Medical uses of stem cells; Treatment of Brain Damage; Stem cell technology; Use in cancer therapy; spinal cord injury treatment; Treatment of heart failure; Blindness and vision impairment; Neural and behavioral birth defects; Wound healing;  Infertility; Embryonic stem cell controversy. |
| 9 | **Cancer:** Causes and types of cancer, Types of Cancer, Viral carcinogenesis; Tumor suppressors; Oncogenes and signal transduction; Growth and spread of cancer; Molecular basis of cancer therapy; Molecular markers programmed cell death and its regulation in normal physiology, apoptosis and cancer development, physiologic apoptosis; Regulation and  execution of mammalian apoptosis, Cytokine signaling and role of apoptosis in tumor genesis. |

**LEARNING SOURCE:** Self Learning Materials

## ADDITIONAL READING:

1. Lodish Harvay, Molecular Cell Biology, W.H. Freeman, 2008, Sixth Edition.
2. M. Cooper Geoffery, The Cell: A molecular Approach, ASM Press, 1997, Volume 2
3. Freeman W.H.: Molecular Cell Biology Solutions Manual, 2008.
4. Principles of cell and Molecular Biology, Kleinsmith LJ & Kish VM, Harper Collins College Publishers (1995).
5. Cell and Molecular Biology, Karp G, John Wiley and Sons. (1999).

## WEB LINKS:

1. https://[www.nlm.nih.gov/medineplus/ency/article/001191.htm](http://www.nlm.nih.gov/medineplus/ency/article/001191.htm)
2. https//en.m.wikipedia.org/wiki/infertility
3. http//en.m.wikipedia.org/wiki/musecell

# CELL BIOLOGY (P) – BIO16102P

1. The bright field microscope
2. Measurements: ocular and stage micrometers (Measuring area and volume)
3. Measurement of cell organelles
4. The phase contrast and inverted phase microscope
5. The transmission electron microscope
6. Comparison of electron micrographs
7. Microscopic Examination of Cells
8. Dilution Techniques
9. Measuring Enzyme Activity
10. Physiological Processes of Bacteria
11. Photosynthesis
12. Comparison of Normal and Transformed cells
13. Blood smear preparation

# MICROBIOLOGY – MBL16108

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| **UNIT** | **CONTENT** |
| 1 | **The World of Bacteria:** General Properties of Bacteria, Structure of Bacteria, External Structure, Plasma Membrane, Internal Structure; Ribosomes, Structure, Function, Regulation; Structure Linkage, Function, Storage Granules; Endospores, Formation and Destruction, Appendages; Classification of Bacteria, Bergey’s Classification of Bacteria, Kingdom Procaryotae, Classification of Bacteria according to the Shape of Bacteria, Classification Based on Cell Wall, Classifying Bacteria on Cellular Respiration, Classifying Bacteria by Growth Factors; Nutritional Requirements’ of Bacteria and the Properties of Growth Media,  Growth Media, Selective Media, Different Types of Media, Media Requirements, Media Sterilization, Differential Media, Transport Media, Enriched Media, |
| 2 | **History and Scope of Microbiology:** History of Microbiology, Ancient, Modern; Fermentation, Germ Theory of Disease, Immunization; Classification of Microbes, Scopes of Microbiology, Classification of Microbes; Anatomy of Prokaryotes, Eukaryotic Cells;  Morphology and Ultra Structure of Virus, Morphology, Bacteriophages; Protozoa, |

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|  | Morphology; Life Cycle of Intestinal Protozoa, Life Cycle of Plasmodium in Man, Life Cycle of Plasmodium in Female Anopheles Mosquito Ingestion of Gametes by Mosquito;  Algae, Morphology, Anatomy of Algal Cell. |
| 3 | **Microbial Metabolism:** Different Media with Nutrient Composition, Differential Media, Transport Media, Enriched Media; Classification of Bacteria based on Nutritional Requirement, Autotrophs, Heterotrophs; Transport across Membranes, Structure of Cell  Membrane, Movement across Cell Membranes, Vesicles. |
| 4 | **Staining Techniques:** Procedure and principle of staining, Gram’s staining; Acid fast staining techniques, Principle; Flagella stain, Materials; Endospore staining, Dorner’s method  of staining endospores, Schaeffer-Fulton Method for Staining Endospores. |
| 5 | **Microbial Growth and Nutrition:** Methods for Measurement of Cell Mass, Methods for measurement of Cell numbers; Bacterial Growth Curve, Four characteristic phases of the growth cycle are recognized, Growth rate and generation time, Calculation of generation  time; Measurement of growth fields, Synchronous growth, Continuous culture or Batch Culture method. |
| 6 | **Microbial Ecology:** Role of microbes on the earth; Symbiosis, Mutualism, Commensalism,  Parasitism; Plant growth promoting microorganisms (PGPM) with bio control activities; Biological Control agents (BCA) with growth promoting activities, biological Interactions; Nitrogen fixation, Nitrogen Uptake, Nitrogen Mineralization; Microbial Bio-deterioration,  Bio-deterioration of Wood Pulp and Paper. |

**LEARNING SOURCE:** Self Learning Materials

## ADDITIONAL READING:

* 1. Ryan K.J. and Ray C.G. Sherris, Medial Microbiology, 4th Edition. McGraw Hill. Pp. 376-7, 2004.
  2. Krishna B.V., Patil, A.B., Chandrasekhar, M.R.: Fluoroquinolone-resistant Vibrio Cholerae isolated during a cholera outbreak in India. Trans R Soc Trop Med Hyg 100 (3): 224-26, March 2006.
  3. Hudson, J. Louis Pasteur. Catholic Encyclopedia, New York: Robert Appleton Company, 1913.
  4. Thiel, Theresa. Science in the Real World. 1999.

## WEB LINKS:

1. [http://faculty.college-prep.org/~bernie/sciproject/project/kingdoms/Bacteria4/Final/properties%](http://faculty.college-prep.org/%7Ebernie/sciproject/project/kingdoms/Bacteria4/Final/properties%25) 20of%%20bact.htm.
2. [http://www.microbeworld.org/history-of-microbiology.](http://www.microbeworld.org/history-of-microbiology)
3. [http://www.springer.com/life+sciences/](http://www.springer.com/life%2Bsciences/) microbiology/journal/248

# IMMUNOLOGY – MBL16109

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| **UNIT** | **CONTENT** |
| 1 | **Mechanism of Immune Response:** Types of Immunity, Immune System, Primary Lymphoid Organ, Secondary Lymphoid Organ; Antigen, Immunoglobulin Structure. |
| 2 | **Biology of Complement System:** MHC structure, Nomenclature; HLA typing, Serologic Methods, Microcytotoxicity Assay; Cell mediated immunity, Macrophage Activation; Cell mediated cytotoxicity, NK Cells, K Cells; Hypersensitivity, Type I Hypersensitivity, Type II Hypersensitivity, Type III Hypersensitivity, Type IV Hypersensitivity; Allergen immunotherapy, Treatment; Immunodeficiency disorders; Transplantation, Pre- transplantation Screening; Suppression of the immune system, Heart Transplantation, Kidney  Transplantation, Stem Cell Transplantation; Classical Complement Pathway, Alternative |

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|  | Pathway, Lectin Pathway (MBL-MASP). |
| 3 | **Antigen and Antibodies:** B cells, Rosetting Techniques; Antibody production, Chinese Hamster Ovary (CHO), Other Cell lines; Screening of cell lines, Steps in a Fed-Batch Process; Monoclonal antibody production, Conventional Method of Antibody Production, Hybridoma Technology, Monoclonal Antibody Production by Hybridoma Technology, Preparation of Cells; Isolation of antibodies, Immunotoxins, Chimeric Immunotoxins, Humanized Antibodies, CDR Grafted Antibodies, Heteroconjugate Antibodies; Steps in a western blot, Tissue Preparation, Gel Electrophoresis, Transfer, Blocking, Detection; Western Blot using radioactive detection system, Analysis, Colorimetric Detection, Chemiluminescent Detection; 2-D Gel Electrophoresis, Two-dimensional Gel  Electrophoresis, Medical Diagnostic Applications, Dot Blot, ELISA. |
| 4 | **Study of Blood Cells:** Isolation of mononuclear cells by Ficoll-Hypaque, Gradient Centrifugation, Depletion of Monocytes/Macrophages from Mononuclear Cells using Adherence Method, Depletion of Contaminating Cells from Mononuclear Cell; B-Cells,  Development of B-Cells, Immune Tolerance; Fluorescence Activated Cell Sorting (FACS), Quantifying FACS Data, Mixed-Lymphocyte Reaction. |
| 5 | **Cytokines:** Cytokine, Effect; Cytokine receptors, Disease; Cytokine assays, Cytokine Flow Cytometry, Principles of Flow Cytometry; Mechanism of killing, Perforin/Granzyme Killing, FasL/Fas Killing; Natural killer cells, Activation; History and Discovery, Edward Jenner, Cowpox and Vaccination; Elusive vaccine and the ethics of vaccine research, DNA Vaccines, Current Use, Plasmid Vectors for Use in Vaccination; Delivery methods, Immune Response Raised by DNA Vaccines; Mechanistic basis for DNA raised immune responses, DNA Uptake Mechanism, Antigen Presentation by Bone Marrow-Derived Cells, Alternative Boosts; Additional methods of enhancing DNA- Raised immune responses, Formulations of  DNA, Alphavirus Vectors. |
| 6 | **Immune Response:** Commensal microorganismes; Pathogens, Viruses, Bacteria, Fungi,  Protozoa; Innate immune response; Adaptive immune response. |
| 7 | **Hypersensitivities:** Types and mechanism of hypersensitivity, Type I Hypersensitivity Immediate Hypersensitivity, Type II Hypersensitivity, Type III Hypersensitivity, Type IV Hypersensitivity or Delayed Hypersensitivity; Immune to Microbes, Susceptibility to Extracellular Bacterial Infections, Susceptibility to Intracellular Bacterial Infections,  Susceptibility to Fungal Infections, Susceptibility to Viral Infections, Susceptibility to Protozoa; Immune to tumors. |
| 8 | **Cancer:** Systemic symptoms, Causes, Definitions; Types of cancer; Breast cancer, Causes, Symptoms, Tests, Treatment; Lung Cancer, Causes, Symptoms, Tests, Treatment; Skin cancer, Causes, Symptoms, Tests, Treatment; Prostate cancer, Causes, Symptoms, Tests,  Treatment. |

**LEARNING SOURCE:** Self Learning Materials

## ADDITIONAL READING:

1. Retief F.P., Cilliers L.: The epidemic of Athens, 430-426 BC. South African Medical Journal, 88 (1): 50-3, 1998.
2. Parham P. The Immune System, New York: Garland, 2005.
3. Reth M. Antigen Receptors on B cells. Annu. Rev. Immunol.; 10: 97-121, 1992.
4. Castro, J.B.D. (2011). Cancer: Cause, Care and Cure. B. Jain Publishers Pvt. Ltd.

## WEB LINKS:

1. <http://health.india.com/diseases-conditions/breast-cancer-causes-symptoms-myths-diagnosis-> treatment/?gclid=CJ\_Yz40UpwbCFc9U4godL2sAoA
2. <http://www.immune.org.nz/category/tags/types-immunity>
3. <http://textbookofbacteriology.nit/immune.htm>

# IMMUNOLOGY (P) – MBL16109P

1. Detection of a Single Antibody Producing Cell (Jerne Plaque Assay)
2. MHC Polymorphism: HLA Typing by PCR
3. Phagocytosis
4. Analysis of negative selection in the T cell repertoire (Central tolerance)
5. Antibody interactions with antigens
6. Antibodies as probes
7. Immunoassay
8. Isolation of cells
9. Phagocytosis, complement and antibody-dependent cytotoxicity
10. Lymphocyte structure
11. Lymphocyte function
12. The cytokines
13. Immunological manipulations in vivo

# BACTERIOLOGY –MBL16112

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| **UNIT** | **CONTENT** |
| 1 | **Cell Structure:** Morphology; Bacteria, size, shape and arrangement, Bacterial cell envelope, Pili or Fimbriae, Capsules/Extracellular Polymeric Substances (EPS) or Extracellular Polymers (ECP), Flagellum (pl. Flagella); Cell wall, Gram positive Cell walls, Gram Negative cell walls, Cytoplasmic Membrane – Cell Membrane, Bacterial Intracellular Structures; Eukaryotic Cell Structure, Plasma Membrane, Nucleus, Endoplasmic Reticulum, Golgi Apparatus, Mitochondria, Chloroplasts, Lysosomes, Peroxisomes, Cytosol, Cytoskeleton, Microtubules, Plant Cell Wall, Plant Cell Vacuoles; Staining, Staining of Protozoa, Staining of Fungi and Algae, Lactophenol-cotton Blue Stain, Preparation of Smears for light microscope examination, Wet mounts and hanging drop techniques, Negative Staining or background staining technique, Fixed, Stained Smears, Microbiological Stains  and Staining, Simple Staining, Methylene Blue Staining, Differential Staining, Gram Staining, Acid Fast Staining – Ziehl Neelsen Method, Other Differential Staining Procedures. |
| 2 | **Microscopy:** Microscopy, Light Microscopy, Magnification, Dark field microscopy, Phase contrast microscopy, Immunofluorescence Microscopy, Confocal scanning microscopy; Electron Microscopy, Transmission electron microscopy, Scanning electron microscopy,  Microscope slide techniques. |
| 3 | **Overview of Microbial World:** Microorganisms; Bacterial Shapes; Classification of  Bacteria, Classification of Bacteria based on Bergey’s manual, Actinomycetes, Archaeobacteria. |
| 4 | **Systematic Bacteriology:** Disease caused by gram positive Cocci, Staphylococcal Infections, Streptococcus Infections; Diseases caused by Gram Negative Cocci, Neisseria Meningitidis, Neisseria Gonorrhoea, Mycobacterium Tuberculosis, Mycobbacterium Leprae; Diseases Caused by Toxigenic Bacteria, Diphtheria, Clostridium, Bacillus, Vibrio Mycolplasma, Rikketsia and Chlamydia, Coxiella, Haemophilus, Treponema, Propionibacterium, Zoonotic Bacteria; Diseases caused by Gram Negative Bacteria of Family Enterobacteriaceae, Salmonella, Bacillary Dysentery (Shigella), Urinary Tract Infection (UTI), Escherichia Coli, Helicobacter, Klebsiella, Proteus, Spirochaetes; Diseases caused by  Mycoplasma, Chlamydia, Bordetella, Pseudomonas, Legionella. |

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| 5 | **Growth and Survival of Microorganisms:** Growth curve and growth parameter; Survival of microorganism in nature, Microbial Associations with Animals, Microbial Associations with Plants, Microbial Associations with other Microorganisms; Microorganisms in Natural Environment, Carbon Cycle, Nitrogen Cycle, Sulphur Cycle, Phosphorus, Microbiology of Soil, Microbiology of Freshwater, Microbiology of Seawater; Beneficial Effects of  Microorganisms in the Environment, Wastewater Treatment, Bioremediation. |
| 6 | **Cultivation of Microorganisms:** Growth Requirements; Nutritional Categories, Bacterial Nutrition and Cultivation; Cultivation of Microorganisms, Growth Media for the Cultivation of Bacteria, Preservation of Microbial Cultures; Factors Affecting Microbial Growth, Temperature, pH, Oxygen, Carbon Dioxide, Osmotic Pressure, Light; Kinetics of Microbial  Growth, Batch Culture and Continuous Culture, Growth in Multicellular Microorganisms. |
| 7 | **Microbial Metabolism:** Microbial metabolism: An Overview; Enzymes, Enzyme Classification, Certain Enzymes have a Non Protein Component, Environmental Factors Affect Enzyme Activity, Substrate Concentration, Enzyme Inhibitors; Principles of Energy Generation, Oxidation-reduction Reactions; Aerobic Respiration, Oxidative Phosphorylation and Electron Transport Chain; Fermentation, Other Types of Fermentation; Metabolism of Lipids and Proteins; Oxidation, Anaerobic Respiration, Photosynthesis, Anabolic Reactions,  Regulation of Metabolism, Feedback Inhibition, Differences between Respiration in Mitochondria (Eukaryotes) and Bacteria (Prokaryotes). |
| 8 | **Bacterial Genetics:** Nucleic acid structure and functions, Bacterial Nucleic Acid/Nucleoid/Nuclear Apparatus, Components of DNA, Structure of DNA, DNA Synthesis  – Replication in Bacteria, DNA Polymerases, Okazaki Fragments; Structure of RNA; Types of RNA, Messenger RNA (mRNA), Transfer RNA (tRNA) or Soluble RNA, Ribosomal RNA (rRNA), RNA Synthesis in Bacteria: Transcription; Building Blocks of Proteins, Transcription, Transcription Machinery, Three Phases of Transcription; Mutations, Mutations and Mutagenesis, Spontaneous Mutations, Induced Mutations, Expression of Mutations; Gene Expression, DNA Replication in Prokaryote, DNA Replication in Eucaryotes, Transcription in Prokaryotes, Translation, Regulation of Gene Expression, Induction of Gene Expression, Repression of Gene Expression; Conjugation, Gene Transfer in Conjugation is One Way Only, Transduction, Transposable Elements; Genetic Engineering, Main Steps of a Cloning Protocol, Plasmid Cloning Vectors, Bacteriophage as Cloning Vectors, Eukaryotic Cloning Vectors, YACs, BACs and PACs; Viruses as Vectors in Eukaryotic Systems,  Cloning Vectors for Higher Plants; Polymerase Chain Reaction (PCR). |
| 9 | **Destruction of Microorganisms:** Sterilization, Sterilization by Heat, Sterilization by Irradiation, Filtration, Sterilization using Ethylene Oxide; Disinfection, Alcohols, Halogens, Phenolics, Surfactants, Kinetics of Cell Death, Killing by Irradiation; Antimicrobial Drug,  Antibiotics, Resistance to Antibiotics, Antifungal Agents, Antiviral Agents, Bacteriophage: Our Secrete Weapon against Infections. |
| 10 | **General Principles in Diagnostic Microbiology:** Collection and handling of samples; Laboratory safety; Universal precautions, Precautions for Blood and Other Body Fluids,  Safety for Lab; Antimicrobial assays, Laboratory animal – An Introduction. |

**LEARNING SOURCE:** Self Learning Materials

## ADDITIONAL READING:

* 1. Pelczar M.J, Chan E.C.S, Kleig N.R., 1993: Microbiology, Tata McGraw Hill.
  2. Stuart Hoggey, 2005: Essential Microbiology, Wiley.
  3. Tom Betsy and Jim Keogh, 2005: Microbiology Demystified, McGraw Hill.
  4. L.M. Prescott, 2002: Microbiology, 5th Ed., McGraw Hill.

## WEB LINKS:

1. <http://www.ncbi.nlm.nih.gov.books/NBK8014/>
2. <http://www.nature.com/nrmicro/journal/v8/n12_supp/full/nrmicro1523html>

# BACTERIOLOGY (P) – MBL16112P

1. To isolate a pure culture by streak plate method
2. To perform gram staining of bacteria
3. Isolation of micro-organism from soil by serial dilution – agar plating method
4. To measure antibiotic sensitivity test or use of antibiotic disc for evaluating the efficacy of the drug.
5. To study the growth curve of bacteria at 370c.
6. To study the effect of temperature on growth of given microbes.
7. To study the effect of pH on the growth of given microbe.
8. To study Catalase activity of microorganism
9. Indol production production test.
10. Methyl red test and Voges- Proskauer (VP) test
11. To study the Growth Curve of Bacteria at 37o C with Shaking at 150 rpm
12. To Study the Effect of Temperature on Growth of Given Microbe.
13. To Identify the Unknown Bacterium Isolated in the Lab.

# MYCOLOGY – MBL16113

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| **UNIT** | **CONTENT** |
| 1 | **Classification of Fungi:** Fungi, Beneficial Effects of Fungi, Harmful Effects of Fungi, General Properties of Fungi, Morphology of Fungi, Characteristics of Fungi, Fossil Record, Biogeography, Notable Fungi; Discussion of phylogenetic relationships; Moulds; Yeasts; Reproduction in fungi; Classification of fungi, Zygomycetes, Ascomycetes, Basidiomycetes; Lichens; Mycorrhizae, Arbuscular Mycorrhizas, Ectomycorrhizas,  Arbutoid Mycorrhizas, Orchid Mycorrhizas, Ericoid Mycorrhizas, Mycorrhizal Fungi. |
| 2 | **Growth of Fungi:** Growth Characteristics, the Influence of Environmental Factors on Growth; Growth kinetics in liquid media: Batch Culture, Characteristic S-shaped Growth Curve, Loge (Biomass or Cell Concentration) v. Time, Log10 (Biomass or cell concentration) v. Time, Doubling Time (or Generation Time) Td; Growth Kinetics in Liquid Media: Continuous Culture; Growth Kinetics on Solid Media, Radial Extension v. Time: Peripheral Growth Zone; Isolation of Fungi, Selective Media, Culture of Fungi; Storage of Fungi, Storage in Water, Cold Temperature, Under Oil, Freeze Drying or Lyophilisation, Low Temperature Storage; Sabouraud Dextrose Agar, Raymond  Sabouraud, Standard Ingredients in Sabdex Agar, Preparing Sabdex Agar. |
| 3 | **Mycoses:** What is Mycosis? Types of Mycoses; Superficial Mycoses, Malassezia Infections, Tinea Nigra, White Piedra, Black Piedra; Cutaneous Mycoses, Dermatophytosis, Candidiasis, Candiduria; Subcutaneous Mycoses, Sporotrichosis, Chromoblastomycosis, Lobomycosis, Mycetoma, Phacohyphomycosis, Zygomycosis;  Systemic Mycosis, Histoplasmosis, Coccidioidomycosis, Blastomycosis, Paracoccidioidomycosis. |
| 4 | **Lab Diagnosis:** Sampling, Cerebrospinal Fluid (CSF), Sputum, Brinchial Washings and Throat Swabs, Skin Scrappings and Swabs, Blood and Bone Marrow, Tissue Biopsies from Visceral Organs, Urine; Direct microscopical examination; Culture; Identification, macroscopic examination, microscopic examination; Serological Diagnosis,  Immunodiffusion, Counter immunoelectroporesis (CIE), ELISA, Immunoblotting. |
| 5 | **Immunity in fungal Disease:** Introduction to fungal disease; Factors predisposing to |

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|  | fungal infections; Fungal Infections in HIV. |
| 6 | **Immuno-diagnosis:** Value of Immunodiagnosis, Advantages of Immunodiagnosis. |
| 7 | **Epidemiology:** Candida species: Human Pathogens, Intertriginous Candidiasis, Candida  Onychomycosis; Aspergillosis; Zygomycetes; Pityriasis Folliculitis; Seborrheic Dermatitis. |
| 8 | **Mycotoxin:** Toxicology and human health; Major mycotoxins, Aflatoxins, Citrinin, Ergot Alkaloids, Fumonisins, Ochratoxin, Patulin, Trichothecenes, Deoxynivalenol, Zearalenone;  Other Mycotoxins and Purported Mycotoxicoses. |
| 9 | **Bioterrorism:** Role of Mycotoxin in Biowarfare; Indoor air quality and sick-building  syndrome; Food safety and regulation, Regulatory control regarding Aflatoxin, Detoxification strategies. |
| 10 | **Antifungal Agents:** Modes of action; Classes, Polyene Antifungals, Imidazoles, Triazoles, Thiazoles, Allylamines, Echinocandins, Others; Antifungal agents, Topical Drugs, Systemic Drugs; Systemic infections, Amphotericin B (Fungizone, Amphotec), Flucytosine (Ancobon), Azoles – Introduction; Antifungal Susceptibility Tests, CLSI M27-A2 Standard for Yeasts, CLSI M44-A Standard for yeasts by Disk Diffusion, CLSI M38-A Standard for  Moulds, Commercially Available Systems, Disk Diffusion and ETEST Methods; Interpretation of Zone Diameters and MICs. |

**LEARNING SOURCE:** Self Learning Materials

## ADDITIONAL READING:

* 1. R.S. Mehrotra, K.R. Aneja: An Introduction to Mycology, 2nd Ed. 2005.
  2. Alexopoulos: Introductory Mycology, 4th Ed. 2007.
  3. Chicester Ajello L and R.J. Hay. 1997. Medical Mycology vol 4 Topleley & Wilson’s Microbiology and Infectious infections. 9th Edition, Arnold London.
  4. Kwon Chung KJ and JE Bennett 1992. Medical Mycology Lea & Febiger.

## WEB LINKS:

1. [www.science.jrank.org](http://www.science.jrank.org/)
2. [www.pharmacology.org](http://www.pharmacology.org/)
3. <http://www.dhhs.nh.gov/dphs/lab/doeuments/mycology.pdf>
4. [www.essortment.com](http://www.essortment.com/)

# VIROLOGY – MBL16114

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| **UNIT** | **CONTENT** |
| 1 | **Morphology:** Origin of viruses, Survivors of Pre-cellular First Living Inhabitants of the Earth, Derived from Normal Constituents of the Cell; Biological Status Nature of Viruses, Definition, Properties of Viruses, Host Factors for Viral Infections, Transmission of Viruses, Structural Components of Viruses, Morphology, Viral Envelope; Structure and complexity of virus genome, RNA Virus Genomes, Small DNA Genomes, Large DNA Genomes,  Segmented and Multipartite Virus Genomes, Importance of Knowing Viral Genome – Molecular Genetics; Applications, Epidemics and Pandemics. |
| 2 | **Cell Culture:** Virus Cultivation, Inoculation into Animals, Embryonated Eggs, Tissue Culture; Cell Culture, Types of Cell Cultures, Concepts in Mammalian Cell Culture, Applications of Cell Culture, Culture of Non-mammalian Cells; Basic Techniques, The “Do’s and Don’ts” of Cell Culture, Aseptic Technique and Good Cell Culture Practice, Resuscitation of Frozen Cell Lines, Subculture of Adherent Cell Lines, Subculture of Semi Adherent Cell  Lines, Subculture of Suspension Cell Lines, Cell Quantification; Monolayer Cell Culture, Formation Time, Monolayer Phases and Equations of State. |

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| 3 | **Assays:** Physical methods for the quantification of viruses, Applications, Concept, benefits; Chemical Methods of Viral Assay, Traditional Methods, Modern Methods; Measurement of  Viruses by End-point Dilution Assay, Vaccinia Pock Counting, Titration Technique. |
| 4 | **Serology:** Serological diagnosis, Criteria for Diagnosing Primary Infection, Criteria for Diagnosing Re-infection/Re-activation, Limitations of Serological Diagnosis, Problems Associated with Serology; Complement Fixation Test, Titration of haemolytic Serum and Complement, Titration of Antigen and Antibody, CFT Proper, Advantages of CFT, Disadvantages of CFT; Haemagglutination Inhibition Test; ELISA, Competitive Methods, Sandwich (Indirect) Methods, Sandwich Inhibition Methods, Antibody Capture Methods, Assay Characteristics; Single Radial Haemolysis; Immunofluorescence; Neutralization; IgG Avidity Tests, Molecular Techniques, Polymerase Chain Reaction, Other Amplification  Techniques; Radioimmuno Assay. |
| 5 | **Plant Viruses:** Viruses; Classification of viruses, General ICTV Classification, Baltimore Classification, Six Major Groups, based on the Nature of the Genome, Viruses that Multiply only in Plants; General Symptoms of Viral Diseases of Plants (Symptomatology), External Symptoms of Viral Diseases of Plants, Internal Symptoms of Viral Diseases of Plants; Classification of Plant Viruses; Purification (or Isolation) of Plant Viruses; Tobacco Mosaic Virus (TMV), Structure of Tobacco Mosaic Virus (TMV), Life Cycle (Replication) of Tobacco Mosscaic Virus (TMV), Disease Cycle and Epidemiology, Disease Management; Potex Virus, Potato Latent Disease (Potato Virus X), Symptoms, Life Cycle, Prevention/Control; Cyanophages, Morphology of Cyanophages, Growth Cycle (Replication) of Cyanophages; Mycoviruses, Morphology of Mycoviruses, Replication of Mycoviruses;  Mycoplasma Viruses; Acholeplasma Viruses. |
| 6 | **Bacteriophage:** Bacteriophage: Composition and Structure, Composition, Structure; Classification of Bacteriophage, Morphological Groups of Bacteriophages, Families of Bacteriophages, Temperate Bacteriophage, Small DNA Bacteriophage, RNA Bacteriophages; Life Cycle (Multiplication or Infection Cycle) of T-Even Phages; One Step Growth Curve;  Infection of Host Cells; Phage Multiplication Cycle, Lytic or Virulent Phages, Lysogenic or Temperate Phage, Lytic vs Lysogenic Cycle; Immunity. |
| 7 | **Animal Virus:** Classification of Viruses, ICTV Classification, Baltimore Classification, Holmes Classification, LHT System of Virus Classification; Papillomavirus Family, Lytic Cycle, Features to Note about Polyoma Virus Strategy; Adenoviruses, Classification, Structure, Pathogenesis and Replication, Properties, Clinical Syndromes, Lytic Cycle, Features to Note about Adenovirus Strategy; Herpes Viruses, Herpes Virus Structure – General, Herpes Virus Replication, Herpes Simplex Virus (HSV), Epidemiology, Diseases caused by Herpes Simplex Viruses, Diagnosis of HSV Infections, HSV Chemotherapy; Varicella-Zoster Virus (Also Known as Herpes Zoster Virus, Human Herpes Virus-3), Diseases Caused by Varicella-Zoster Virus; Cytoplasmic DNA Viruses, Poxviruses; SV40  Virus, History, Transcription, Theorized Role in Human Disease. |
| 8 | **RNA Virus:** Latent Viruses, Lysogeny, RNA Virus Replication – General Strategies, Translation Problem, Genome Size of RNA Viruses; Types of RNA Viruses, Positive Strand RNA Viruses, Non-Segmented Negative Strand Viruses, Segmented Negative Strand Viruses, Double Stranded RNA Viruses Reovirus Family (Reoviridae); Oncogenic RNA Viruses, Classes of Tumor Viruses, Transformation and Oncogenes; RNA Tumor Viruses (Retroviruses), Retrovirus Structure, Groups of Retroviruses Oncovirinae; Mechanism of  Viral Genome Replication; Oncogenes in Retroviruses; Cellular Proto-oncogenes, Characteristics of Cellular Proto-oncogenes; Retinoblastoma: A Recessive Tumor. |
| 9 | **HIV:** History of Aids; Course of infection, Acute Infection (Acute Retroviral Syndrome), A Strong Cell-mediated and Humoral Anti-HIV Immune Defense, A Latent Reservoir, Onset of Disease – AIDS; HIV Types, Sub-groups and Sub-types; Cells that are Infected by HIV, CD4+ T4 Helper Cells, Natural Killer Cells, CD8+ Killer T Cells, Macrophages, Cells of the Nervous System; Reverse Transcription and Integration; Cellular Latency, Mechanism of Cellular  Latency; Structural Components, Surface Structures, Internal Structures, Genome. |
| 10 | **Life Cycle of Ortho, Myxo and Paramyxo Viruses:** Animal RNA Virus Encode a Polymerase, Viral messenger RNA, The Monocistronic RNA problem, Life cycle of picornaviruses, Translation, RNA Replication, Assembly; Orthovirus, Lifecycle, Viability and  Disinfection, Vaccination and Prophylaxis. |

**LEARNING SOURCE:** Self Learning Materials

## ADDITIONAL READING:

1. John Carter, Venetia A. Saunders: Virology – Principles and Applications, 2007.
2. Nigel Dimmock, Andrew Easton, Keith Leppard: Introduction to Modern Virology, 6th Ed.
3. Chatterjee R (Feb 2007): Cell Biology. Cases of Mistaken identity. Science 315.

## WEB LINKS:

1. <http://www.slideshare.net/specialclass/virus-morphology-classification>
2. [www.pathmicro.med](http://www.pathmicro.med/)
3. [www.atsu.com](http://www.atsu.com/)

# MOLECULAR BIOLOGY – MBL16111

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| **UNIT** | **CONTENT** |
| 1 | **Recombinant DNA Technology:** Development of Recombinant DNA Technology; Techniques Involved in Recombinant DNA Technology; Enzymes Involved in Recombinant DNA Technology; Discovery of Restriction Endonucleases; Restriction System, Restriction Endonuclease Nomenclature, Major Classes of Restriction Endonucleases, Recognition Sequences for Type II Restriction Endonucleases, Sites of Cleavage, Frequency of Recognition Sequences; Restriction-Modification System; DNA Ligases; End-modification Enzymes; DNA Cloning, Steps Involved in Cell-based DNA Cloning, Vector DNA, Different Types of Cloning Vectors, Plasmid DNA as a Vector, Bacterial Artificial Chromosome (BAC), Cloning Vectors based on Viral DNA, Cloning Vector based on Phage, Replacement Vectors, Insertion Vectors, Cosmids, Cloning Vectors based onMI3 Phage, Phagemic Vectors, Yeast Artificial Chromosome (YAC) Vectors, Transfer of Recombinant Plasmid DNA to a Bacterial Host, Amplification and Purification of Recombinant Plasmid DNA, Applications of DNA Cloning, Transfer of Colonies to a DNA binding Membrane, Expression Libraries; Restriction Mapping, Restriction Fragment Length Polymorphism (RFLP), RFLPs can serve as Markers of Genetic Diseases; DNA Sequencing, Manual DNA Sequencing by the Sanger “Dideoxy” DNA Method, DNA Sequencing by Maxam-Gilbert Method (Chemical Degradation Method), Automated DNA Sequencing; Applications of RDT in Medical and Health Care; Gene Therapy; Vaccine Production. |
| 2 | **Blotting Techniques and their Applications:** Molecular hybridization; Types of Blotting  Techniques, Southern Blotting, Northern Blotting, Western Blotting, Dot and Slot Blotting. |
| 3 | **Nucleic Acid Amplification Techniques:** Target amplification system; Emergence of the amplification techniques; Detection of specific bacterial pathogen, Cycling Amplification Technologies, Isothermal Amplification Technologies, Cycling Probe Technology, Detection of Bacterial Pathogens by Multiple Targets or Universal Targets, Detection of Bacterial Pathogens by Nucleic Acid Amplification Techniques; Fluorescence in Situ Hybridization (FISM); Peptide Nucleic Acid – FISH; Line Probe Assay (LiPA); Hybridization Protection Assay (HPA); Mass Spectrometry (MS); Relevance of Nucleic Acid Amplification Techniques in the Clinical Laboratory; Applications of Nucleic Acid Amplification Techniques in Identification of Various Diseases, Central Nervous System (CNS) Diseases, Hepatitis, Gastroenteritis, Sexually Transmitted Diseases, HIV Infection and AIDS, Bacterial Antibiotic Resistance and Virulence Factor Genes, Methicillin-resistant Staphylococcus Aureus, Respiratory Infections; Precautions of using Nucleic Acid  Amplification Technologies; Future Trends for Nucleic Acid Amplification Technologies. |
| 4 | **PCR & its Applications in Diagnostics:** Basic mechanism of PCR; Primary Requirements  of PCR Experiments; DNA polymerase enzymes; Primer Design; Paraffin-wax-embedded |

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|  | Material; Key Factors Affecting the PCR; Different Types of PCR, RT-PCR, Real-time Quantitative PCR, Long Accurate PCR (LA-PCR); Analysis of products by PCR, Basic Analysis, Single-stranded Conformational Polymorphism Analysis, Restriction Fragment Length Polymorphism, Heteroduplex Analysis, Sequence Analysis; Applications of polymerase chain reaction; Application of PCR in Diagnostics, Role of PCR in Detecting Infectious Agents, Role of PCR in Cancer Diagnostics, Role of PCR in Genetic Diseases and Paternity Testing, Role of PCR in Histopathology, Role of PCR in Forensic Sciences;  Future Prospective of Polymerase Chain Reaction. |
| 5 | **Genotyping of Bacteria and Virus:** What is Genotype? Genotype and Genomic Sequence, Genotype and Phenotype, Genotype and Mendelian Inheritance, Genotype and Genetics, Genotype and Mathematics; Genotype Determination, Single Nucleotide Polymorphisms (SNP) Genotyping Techniques, SNP Genotyping; Allele Discrimination Method, Allele- specific Single-base Primer Extension, Allele-specific Enzymatic Cleavage; Detection of Allele-specific Products, Methods Utilizing Fluorescent Labels, Fluorescence Polarization (FP); Mass Spectrometry, SNP-based Mass Spectrometry Methods for Microbial and Viral Detection and Identifications, Mass Spectrometry in Clinical Microbiology, Comparative Sequence-based Mass Spectrometry Methods for Microbial and Viral Detection and Identification, Multilocus Sequence Typing with MALDI-TOF Mass Spectrometry, Quasispecies Analysis with MALDI-TOF mass Spectrometry; Pyrosequencing; Molecular Detection and Genotyping of Pathogens; Bacterial Pathogens, Bacterial Strain Typing,  Bacterial Resistance Testing; Viral Pathogens, Viral Detection, Viral Genotyping. |
| 6 | **Transposable Genetic Elements:** Types of Transposons; Retroviruses as Transposable Elements; Transposons Causing Diseases; Evolution of Transposons; Applications; P Element Structure; Hybrid Dysgenesis, Population Biology, Transposition; Transposase, Fate of the Donor Site, Regulation of P Element Mobility, Tissue Specificity, Cytotype and Repressors, Type I Repressor, Type II Repressor Elements, P Elements as Molecular  Biological Tools, Mutagenesis, P Element Medicated Transformation; Enhancer Trapping, Making Flanking Deletions, Ac/Ds Transposable Elements of Corn. |
| 7 | **Gene Expression:** Comparison with DNA, Structure, Synthesis; Types of RNA; In Translation, Regulatory RNAs, RNA Processing, RNA Genomes, Reverse Transcription, Double stranded RNA; RNA Transcription, Processes of Transcription, Post transcriptional Processing of RNAs, Processes of Polyadenylation; Discovery of the Genetic Code, Transfer of Information Via the Genetic Code; Sequence Reading Frame, Start/Stop Codons, Effect of Mutations; Degeneracy, Variations to the Standard Genetic Code;  Transcription, Events Following Protein Translation; Post translational Processing of Polypeptides. |
| 8 | **Regulation of Gene Expression:** History; Overview, The Operon as a Unit of Transcription; Structure, Regulation; Genetic Control in Prokaryotes, It gets more complicated - the Lac Operon Revisited, Transcriptional Control, Transcription Start Site, Basal Promoter, Post transcriptional Control, Split Genes, Translational Control, Post Translational Control, Introduction; Gene Control in Prokaryotes, The trp Operon; Gene Control in Eukaryotes, Chromatin Structure and Control of Gene Expression, Epigenetic control of gene expression, Control of Eukaryotic Transcription Initiation, Typical Structure of a Eukaryotic mRNA Gene, Structural Motifs in Eukaryotic Transcription Factors; Small  RNAs and Post transcriptional Regulation, Model for Processing miRNAs and siRNAs. |
| 9 | **Gene as Unit of Mutation:** Types of Mutations, Base Pair Substitutions; Frame shift Mutations; Origins of Spontaneous Mutation, DNA Replication Errors and Polymerase Accuracy, Base Alterations and Base Damage, Spontaneous Frame shift Mutations; Mutagens, Chemical Mutagens, Base Analogs, Intercalating Agents, Ionizing Radiation; Biological Effects of Radiation, Damage Reversal; Ligation of Single Strand Breaks; Damage Removal, Base Excision Repair, Mismatch Repair, Nucleotide Excision Repair, DNA Damage Tolerance, Check Points, Competent Cells, Competency, Procedure; Conjugation, Conjugation Involving Hfr Bacteria; Mapping Genes on Bacterial Chromosomes, Transduction, Generalized Transduction; Specialized Transduction, Transformation; Mechanisms of Transformation, Plants; Applications of Gene Transfer in  Different Fields, Gene Therapy; Disease Control, Growth Promotion, Cloning.. |
| 10 | **Oncogene & its Properties:** Products of oncogenes, Transcription Factors; Chromatin |

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|  | Remodelers; Growth Factors, Growth Factor Receptors, Signal Transducers; Apoptosis Regulators, Oncogene Activation, Chromosomal Rearrangements, Gene Amplification, Oncogenes in Cancer Initiation and Progression, Oncogenes as Therapeutic Targets; MicroRNA Genes, Radiation; Carcinogens in Prepared Food; Carcinogens in Cigarettes, Circadian Disruption, Mechanisms of Carcinogenicity, Apoptosis, Significance of Apoptosis, Morphological Features of Apoptosis, Caspases are Central Initiators and Executioners of Apoptosis; Extrinsic Apoptosis Pathways of Type I and Type II, Mitochondria as Central Regulators of Intrinsic Apoptosis Pathways, Regulatory Mechanisms in Apoptosis Signaling; The Bcl-2 Family; Regulation of Apoptosis by IAPs,  Disease as a Consequence of Dysregulated Apoptosis. |

**LEARNING SOURCE:** Self Learning Materials

## ADDITIONAL READING:

1. George Patrinos, Wilhelm Ansorge: Molecular Diagnostics. Academic Press; 1 edition (June 20, 2005).
2. Molecular Biology of the Gene (1987) Watson J. D., Hopking N., Robast J. and Steiz, J.
3. Molecular cell Biology (1999) Lodish, H., Baltimore, D., Berk, A, Zipursky SL, Paul M and Darnell J.
4. An Introduction to Molecular Biotechnology: Molecular Fundamentals, Methods, Applications in Molecular Biotechnology by Michael Wink. March 2011, Wiley-Blackwell.

## WEB LINKS:

1. <http://www.biotecharticles.com/HealthcareaArticle/BCR-ABL1-Oncogene-and-its-Leukemic-> Properties-3036.html
2. <http://www.pnas.org/content/80/15/4679.full.pdf>
3. <http://www.ncbi.nlm.nih.gov/pubmed/14699492>

# MOLECULAR BIOLOGY (P) – MBL16111P

1. Cell Fractionation
2. Differentiation
3. Nucleic Acids
4. Preparation of genomic DNA from bacteria
5. PCR amplification of DNA
6. Restriction enzyme digestion of DNA
7. Phenol/chloroform extraction of DNA
8. Ethanol precipitation of DNA
9. Transformation of E. coli by electroporation
10. Preparative DNA Fragment Isolation from an Agarose Gel
11. Ligations of plasmid DNA to insert DNA
12. Southern blotting
13. Western Blot analysis of His-tagged proteins

## YEAR II

**BIOINFORMATICS AND BIOSTATISTICS– BOXI6202**

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| **UNIT** | **CONTENT** |
| 1 | **Introduction to Bioinformatics:** Bioinformatics as Combination of Sciences; Challenges for Bioinformatics Industry; Bioinformatics Partnerships ; KDD Applications; XML for Data Representation; Bioinformaticians vs. Biotechnologists; Bioinformatics and a Bioinformatician; Roles and Responsibilities of Bioinformatics Team; Problem faced in Bioinformatics Area; Database Type,; Relational Database, Terminology, Relations or tables, Base and derived Relations, Domain, Constraints, Stored Procedures, Indices; Relational Operations, Normalization; Object oriented Database, Comparison to Relational Databases; Specialized Databases, Database structure: Records and fields; Data Mining; Identifications of Protein sequence from DNA Sequence; Input and output; calculation f Sequence Alignment for Evolutionary Interferences to Aid in Structural and Functional Analysis, Initialization Step, Matrix Fill Step; Gen Bank Database, Receiving an Accession Number for your Manuscript; Preparing Data for submission to Gen Bank, Sequin Macro Send, Whole Genome Shotgun Sequence submissions, third Party Annotation Database, Sending  the Data to Gen Bank, Getting an Accession Number |
| 2 | **Techniques in Bioinformatics:** Visualization of Structure information, Database similarity searching, Searching of Database for similar new sequence; Examine the Alignment Scores and Statistics, Statistics; Multiple Alignment and Database Searching, Sequencing and Assembling Genome using computer; Some other Methods of Genome sequencing and Assembly, Eulerian Path, Align-Layout-Consensus, BAC-by-BAC(Hierarchical) Sequencing; Genome, Genomics; Gene Therapy, Gene Splicing, Gene Silencing, Bio information and Human Genome, Functional Genomics; Functional annotation for Genes, Genome Annotation, Rosette Stone Approach, Functional Genomics and Bioinformatics,  Structural Genomics |
| 3 | **Introduction to Biostatistics:** Definition and Functions of Statistics, Functions of Statistics; Limitation of Statistics; Classification of Data, Types of Classification, Quantitative Classification or classification According to Variables; Statistical Series, Qualitative and Quantitative Series; Some Biostatistical Terms; Organization of Data; Summarizing Data, Frequency Distribution, Grouped Frequency Distribution, Variables; Graphic Representations, Bar Graph, Pie Chart, Histograms; Measures of Central Tendancy, Mean, Medium, Mode, Measuring Dispersion, Coefficient of Variance, Skewness, Karl Pearson’s  Coefficient of Skewness |
| 4 | **Measures of Depression:** Classical Definition; Counting Techniques, Fundamental Principle Of Counting, Permutation; Statistical or Empirical Definition of Probability, Definition (R.Von Mises); Axiomatic or Modern Approach to Probability, Sample Space, Events; Sampling; Tree Diagrams, Theorems on Probability; Theoretical Probability Distributions; Discrete Probability Distribution, Probability Histogram, Mean and Variance; Binomial Distribution, Probability Function or Probability Mass function, Fitting of Binomial Function, Features of Binomial Distribution, Uses of Binomial Distribution; Poisson Distribution, Poisson Process, Features of Poisson Distribution, Uses of Poisson Distribution; Normal Distribution, The conditions of Normality, Probability Density Function, Shape of normal Probability Curve, Properties of Normal Probability Curve, probability of Normal Variate in an Interval, Fitting a Normal Curve; Chi-square 2 Distribution, Features of 2 Distribution, sampling Distribution of Variance; Types of Data Collection, Census, Sample survey, administrative Data; Theory of Estimation, Point Estimation (Properties of Good Estimator), Methods of Point Estimation; Two Types of Error, Power of a Test; Critical Region and One Tailed Vs. Two Tailed Test, Test of Hypothesis Concerning Mean; Paired T-Test, Test of Hypothesis Concerning Standard Deviation, Test of Hypothesis Concerning  Correlation Coefficient, Uses of Chi-square 2 Test |
| 5 | **F-Statistics:** Features of F-distribution; The Fisher’s Exact Test, Fisher’s Exact Test for a |

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|  | 2x2 Table, Fisher’s Exact Test for an n x m Matrix, Fisher’s Exact Test as an Alternative to Chi-Squared Test; Chi-square Test of Independence, The Logic of Chi-squared, Chi-squared Test of Association, chi-squared Test of Homogeneity; F-Test and T-Test, F-distribution, T- distribution; Parameter Estimation, Regression Equation; Linear Regression and Least Squares; T-Test of the Regression Coefficient, Examinations Of Assumptions; Transformations, Variance-stabilizing Transformations, Method to Calculate Regression  Coefficient |
| 6 | **Introduction to Database Concept:** Basics of Computers, Need for Computer, Generations of Computer; Types of Computers, Computer sizes and Power, Super Computer and Mainframe, Minicomputer, Workstation, Personal Computer; Components of a Computer system; Computer Hardware Devices, Central processing Unit(CPU), Memory, USB Driver  /Flash Memory, Random Access Memory(RAM), Read Only Memory(ROM); Input Devices; Output Devices; Storage Devices; Ms-Office, Word, Ms-Excel, MS-Power Point, MS Access; Relational Database, Real World Example of Database Applications; Office Automation Tools; internet, How Internet Works, Advantages of Internet, Equipment Needed  for Internet, Electronic Mail(E-Mail), Chatting, Managing Clients through E-Mail; Web Browsers |
| 7 | **Computer Orientated Statistical Techniques using Excel:** Frequency Function;  Calculating the Mean and Standard Deviation with Excel, Setup the Variance Calculations |

**LEARNING SOURCE:** Self Learning Materials

## ADDITIONAL READINGS:

* 1. Claverie, J.M. and C. Notredame, Bioinformatics for Dummies. Wiley, 2003.
  2. Cristianini, N. and Hahn, M. Introduction to Computational Genomics, Cambridge University Press, 2006
  3. Kohane, et al. Microarrays for an Integrative Genomics. The MIT Press, 2002.
  4. Mount, David W. Bioinformatics: Seque3nce and Genime Analysis Spring. Harbor Press, May 2002.

## WEB LINKS:

1. <http://www.nature.com/naturejobs/science/jobs/405301-bioinformatician-crg-bioinformatics-> core-facilities
2. <http://www.biomickwatson.wordpress.com/2013/04/23/a-guide-for-the-lonely-> bioinformatician/
3. [http://www.people.ysu.edu/~gchang/EXCEL/EXCEL\_sd.pdf](http://www.people.ysu.edu/%7Egchang/EXCEL/EXCEL_sd.pdf)
4. <http://www.spreadsheet.about.com/od/excelfunctions/pt/2010-10-03-Excel-2007-Standard-> Deviation-Function.htm

# BIOINFORMATICS AND BIOSTATISTICS (P) – BOX16202P

1. Finding motif in a sequence from an external file using Perl script
2. Reading sequence from an external file using Perl script
3. Retrieve the protein or DNA sequence and convert it into FASTA format
4. Find out the similarity search of unknown protein sequence using BLAST
5. Find out the similarity search of unknown protein sequence using FASTA
6. Open Reading Frame prediction for different protein out of some given nucleotide sequences
7. Exon identification using available software for a given nucleotide sequences
8. Gene finding related search for a given nucleotide sequences in order to predict the Gene
9. Secondary structure prediction for Amino acid sequence of a given protein
10. Predict and visualize the 3D structure of any protein
11. Prepare sequence file in FATSA format and multiply, align them using web based CLUSTALW
12. Molecular modeling using Moddler Software
13. Docking studies using Autodock Software

# MEDICAL MICROBIOLOGY–MBL16209

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| **UNIT** | **CONTENT** |
| 1 | **Introduction to Medical Microbiology:** History of Medical Microbiology; Commonly Treated Infectious Disease; Causes and Transmission of Infectious Disease; Introduction and  Types of Pathogens |
| 2 | **Lab Diagnostic of Common Bacterial Infection:** Respiratory Tract Infection; Meningitis; Pyogenic Wound Infection; Diphtheria; Whooping Cough; Gas Gangrene; Food Poisoning; Enteric Fever; Acute Diarrhea; Cholera; Urinary Tract Infection; Tuberculosis; Leprosy; Anthrax; Plague; Typhus Fever; Syphilis; Gonorrhea and Other  STD’s |
| 3 | **Lab Diagnosis of Fungal Infections:** Fundamentals of Fungi and Fungal Infections; Laboratory Diagnosis of Fungal Infections; Lab Diagnosis of Superficial Dermatophyte Fungal Infection; Laboratory Diagnosis of Candidiasis; Laboratory Diagnosis of  Cryptococciosis; Lab Diagnosis of Pulmonary Infections; Laboratory Diagnosis of Subcutances Mycosis and Mycetoma 3.8Diagnosis of Eye and Ear Fungi Infection |
| 4 | **Epidemiological Markers of Micro-organism: Basic Concepts;** Traditional Microbial  Identification Methods; Phenotypic Method; Genotyping; Serotyping; Bacteriophage Typing Method; Bacteriocin Typing Method |
| 5 | **Advance Technology in Microbiology:** Gas Liquid Chromatography (GLC), Principle of Gas Chromatography; High Performance Liquid Chromatography (HPLC); Coaglutination; Counter Current Inmmuno Elecrophoresis (CCIEP); Enzyme-Linked Immunosorbent  Assay (ELISA) Test, Use of Enzyme-Linked Immunosorbent Assay (ELISA) in Microbiology |
| 6 | **Rapid Diagnostic Methods and Automation in Microbiology:** Rapid Methods in  Microbiology; Rapid Microbiological Methods, Microbial Detection – Qualitative, Microbial Detection – Quantitative |
| 7 | **Serological Tests:** WIDAL Test; Antistreptolysin – O (ASO Test); Rose Waller Test; Latex Fixation Test; C reactive Protein Test; Brucella Agglutination; Cold Agglutination; VDRL Test; Troponema Palladium Haemagglutination Test (TPHA Test); Fluorescent Treponemal  Antibody Test (FTA – ABS Test) |
| 8 | **Serological Tests for Fungal Infections and Skin Tests:** Antigens and Antibodies Tests for Diagnosing Fungal Infections; Diagnosing Fungal Infections, (Based on Humoral-Mediated Immune Response); Skin Test in Medical Mycology (Based on Cellular Mediated  Response), Histoplasma Skin Test, Candida Skin Test; Limitations of Skin Tests |
| 9 | **Principles of Serological Techniques Used in Virology:** Enzyme-Linked Immunosorbent Assay (ELISA) Test; Radioimmunoassay (RIA) Test; Immuno fluorescence (IF) Test, IF Procedure for the Detection of Viral Antigens and Antibodies, Techniques of IF Test; Immunoperoxidase Test, The Procedure for Immunoperoxidase Test, Procedure for Staining  of Tissue Culture Cells; Application of Serology in Important Viral Infections |
| 10 | **Prevention of Viral Diseases:** Principles of Sanitation; Use of Interferon; Antiviral Drugs |
| 11 | **Immunization:** Passive Immunization; Active Immunization |
| 12 | **Immunity in Viral Infection:** Immune System, Cytokine System, Interferon; Chemokine,  Interleukins and TNF; Defence Mechanism Aainst Viral Infection; Complement System; |

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|  | Processing and Presenting Viral Proteins; Mechanisms that Viruses Make Use of to  Evade Immune Response; Immunopathy of Viral Infection |
| 13 | **Sexually Transmitted Disease:** Signs and Symptoms; Causes of STDs; Patho physiology;  Prevention; Screening |
| 14 | **Animal Care, Handling and Uses in Parasitology:** Laboratory Animal Care; Animal Handling, Handling of Guinea Pigs, Handling of Mouse, Animal Handling and Ethics; Uses  of Animals in Parasitology |
| 15 | **Parasitic Antigen, Anti Serum:** Preparation of Parasitic Antigens, Preparation of  Antiserum, Handling and Operating the Equipments |

**LEARNING SOURCE:** Self Learning Materials

## ADDITIONAL READING:

* 1. Microbiology: An Introduction, Eighth Edition by Gerard J. Tortora, Berdell R. Funke, Christine L. Case, Hardcover: 944 pages, Publisher: Benjamin Cummings
  2. Frank N. Egerton (2006). “A History of the Ecological Sciences, Part 19: Leeuwenhoek’s Microscopic Natural History”. Bulletin of the Ecological Society of America
  3. William E. Paul, Lippincott Williams & Wilkins, Fundamental Immunology, 2008
  4. Harlow and D. Lane, Cold Spring Harbor Laboratory Press, 1988, 726 pp., comb bound,antibodies- laboratory

## WEB LINKS:

1. <http://www.microbeworld.org/history-of-microbiology>
2. <http://www.bing.com/images/search?q=STD>’s&qpvt=STD%27s&FORM=IGRE#view=det ail&id=C266ACD2A9C23F2041 D1CA569DD6635969AB129B&selectedIndex=0
3. <http://en.wikipedia.org/wiki/Fungal_keratitis>
4. <http://www.rightdiagnosis.com/f/fungal_infections/symptoms.htm>

# MEDICAL MICROBIOLOGY (P) – MBL16209P

1. Pathogenic fungi of the skin Direct examination of infected tissues for dermatophytes
2. Examination of sputum for tuberculosis
3. Microorganisms of the gastrointestinal tract
4. Primary Isolation of enteric pathogens- Salmonella and Shigella
5. Preliminary identification of enteric pathogens using triple sugar iron agar (TSIA) medium
6. Microorganisms of the urinary tract (urine)
7. Estimation of urine bacteria by calibrated loop direct streak method
8. Examination of bacteriuria by using Urine Dip Slide
9. Microorganisms of the genital tract
10. VDRL and RPR serological tests for syphilis
11. Estimation of hemoglobin contents of human blood
12. Blood group determination: Slide agglutination
13. Tube agglutination test: The Widal test.

# FERMENTATION TECHNOLOGY– MBL 16210

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| **Unit** | **Content** |
| 1 | **Introduction to Fermentation Technology:** Interaction between chemical Engineering, Microbiology and Biochemistry, Chemical Engineering, Microbiology and Biochemistry; History of Fermentation, From Chemistry to Microbiology: Pasteur’s Conversion, Distinguishing between Activities of Whole Organisms and of Enzymes, Sugar Metabolism and Enzyme Specificity; Introduction to Fermentation Processes, Fermenter Design and Control, Chemical Process of Fermentation, Microbial Culture Selection for Fermentation  Processes, Media Formulation and Process Optimization. |
| 2 | **General Considerations of Fermentation:** Metabolic Pathways and Metabolic Control  Mechanisms, Metabolic Pathways, Metabolic Control Mechanisms; Primary and Secondary Metabolites, Products of Fermentation Processes. |
| 3 | **Microbial Growth Kinetics:** Batch Culture, Fermentation Processes of Batch Culture, Mathematical Expressions of Batch Culture, Microbial Growth Kinetics, Measurement of Growth and Nutrients, Heat Evolution, Media Formulation; Sterilization, Kinetics of Thermal  Death of Microorganisms, Batch and Continuous Sterilization. |
| 4 | **Continuous Culture:** Continuous Culture System, Productivity, Product Formulation. |
| 5 | **Design of Fermenters:** Aeration and Agitation, Power Requirement Oxygen Transfer Kinetics; Concepts of Newtonian and Non Newtonian Fluids, Plastic Fluids Apparent  Viscosity, Foam and Antifoam. |
| 6 | **Instrumentation and Control:** Scale up, Scale-up Studies, Scale up Studies, Scale- down  Studies; Instrumentation Control, Fermenter; Physical and Chemical Environment Sensors, Downstream Process. |
| 7 | **Improvement of Industrially Important Microorganisms:** Selection and Genetically Improvement of Industrial Microorganisms, Genetic Improvement of Microbial Starter Cultures, Traditional Genetic Improvement Strategies, Natural Gene Transfer Methods, Genetic Engineering, Efficient Gene Transfer Systems, Steps Involved in the Development of Industrial Microbiology, Improvement of Microbes for Industrial Processes, Industrial Microbiology; Chemistry and Biosynthesis of Antibiotics and Vitamins, Antibiotics,  Biosynthesis Vitamins and Amino Acids. |
| 8 | **Metabolic Regulations in Microorganisms:** Genetic Recombination in Industrial Microorganism, Primary Metabolites; Microbial Production of Amino Acids, Lysine Glutamic Acids, Aromatic Amino Acids, Vitamins, Organic Acids, Alcohols, Other Compounds; Microbial Production of Antifungal Antibiotics and Broad Spectrum  Antibiotics, Antifungal Antibiotics, Microbial Transformation of Steroids, Microbiological Assay Techniques, Microbiological Estimation of Antibiotics and Vitamins. |
| 9 | **Fermentation Economics:** Isolation of Microorganisms of Potential Industrial Interest, Strain Improvement, Market Potential, Plant and Equipment, Air Sterilization, Heating and Cooling, Aeration and Agitation, Batch Process Cycle Times, Recovery Costs; Water Usage  and Recycling; Effluent Treatment. |

## LEARNING SOURCE: Self Learning Materials ADDITIONAL READINGS:

* 1. Barnett, J.A. A history of research on yeast 1: Work by chemists and biologists, 1789-1850. Yeast 14, 1439-1451(1998).
  2. Robert W. Hutkins (2006) Microbiology and Technology of Fermented Foods, Wiley
  3. Edward R.(Ted) Farnworth (2003) Handbook of Fermented Functional Foods (Google eBook), CRC Press
  4. B.J. Wood (1997) Microbiology of Fermented Foods, Volumes 1 and 2, Springer.

## WEB LINKS:

1. <http://articles.sun-sentinel.com/2011-04-18/health/>
2. <http://www.cookinggodsway.com/>
3. <http://www.shape.com/blogs/shape-yourlife/should-you-be-eating-more-fermented-foods-> comsumption-article/
4. <http://en.wikipedia.org/wiki/Bio-fermentation_technology>

# FOOD AND DAIRY MICROBIOLOGY– MBL16211

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| **UNIT** | **CONTENT** |
| 1 | **Scope of Food Microbiology:** Microorganisms and Food, Microorganisms Importance in Food, Food Spoilage/Preservation, Food Safety, Fermentation; Microbiological Quality  Assurance. |
| 2 | **Microorganisms and Food Materials:** Diversity of Habitat; Microorganisms in the Atmosphere, Air borne bacteria, Air borne Fungi; Microorganisms of Soil; Microorganisms of Water; Microorganisms of Plants; Microorganisms of Animal Origin, The Skin, The  Nose and Throat. |
| 3 | **Factors Affecting the Growth and Survival of Microorganisms in Foods:** Microbial Growth; Intrinsic Factors, Nutrient Content, Acidity and Buffering Capacity, Redox Potential, Antimicrobials Barriers and Constituents, Water Activity; Extrinsic Factors, Relative Humidity, Temperature, Gaseous Atmosphere; Implicit Factors; Predictive Food  Microbiology. |
| 4 | **Microbiology of Food Preservation:** Heat Processing, Pasteurization and Appertization, Quantifying the Thermal Death of Micro organisms: D and z Values, Heat Sensitivity of Micro organisms, Describing a Heat Process, Spoilage of Canned Foods, Aseptic Packaging; Irradiation, Microwave Radiation, UV Radiation, Ionizing Radiation; High Pressure Processing-Pascalization; Low Temperature Storage-Chilling and Freezing, Chill Storage, Freezing; Chemical Preservatives, Organic Acids and Esters, Nitrite, Sulphur  Dioxide, Natamycin, Natural Food Preservatives; Modification of Atmosphere; Control of Water Activity; Compartmentalization. |
| 5 | **Microbiology of Primary Food Commodities:** What is Spoilage; Milk, Composition, Micro flora of Raw Milk, Heat Treatment of Milk, Milk Products; Meat, Structure and Composition, Crustaceans and Mollusks, Spoilage of Fresh Fish; Plant Products, Cereals, Preservation of High moisture Cereals, Pulses Nuts and Oilseeds, Fruits and Fruit Products,  Vegetables and Vegetable Products |
| 6 | **Food Microbiology and Public Health:** Food Hazards; Significance of Food borne Disease; Incidence of Food borne Illness; Risk Factors Associated with Food borne Illness;  The Changing Scene and Emerging Pathogens; The site of Food borne Illness: The Alimentary Tract; Pathogenesis of Diarrheal Disease. |
| 7 | **Non-bacterial Agents of Food borne Illness:** Helminths and Nematodes, Platyhelminths: Liver Flukes and Tapeworms, Roundworms; Protozoa, Giardia Lamblia, Entamoeba Histolytica, Sporozoid Protozoa; Toxigenic Algae, Dinoflagellate Toxins, Cyanobacterial Toxins, Toxic Diatoms; Toxigenic Fungi, Mycotoxins and Mycophagy, Mycotoxins of Aspergillus, Mycotoxins of Penicillium, Mycotoxins of Fusarium, Mycotoxins of Other  Fungi; Food borne Viruses, Polio, Hepatitis A and E, Gastroenteritis Viruses, Sources of Food Contamination, Control; Spongiform Encephalopathy. |
| 8 | **Fermented and Microbial Foods:** Fermented Food Products; Yeasts; Lactic Acid Bacteria; Activities of Lactic Acid Bacteria in Foods, Antimicrobial Activity of Lactic Acid Bacteria, Health promoting Effects of Lactic Acid Bacteria- Probiotics, Malo lactic Fermentation; Fermented Milks, Yoghurt, Other Fermented Milks; Cheese; Fermented Vegetables, Sauerkraut and Kimchi, Olives, Cucumbers; Fermented Meats; Fermented Fish; Beer; Vinegar; Mould Fermentation, Tempeh, Soy Sauce and Rice Wine,  Mycoprotein. |

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| 9 | **Methods for the Microbiological Examination of Food:** Indicator Organisms; Direct Examination; Cultural Techniques; Enumeration Methods, Plate Counts, Most Probable Number counts; Alternative Methods, Dye reduction Tests, Electrical Methods, ATP Determination; Rapid Methods for the Detection of Specific Organisms and Toxins,  Immunological Methods, DNA/RNA Methodology, Sub typing. |
| 10 | **Controlling the Microbiological Quality of foods Methods for the Microbiological Examination of Foods:** Quality and Criteria; Sampling Schemes, Two class Attributes Plans, Three class Attributes Plans, Choosing a Plan Stringency, Variables Acceptance Sampling; Quality Control Using Microbiological Criteria; Controls at Source, Training, Facilities and Operations, Equipment, Cleaning and Disinfection; Codes of Good Manufacturing Practice; Hazard Analysis and Critical Control Point Concept, Hazard Analysis, Identification of Critical Control Points, Establishment of CCP Deviations,  Verification, Record Keeping; Quality Systems: BS 5750 and ISO 9000 Series. |

**LEARNING SOURCE:** Self Learning Materials

## ADDITIONAL READINGS:

1. Michael T. Madigan, Thomas D. Brock (2009) Brock biology of microorganisms, Pearson/ Benjamin Cummings
2. Michael Pelczar (1993) Microbiology McGraw-Hill Companies; 6th Edition
3. William C Frazier and Dennis C Westhoff (1998)
4. Food Microbiology McGraw-Hill College; 4 Sub editions.

## WEB LINKS:

1. <http://www.en.wikipedia.org/wiki/Food_microbiology>
2. <http://www.ww4.msu.ac.zw/elearning/material/1189175201ch301lectnotes06.pdf>
3. <http://www.biotech.kth.se/bioprocess/enfors/Downloads/FoodMicrobiology.pdf>
4. <http://biotech.iisuniv.ac.in/content/food-and-dairy-microbiology>

# ENVIRONMENTAL MICROBIOLOGY– MBL16212

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| **UNIT** | **CONTENT** |
| 1 | **Introduction to Environmental Microbiology:** Structure and Activities of Microbial Communities; Microbial interactions and Interactions with Macro organisms; Population Biology of Micro organisms; Microbes and Surfaces (Adhesion and bio-Film formation); microbial community Genetics and Evolutionary Processes; (Global) Element cycles ad Biogeochemical Processes; Microbial Life in Extreme and Unusual Little explored  Environments |
| 2 | **Aerobiology:** Droplet Nuclei, Aerosol; Assessment of Air Quality; Solid Liquid-  Impingement Methods; Brief Account of Airborne Transmission of microbes, Viruses, bacteria and fungi, Diseases and Preventive Measures |
| 3 | **Aquatic Microbiology:** Water Ecosystems; Types, Fresh water, Marine Habitats; Zonation of Water Ecosystems, Upwelling, Eutrophication, Food Chain; Portability of water,  Microbial Assessment of Water Quality, water Purifications, Brief Account of Major Water Borne Diseases and their Control Measures |
| 4 | **Soil Microbiology:** Classifications of Soils, Physical Characteristics, Chemical Characteristics; Types of Micro flora of Soil; Microbial Interactions, Mutualism  ,Commensalism, Competition, Amensalism, Synergism, Parasitism, Predation;  Biogeochemical Cycles and the Organisms; Carbon Cycle; Nitrogen Cycle; Sulphur cycle; Phosphorous cycle; Biofertilizers, Different types of Biofertilizers, Application of |

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|  | Biofertilizers |
| 5 | **Biological Nitrogen Fixation:** Nitrogenase Enzyme- nif Genes, Genetic Complementation, Nitrogenase Gene Cluster, Manipulation of nif genes,; Symbiotic Nitrogen Fixation-(Rhyzobium, frankia), Nonsymbiotic microbes- Azotobactor, Azospirillium (Vesicular Arbuscular Mycorrhizae- VAM); Ecto, Endo and  Ectendomycorrhizae; Rumen Microbiology |
| 6 | **Waste Treatment:** wastes, types of wastes, Solid and Liquid Wastes Characterization; Treatments, Physical, Chemical, Biological, Aerobic, Anaerobic, Primary, Secondary, Teritary; Solid Waste Treatment, Saccharification, Gasification, Composting; Utilization of  Solid Wastes; liquid Waste Treatment , Trickling, Activated Sludge, Oxidation pond, Oxidation Ditch, Low-Oxygen (Anixic) zone |
| 7 | **Waste Water Treatment :**Types of Waste Water Treatment; Agriculture Wastewater Treatment, Nutrient Runoff; Industrial Wastewater Treatment, Coagulation, Precipitation, Floatation, Adsorption, Electrodialysis; Sewage Treatment, Pretreatment, Primary Treatment, Collection System, Wastewater Management Trickling Filter System; Radioactive Waste Treatment, Ion Exchange/Sorption, Advance in Conventional  Treatment of Organic Liquid wastes |
| 8 | **Positive Role of Microbes in Environment:** Biodegradation of Recalcitrant Compounds, Lignin, Pesticides, Biodegradation of Pesticides; Bioaccumulation of Metals and Detoxification, Bioaccumulation of Metals, Biodeterioration, Biodeterioration Textiles;  Metal Corrosion, Mode of Deterioration and Organisms involved in Deterioration |
| 9 | **Negative Role of Microbes in Environment:** Negative role of Microbes in Environment- Disadvantages, Mode of Prevention; GMO and their impact , Benefits, Concerns, Environmental Concerns, Concern in Marketing Genetically Modified and Non- Genetically Modified Products, Conclusions; Molecular approach to Environmental Management; Derivative Plasmids; Genetic Exchange in Xeno- biotic compounds, Role of  Microbes, Biochemical Pathways, Aerobic Pathway, Anaerobic Pathway, Co-metabolic Pathway |

**LEARNING SOURCE:** Self Learning Materials

## ADDITIONAL READINGS:

1. Hedges, J. I. 1992. Global Biogeochemical Cycles: Progress and Problems, Marine Chemistry.
2. Eswaran, H., E. Van den Berg and P. Reich, Organic Carbon in Soils of the World.
3. Siegenthaler, U. and J. L. Sarmiento. Atmospheric Carbon Dioxide and the Ocean, Nature.
4. Schimel, David S., B. H. Braswell, E.A. Holland, D. S. Ojima, T H. Painter, W. J. Parton and
   1. R. Towshend. Jaffe, D. A. Global Biogeochemical Cycles, Academic Press, San Diego.

## WEB LINKS:

1. <http://www.onlinelibrary.wiley.com/journal/10.1111(ISSN)1462-2920>
2. [http://www.onlinelibrary.wiley.com](http://www.onlinelibrary.wiley.com/)….Environmental Microbiology
3. <http://en.wikipedia.org/wiki/Microbiology>
4. <http://www.eawag.ch/forschung/umik/index_EN>

# DISSERTATION – DSR16201

M.Sc. (Advance Science/Life Science) dissertation is a substantial investigation of a challenging topic in the subject area of M.Sc. (Advance Science/ Life Science). It is intended to give M.Sc. student a major opportunity to exercise their new understanding and advanced skills acquired on their programme by applying them to a significant and advanced practical problem. Students are supervised by a qualified academic with expert knowledge in the subject area while they are doing the M.Sc. dissertation.

The Dissertation must meet international standard in terms of quality and actual bench work. Preparations for the M.Sc. dissertation begin at beginning of 2nd year of the course. Students are expected to consult with their supervisors throughout the second year for guidance and assistance in researching the background to their dissertation.

The role of consult advisor is primarily to advise and provide all sort of scientific and technical support. Your advisor should, of course, guide you to a specific, well-defined dissertation topic and will typically also suggest some initial background reading you should do. Your advisor may also suggest a structure to follow in writing your dissertation proposal. Your advisor may also propose one or more potential solution strategies/methodologies for the work you will propose. It is your responsibility to do the necessary background reading to be able to clearly and concisely summarize the work related to your proposal. You must ensure that this summary is complete and that all work discussed in it is relevant to your proposal. Your proposal should be written by you (with your advisor’s input if you want it). You are advised to submit proposal by *(NAME OF STUDENT)*.

Key components of your dissertation proposal (Synopsis) include:  An abstract of the proposed work

 A clearly specified problem statement (where “problem” is taken in the broadest sense)  An introduction to the problem and your proposed solution

 A review of related work describing how it relates to your proposed work (this review is not intended to be exhaustive but rather representative of existing work in the area)

 A statement of how you propose to solve your problem including sufficient methodology to convince the committee that your proposed solution is likely to be successful

 A description of precisely how you will evaluate the success of your work

The dissertation will carry 200 marks and evaluation of dissertation will be done by external expert of the centre, head of the department and supervisor of the student.

## Dissertation Report

The text of the Dissertation could be arranged in the following sequence.

 An abstract of the proposed work

 Introduction (should include literature review and justification for  the study)

 Objectives (general and specific)  Materials and Methods

 Results

 Discussion (last paragraph of discussion may include conclusions /  Recommendations / suggestions for future work if any)

 References

 Appendices (if any)

You must use your own words and are not allowed to copy directly from books, technical reports, etc. The University takes a very strong view on plagiarism. The centre will be conducting a plagiarism check upon receiving your final report.