

# **M.Sc. MICROBIOLOGY**

## **Objectives of the course**

### **Course objectives:**

Enable the student to:

1. This course aims to impart an insight into the morphology, internal structure and reproduction of the most primitive to evolved group of algae, fungi, virus and bacteria.
2. Familiarize with the basic skills and techniques related to microbiology.
3. Understand DNA as the basis of heredity and variation in microbes.
4. Understand the role, structure and importance of the bio molecules associated with microbiology.
5. Familiarize with the various microbial diseases and measures adopted to control diseases.
6. Understand the importance of genetic engineering in human welfare.
7. Familiarize with applied aspects of microbial physiology in other fields like agriculture, environment and food industry.
8. Acquaint the student with the significance of Environmental microbiology.
9. Use of computers to handle biological data base.
10. Help the student to explore the potentialities of various underutilized microbes to project as the future food prospects.
11. Familiarize with the fundamental principles of microbiology, various developments in microbiology and potential applications.
12. Familiarize with the recent trends in the field of applied microbiology.

## M.Sc. MICROBIOLOGY

<b>SEMESTER – I</b>				
<b>Course Code</b>	<b>Title of Course</b>	<b>L</b>	<b>P</b>	<b>C</b>
MMI 001A	<b>BACTERIOLOGY</b>	4		4
MMI 002A	<b>INSTRUMENTATION</b>	4		4
MMI 003A	<b>BIOCHEMISTRY &amp; ENZYMOLOGY</b>	4		4
MMI 004A	<b>VIROLOGY, MYCOLOGY AND PHYCOLOGY</b>	4		4
MMI 005A	Microbial Diversity & Instrumentation Lab		12	12
	<b>Total Credits</b>		<b>28</b>	
<b>SEMESTER – II</b>				
MMI 006A	<b>FERMENTATION TECHNOLOGY</b>	4		4
MMI 007A	<b>MOLECULAR BIOLOGY AND MICROBIAL GENETICS</b>	4		4
MMI 008A	<b>IMMUNOLOGY</b>	4		4
MMI 009A	<b>BIostatISTICS AND COMPUTER APPLICATIONS</b>	4		4
MMI 010A	Fermentation, Molecular Biology, Immunology and Computer Lab		12	12
	<b>Total Credits</b>		<b>28</b>	
<b>SEMESTER – III</b>				
MMI 011A	<b>MEDICAL MICROBIOLOGY</b>	4		4
MMI 012A	<b>GENETIC ENGINEERING</b>	4		4
MMI 013A	<b>MICROBIAL TECHNOLOGY</b>	4		4
MMI 014A	<b>APPLIED ENVIRONMENTAL MICROBIOLOGY</b>	4		4
MMI 015A	Medical, Environmental Microbiology and Genetic Engineering Lab		12	12
	<b>Total Credits</b>		<b>28</b>	
<b>SEMESTER – IV</b>				
MMI 016A	<b>Review Report</b>		8	
MMI 017A	<b>Dissertation</b>		18	
MMI 018A	Seminar		2	
	<b>Total Credits</b>		<b>28</b>	
	<b>Total Credits of All Four Semesters</b>		<b>112</b>	

## **SEMESTER I**

### **MMI 001A BACTERIOLOGY**

**Credits: 04**

#### **Classification**

Classification of microorganisms- introduction, Haeckel's three kingdom concept, Whittaker's five kingdom concept, five domain system of classification. Modern trends in classification (ribotyping, NA hybridization, RNA fingerprinting). Classification and salient features of bacteria according to Bergey's manual of systematic bacteriology(a brief outline) Morphological types of bacteria . Nutritional classification of bacteria

#### **Ultra structure of bacteria:**

Cell wall structure and synthesis, cell membrane,. Flagella and motility, chemotaxis Pili, Cell inclusions like Glycogen granules, Volutin granules, Carboxysomes etc, Slime sheet and capsule. Endospore structure and formation stages of sporulation, activation germination and outgrowth of bacterial endospores.

#### **Eubacteria and Archaeobacteria**

General characters and structure of Spirochetes, cyanobacteria, purple and green bacteria, rickettsia, Chlamydia, budding bacteria and sheathed bacteria. Gram positive bacteria- endospore forming bacteria, actinomycetes, mycobacteria. Archaeobacteria-methanotrophs, halophiles and sulphur bacteria.

#### **Microbial Growth**

The definition of growth, growth curve, measurement of growth and growth yields, Synchronous growth, Continuous, Batch and Fed Batch Culture; Growth as affected by environmental factors like temperature, acidity, alkalinity, water availability oxygen and pH, activity of water and gaseous environment, maintenance and preservation of microorganisms

## **Microbial Physiology**

Photosynthesis: Oxygenic photosynthetic microbes and anoxygenic photosynthetic microbes. Brief account of photosynthetic and accessory pigments-chlorophyll and bacteriochlorophylls, rhodopsin, carotenoids, phycobiliproteins; oxygenic-anoxygenic photosynthesis.

### ***Suggested Readings***

1. Basic and Practical Microbiology, Ronald M Atlas, Mac Millan Company New York, 1989
2. Biology of Microorganisms, T D Brock, M T Madigan, (10 edition), Pearson education, Inc., 2003
3. Microbiology , Prescott, Harley, Klein, (6 edition), Mc Graw Hill Companies,2005
4. Microbiology Fundamentals and Applications , R M Atlas, (2edition), Maxwell Macmillan International edition, 1989th
5. Microbiology-a Laboratory Manual, J G Cappuccino and N Sherman, (6 edition),Addison Wesley, Pearson education, Inc., 2006
6. Microbial diversity: current perspectives and potential applications, Satynarayana T. & Johri B.N. I.K. International Pvt. Ltd. 2005
7. Microbial Physiology, (4edition ), by A.G. Moat ,J.W.Foster and M.P. Spector. Wiley Liss publications 2002.
8. Benson's Microbiological application: Laboratory Mannual in general th Mirobiology (9edition), Brown A E, Mc Gr aw Hill, 2005
9. Foundation in Microbiology, K P Talaro and A Talaro, (4 th edition), Mc Graw Hill, 2002

10. General Microbiology, R Y Stanier, J L Ingharam, M L Wheelies, P R Painter, Mac Millan Education Ltd, 1999

11. Laboratory Fundamentals of Microbiology, I E Alcamo, Jones and Barlett publishers, 2001

12. Microbial Diversity, D Colwd, Academic press, 1999.th

13. Microbiology, M. J Pelczar, E C S Chan, N R Kreig, (5edition), Tata Mc Graw Publication, 2006

## **MMI 002A INSTRUMENTATION**

**Credits: 04**

**Microscopy:** construction of a microscope, Principle and applications of light microscopy (bright field, dark field, phase-contrast, interference, fluorescence, polarization microscopy). Electron microscopy- TEM, SEM, Scanned probe microscopic techniques (STEM, AFM).

**Centrifugation:** Principle, sedimentation analysis & RCF, ultracentrifugation: Preparative (differential and density gradient) and analytical centrifuges.

**Chromatography:** Principle, techniques of chromatography (Paper chromatography, TLC, Column chromatography), types of chromatography (GC, HPLC, Adsorption chromatography, Partition chromatography, Gel filtration, Ion-exchange chromatography and Affinity chromatography).

**Electrophoresis:** Principle, factors affecting electrophoresis, types of electrophoresis - Agarose gel electrophoresis, PAGE, SDS-PAGE, 2-D electrophoresis, Pulsed field gel electrophoresis, isoelectric focussing, immuno electrophoresis.

**Spectroscopy:** Beer-Lambert law, UV-Vis spectroscopy, fluorescence spectroscopy, IR spectroscopy, Raman spectroscopy, Atomic absorption spectroscopy, NMR, ESR, Flame emission photometry, flow cytometry. **Radioisotopic Techniques:** Principle and applications of radiation techniques (Radioisotopes; nature of radioactivity, types of radioactive decay, unit of radioactivity), detection and measurement of radioactivity (Geiger-Muller counter, Solid and liquid scintillation counter, autoradiography).

### *Suggested Readings*

1. Essentials of Biophysics, P Narayanan, New Age Int. Pub. New Delhi. 2000
2. Fundamental Laboratory Approaches for Biochemistry and Biotechnology, A J Ninfa., D P Ballou, Fitzgerald science press, Inc. , 1998
3. Principles and Practice of Bioanalysis, R F Venn, Taylor and Francis, 2003
4. Principles and Techniques of Biochemistry and Molecular Biology ,(6 th edition), K Wilson and J Walker (editor), Cambridge University Press, 2007
5. Bioinstrumentation, J G Webster, John Wiley & Sons Inc. 2004
6. Methods in Modern Biophysics, B Notting, Springer Verlag Berlin Heidelberg New York, 2003
7. Protein Purification Principles and Practice, (3 rd edition), R K Scopes, Springer International, 2004
8. Spectroscopy for the Biological Sciences, G G Hames, John Wiley & Sons Inc. 2005

**Chemical foundations of Biology:** pH, pK, acids, bases, buffers, weak bonds, chemical bonds, Bioenergetics: Principles of thermodynamics: free energy, important energy, rich molecules, standard free energy change, concept of redox reactions. Principles of self assembly, Hierarchy of molecular organization of living systems.

**Amino acids and proteins:** Structure and chemistry of Amino acids, Classification, Chemical Reactions and Physical Properties, Proteins-purification and criteria for homogeneity, structural organization of proteins- primary, secondary, tertiary and quaternary structure. Ramachandran plot. Protein sequencing, glyco and lipo protein structure and function.

**Carbohydrates:** Classification and reactions of aldehyde and ketone group, types, structural features (ring structure, tautomeric forms, mutarotation) of carbohydrates. Metabolism of carbohydrates, glycolysis, Krebs cycle, terminal oxidation/oxidative phosphorylation, reverse TCA cycle, gluconeogenesis, mechanism of ATP synthesis.

**Lipids:** Classification, Structure and functions, Biosynthesis of saturated and unsaturated fatty acids, Metabolism of Lipid and fat bodies: Beta-oxidation and channeling of the products to ATP production: minor pathway of fatty acid oxidation, (alpha and omega oxidation), Biosynthesis of saturated and unsaturated fatty acids. Purines and pyrimidines, denovo and salvage pathways.

**Enzymes:** as biocatalyst, classification, specificity, active site, isozymes.

**Enzyme Kinetics:** Rate of reactions, specific activity, molecular activity,  $K_m$ ,  $K$ , Michaelis Menten & Line weaver Burk plot and Bisubstrate Reaction, enzyme inhibition, mechanism of enzyme catalysis (acid-base electrostatic, metal ion, free radicals, transition state binding and covalent, proximity and orientation effects, Contribution of strain). Factors affecting enzyme activity, enzyme inhibition.

### ***Suggested Readings***

1. Biochemistry, D.Voet and J.G.Voet, John Wiley & Sons, (2 nd Edition), 1995.
2. Principles of Biochemistry, Lehninger ,Nelson and Cox, (3 rdEdition), 1999.

3. Principles and Techniques in Biochemistry and Molecular Biology, Edited by Keith Wilson and John Walker, Cambridge University Press, (6 thEdition), 2007.

4. Biochemistry and Molecular Biology by W.H. Elliot and Daphne C. Elliot, Oxford University Press, (3 rd Edition), 2005.

5. Biochemistry, J. David Rawn, Panima Publishing Corporation, 1 st Indian Reprint,2004.

#### **MMI 004A VIROLOGY, MYCOLOGY AND PHYCOLOGY**

**Credits: 04**

**Brief outline on discovery of viruses**, nomenclature and classification of viruses[LHT system, classification as per VII report of the international committee on taxonomy of viruses], distinctive properties of viruses; morphology & ultra structure; capsids & their arrangements; types of envelops and their composition-viral genome, their types and structure, virus related agents (viroids, virusoids, prions) cultivation of viruses in embryonated eggs, experimental animals, cell cultures; Primary & secondary cell cultures; suspension cell cultures and monolayer cell cultures, cell certain, cell lines and transgenic systems.

**Plant viruses:** Classification and nomenclature, effect of viruses on plants, external appearance of plants; histology, physiology and cytology of plants; Viruses of cyanobacteria, algae and fungi. Transmission of plant virus with vectors (insects, nematodes, fungi) and without vectors (contact, seed and pollens), Prevention of crop loss due to virus infection-virus free planting material; vector control.

**Mycology:** An Introduction to fungi-History, general features of fungi, Classification of fungi, according to Ainsworth and Alexopolus and Mims with the general aspects of Major division of fungi. Nutrition of fungi, Homothallism, Heterothallism, Heterokaryosis, and the Parasexual cycle, Sex Hormones in Fungi. Fungi as insect symbiont. Mycotoxins and Mycotoxicoeses. Attack on fungi by other microbes. Economic importance of fungi.



**Phycology:** An introduction to Algae, General features and classification of algae. Occurrence, thallus organization and reproduction in Chlorophyceae, Euglenophyceae, Phaeophyceae, Rhodophyceae, Xanthophyceae, Pyrrophyceae and diatoms.

Algal ecology & biotechnology. Economic importance of algae. Lichen- ascolichen, basidiolichen, deuterolichen. Economic Importance of lichen.

### ***Suggested Readings***

1. Introduction to Modern Virology, IV. Dimmock Nj, Primrose SB Edition, Blackwell Scientific Publications, Oxford. 1994
2. Virology-3rd Edition, Conrat HF, Kimball PC and Lev y JA. Prentice Hall, Englewood cliff, New jersey 1994.
3. Functionals of plant virology- Mathews, RE. Academic press, San Diego. 1992
4. Text Book on principles of Bacteriology, virology and Immunology- Topley and Wilson. Edward Arnold, London. 1995
5. Diagnostic procedures for viral and Rickettsial diseases. American public Health association, NY. Lenetter 1984
6. The genetics of Bacteria and their viruses- William Hayes. Blackwell Scientific Publishers, London. 1985
7. Principles of microbiology- Ronald M. Atlas. Mosby Year Book, Inc. Missouri 63146. 1985
8. Textbook of Microbiology- R. Ananthnarayan and CCJ Paniker. (6th Edition). Orient Longman Pvt Ltd. 2003
9. An Introduction to Mycology, Mehrotra RS and Aneja KR, New Age International Publishers, 1990

10. Fundamentals of Fungi, Moore E., Landecker , Prentice Hall 11. Plant viruses- Kenneth M.Smith.Universal Book Stall,New Delhi.1999

12. Applied Virology- D.G.A Walkey. International Books & Periodicals supply service.New Delhi. 1985

13. An Introduction to Mycology (III edition) Alexopoulos CJ and Mims CW, Wiley Eastern Ltd., New Delhi, 1979

**MMI 005A Microbial Diversity & Instrumentation Lab**

**Credits: 12**

1. Instrumentation and general lab introduction
2. To determine the acid value of the given oil sample.
3. To prepare biologically important buffers (phosphate and acetate).
4. To separate and identify amino acids by using TLC.
5. To separate and identify carbohydrates using TLC.
6. To find out the concentration of amino-acids in the given sample using ninhydrin.
7. To estimate the presence of carbohydrates.
8. To estimate the presence of Amino acids.
9. To identify of various Algal members.
10. To prepare potato dextrose Agar medium.
11. To carry out the complete coliform test to check the presence of E.coli.
12. To check Oligodynamic effect (effect of heavy metals) on the given bacterial sample.
13. To check the given bacterial culture for amylase (starch hydrolysis) activity.

14. To check the presence of coliform bacteria using LBCP broth.
15. To check the presence of coliform bacteria (E.coli) using EMB agar (confirmatory test).
16. To study DNA profile of the given sample by using AGAROSE GEL ELECTROPHORESIS.
17. To Classify and Identify various fungal members.
18. To stain Endospore.
19. To examine symptoms and transmission of viral diseases.
20. To check the given bacterial culture for its tryptophan utilizing activity.
21. To estimate the total proteins present in the given sample using lowry's method.
22. To Isolate and identify airflora.
23. To Isolate and identify fungi from sewage water.
24. To Isolate and identify soil flora by sprinkle method & serial dilution method.
25. To compare the Rhizospheric and Non-Rhizospheric bacteria (R.S.ratio)
26. To evaluate alcohol as disinfectant.
27. To find out the size of the given spore.
28. To estimate the carbohydrate present in the given sample using Anthrone reagent.
29. To find out the thermal death time of the given bacterial samples.
30. To find out thermal death point of the given bacterial samples.
31. To study the effect of pH on microbial growth
32. To perform simple bacterial staining.
33. To perform the capsule staining of given bacterial samples.

34. To find out the concentration of DNA in the given sample using DPA.
35. To check the given bacterial culture for its Citrate utilizing activity.
36. To check the given bacterial culture for its MRVP activity.
37. To study the effect of osmotic pressure on microbial growth.

## **SEMESTER II**

### **MMI 006A FERMENTATION TECHNOLOGY**

**Credits: 04**

Fermentor: Main components and its uses, peripheral parts and accessories. Control systems and sensors. Fermentor preparation and use: disassembly and cleaning of vessel, autoclaving, inoculation of fermentor vessel, sampling from fermentor vessel and routine maintenance of a fermentor. Specialized bioreactors (pulsed, fluidized bed, airlift bioreactor).

Fermentation media and scale up of fermentation: Medium formulation, energy source, carbon sources, nitrogen sources, minerals, growth factors, buffers, inhibitors and precursors, antifoaming agents. Air and medium sterilization.

Inoculum preparation and scale up of fermentations. Batch, fed batch and continuous fermentations. Multiple fermentation and solid substrate fermentations. Microbial growth cycle, diauxic growth, growth yields.

Isolation, preservation and improvement of industrially important Microorganism. Isolation of industrially important microorganisms. Primary and secondary screening. Preservation of industrially important microorganisms. Strain improvement by genetic recombination approaches and directed screening for mutants with altered metabolism. 15hrs Downstream processing, detection and assay of fermentation products. Removal of microbial cells and solid matter, foam separation, cell disruption, precipitation, filtration, centrifugation, liquid-liquid extraction, chromatography, membrane process, drying and crystallization. Physical, chemical and biological assays for detection of fermentation products.

### ***Suggested Readings***

1. Bioprocess Engineering (2 nd edition) by Michael L.Schuler and F.Kargi .Prentice Hall of India.2002.
- 2 Biochemical Engineering Fundamentals, (2 nd edition). J.E. Bailey and D.F. Ollis Mcgraw Hill International Editions 1986.
3. Process Biotechnology Fundamentals (2 nd edition by S.N. Mukhopadh yaya. Vivi Books Pvt. Ltd.2004
4. Principles of Fermentation Technology by P.F. Stanbury,A. Whittaker & Hall Pergaman. McNeul & Harvey Publications. 1990.

### **MMI 007A MOLECULAR BIOLOGY AND MICROBIAL GENETICS Credits: 04**

Prokaryotic and Eukaryotic gene structure and function. Structure and properties of nucleic acids, Central dogma of molecular biology, Prokaryotic gene structure and organization, Eukaryotic genome structure and chromosome organization Replication in Prokaryotes and Eukaryotes. Enzymes and accessory proteins involved in DNA Replication.

Prokaryotic & Eukaryotic transcription (Initiation, Elongation & Termination), general apparatus of transcription, RNA, Polymerase, General & Specific Transcription Factors, Regulatory elements & mechanism of transcription regulation, Post transcriptional gene silencing (PTGS), Modifications in RNA.

Prokaryotic and Eukaryotic Translation, the translation machinery, Mechanism of initiation, elongation, termination, Regulation of translation, Co & post translational modification of proteins, Localization of proteins, synthesis of secretory & membrane proteins, mitochondria, chloroplast & peroxisomes.

Bacterial genetics: Molecular mapping of genome, genetic and physical mapping, map based cloning. Gene transfer mechanisms-Transformation- molecular mechanism, mapping and other uses of transformation, Transduction- generalized transduction, cotransduction and linkage, mapping by cotransduction, specialized transduction, specialized transducing phage as a cloning vehicle.

Bacterial conjugation, Chromosome transfer in other bacteria. Plasmids and Transposons, Plasmids- types and properties, F- factors description. Plasmids as vectors for genetic cloning. Plasmid replication. Transposons- types, genetic phenomena mediated by transposons in bacteria.

Bacteriophages, Lytic phages-T7 and T4. Lysogenic phages Lambda phage, and P1, M13 and  $\phi$ X174 life cycles, Phage MU and their uses in microbial genetics. Role of microbial genetics in vaccine designing. Microbial genetics and design of vaccines. BCG and design of vaccine for TB and leprosy. DNA vaccines, design and advantages.

### ***Suggested Readings***

1. Microbial Genetics, Stanley R. Maloy, John E. Cronan, Jr., David Freifelder, 2<sup>nd</sup> edition, Jones and Barlett Publishers, 1994.
2. Molecular Genetics of Bacteria, Larry Snyder and Wendy Champness, ASM Press, Washington, D.C., 1997.
3. Essentials of Molecular Biology, George M. Malacinski, David Freifelder, 3<sup>rd</sup> edition, Jones and Bartlett Publishers, 1998.
4. Molecular Cloning: a Laboratory Manual, J. Sambrook, E. F. Fritsch and I. Maniatis, Cold Spring harbor Laboratory Press, New York, 2000.
5. Introduction to Practical Molecular Biology, P. D. Dabre, John Wiley & Sons Ltd., New York, 1988.
6. Genomes. Brown T.A: John Wiley and sons(ASIA) PTE Ltd 1999

7. Molecular Biology of the Cell (2nd Edition) B. Alberts, D. Bray, J. Lewis, M. Raff, K. Roberts, and J.D. Watson, Garland publishing. Inc., New York, 1994.
8. Molecular Biology of the Gene. (5 th Edition) Watson, Baker, Bell, Gann, Levin, Losick: Pearson Education.2003.
9. Molecular Cell biology (2nd Edition) J. Darnell, H. Lodish and D.Baltimore, Scientific American Books,USA,1994.
10. Essentials of Molecular Biology. Malacinski, G M, Freifelder D: Jones & Bartlett Publishers Inc. (1998)
11. From Genes to Clones by Winnacker, Panima Publishing Corporation, New Delhi/Bangalore, 2003
12. Genetics – A molecular approach by Russell, Peter. J, 2003
13. Gene IX (9th Edition) Benjamin Lewin. Ox ford University Press.U.K., 2007
14. Molecular Biology and biotechnology. A compr ehensive desk referen ce. R. A.Meyers (Editor) VCH Publishers, Inc., New York, 1995.

## **MMI 008A IMMUNOLOGY**

**Credits: 04**

Introduction to immune system. Basic Immunology: - Phylogeny of immune system, Innate and acquired immunity, Clonal nature of immune response. Cells of the Immune system: Hematopoiesis and differentiation, Lymphocyte trafficking, B-lymphocytes, T-lymphocytes, Macrophages, Dendritic cells, NK and Lymphokine activated killer cells, Eosinophils, Neutrophils and Mast Cells. Organization and structure of lymphoid organs

Cellular and molecular aspects: Nature and biology of antigens and super antigens. Immunoglobulin: structure, types and their function, Major histocompatibility complex, B-Cell Receptor and T-Cell Receptor, generation and diversity, Complement system. Immune response & its regulation Antigen processing and presentation, generation of Humoral and Cell mediated immune responses, B- and T- cell maturation, activation and differentiation, Cytokines and their role in immune regulation, T-cell regulation, MHC restriction,

**Antigen- antibody interactions:** Precipitation, Immunodiffusion, Immuno-electrophoresis, Agglutination, RIA, ELISA, Immunofluorescence. Advanced concepts in Immunology: Hypersensitivity, Autoimmunity, Vaccine development and immunization programme, Transplantation, Immunity of infectious agents (intracellular parasites, helminthes and viruses), AIDS and other immunodeficiencies, Hybridoma Technology and Monoclonal antibodies.

**Transplantation and Autoimmunity:** organ specific autoimmune disease, systemic autoimmune diseases, graft rejection, evidence and mechanism of graft rejection, prevention of graft rejection, immunosuppressive drugs, HLA and disease, mechanism of immunity to tumor antigen, Autoantibodies in human pathogenic mechanism, experimental models of autoimmune disease treatment of autoimmune disorders.

### ***Suggested Readings***

1. Kuby's Immunology, (4Edition)-R.A. Goldsby, Thomas J. Kindr. Barbara, A.

Osbarne, (Freeman) & Co. New York.

2. Roitt's Essential Immunology,(10edition), Ivan M .Roitt and Peter J. Delves,

Blackwell Science, 2001

3. Instant Notes on Immunology, (2edition), Lydyard, Wheran and Fanger, Viva

Books Pvt. Ltd., 2003

4. Cellular and Molecular Immunology, (3edition), Abbas, Litchman and Pober,

Harcourt Brace and Company, 1998



5. Immunology: A Comprehensive Review. Darla J. Wise and Gordon R. Carter,  
Iowa State University Press, 2001

6. Medical Microbiology and Immunology: Examination and Board Review, (7  
edition), Warren Levinson and Ernst Jawetz, Mc Graw Hill, 2002

**MMI 009A BIostatistics and Computer Applications Credits: 04**

Classification and tabulation of data, frequency distribution. Measures of central tendency and dispersion. Measure of central tendency- Mean, median and mode, Measures of dispersion - range, mean deviation, standard deviation, coefficient of variation, Skewness and kurtosis.

Probability, addition and multiplication theorem of probability. A brief idea of normal, Poisson and binomial distribution.

Tests of significance: Hypothesis testing, Null hypothesis and alternative hypothesis, level of significance. Chi-square test, t-test, F-test, ANOVA-one way and two way classifications. Simple correlation and simple regression.

Introduction to computers- definition, a simple model of computer, fundamental, technical and commercial classification of computer. Characteristics of computer Systems. Data representation and application- input and output devices, Computer Memory, CPU, Types of Software - Application software, System Software, Operating Systems and types. Computer Languages, Windows and its applications. Elements of Desktop, Special Indicators. File Handling in Windows, Accessories.

MS Office and its application-MS Office Fundamentals & Components - MS Word, MS Excel, MS Power Point, MS- Access.

NOTE: Calculators are permitted in examination

### ***Suggested Readings***

1. Biostatistics: A Foundation for Analysis in Health Sciences, (6 th edition), W W Daniel, John Wiley and Sons Inc., 1995.
4. Statistical Methods in Biology, N T J Bailey, Cambridge University Press, 1995.
5. Statistics for Biologist, R C Campbell, Cambridge University Press, 1989.
6. Fundamentals of Biostatistics, Khan, Publishing Corporation, 1999
7. Practical statistics for Experimental Biologists, A C Swardlaw, John Wiley and sons Inc., 1985

### **MMI 010A Fermentation, Molecular Biology, Immunology and Computer Lab**

#### **Credits: 12**

1. To isolate antibiotic resistant microorganisms by replica plating.
2. To isolate antibiotic resistant microorganisms by Gradient plate technique.
3. To determine effect of U.V. rays on bacteria.
4. To isolate plasmid DNA
7. To perform Ouchterlony double diffusion
8. To determine antibody concentration using ELISA
9. To determine antigen concentration using Sandwich ELISA
10. To examine restriction digestion of DNA
14. To examine symptoms produced in plants due to virus infection.
15. To examine viral diseases of plants/animals/human (Specimen/photographs)
16. To prepare models of different type of viruses (Photographs/sketches).

18. To isolate and identify various fungi.

19. To observe permanent slides of algae

### **SEMESTER III**

#### **MMI 011A MEDICAL MICROBIOLOGY**

**Credits: 04**

Normal micro flora and factors responsible for pathogenesis Classification of medically important micro organisms; Normal microbial flora of human body; role of the resident flora. Entry of pathogens into the host; colonization and mechanism of bacterial adhesion establishment, spreading, tissue damage and anti-phagocytic factors; factors predisposing to infections, types of toxins and their structure; mode of action.

Pathogenic bacteria-I:

Diagnostic features of important diseases including their pathogenicity and control. Pyogenic cocci-*Staphylococci*, *Streptococci*, *Neisseria meningitides*, *N. gonococcus*

Gram positive cocci-*Clostridium tetani*, Mycobacteria-*M. tuberculosis*, *M. leprae*

Pathogenic bacteria I

Fungi and Protozoan: Enteric Gram negative bacteria-

*Salmonella*, *Shigella*, *Vibrio cholera*, *E. coli* *Spirochaetes- Treponema palladium*

Chlamydiae- Trachoma, Rickettsial diseases, Diseases caused by Mycoplasma,

Pathogenic fungi-*Candida albicans* Protozoan diseases – Malaria, Amoebiasis

Animal viruses: Epidemiology, life cycle, pathogenicity, diagnosis, prevention and treatment of RNA viruses- Picorna virus family- Poliomyelitis, influenza, Mumps, Measles, DNA viruses; Pox virus- Variola and Vaccina, Herpes virus- Varicella Zoster virus, Hepatitis viruses, Arthropod borne (arbo) Viral disease- Dengu, Swine flu.

Chemotherapy and Antimicrobial agents Mode of action of penicillin, Sulfa drugs, streptomycin, tetracycline and other broad spectrum antibiotics. Antifungal drugs, antiviral drugs. Brief account on available vaccines

### ***Suggested Readings***

Bacterial Pathogenesis. A Molecular Approach, A A Salyers and D D Whitt, ASM Press, 1994

Instant Notes Medical Microbiology, Irving W, Boswell T, Ala Aldeen D, Taylor and Francis group, 2005

Medical virology- Morag C and Timbury M.C. X Edition. Churchill Livingstone, London. 1994

Microbiology A Human Perspective, Nester E. W., Roberts CE, Nester MT, Wm. C. Brown Publishers, 1995.

Text book of Microbiology, R Ananthnarayan an and C K J Paniker, Orient Longman, 1997

Medical Microbiology and Immunology: Examination and Board Review (7th edition), Warren Levinson and Ernst Jawetz, Mc Graw Hill, 2002

Medical Microbiology vol. 1 Microbial infection, vol. 2

Practical Medical microbiology, Churchill Livingstone, 1996

Plant Pathology- Agrios, G. N. Academic Press. 1997

Plant viruses- Kenneth M.Smith.Universal Book Stall, New Delhi.1999

## **MMI 012A GENETIC ENGINEERING**

**Credits: 04**

Tools of genetic engineering Scope and milestones in genetic engineering, Basic tools and techniques used in recombinant DNA technology: Restriction endonuclease, DNA modifying enzymes, cloning vectors: plasmids, bacteriophage, cosmid, phagemids, *in vitro* construction of vectors, expression vectors.

Principle and uses of nucleic acid hybridization. Principle and applications of polymerase chain reaction. Patenting of cloned life forms. Site directed mutagenesis and protein engineering, *in vitro* DNA synthesis, *in vitro* transcription and translation.

Sequencing of genes DNA and genomic library: m- RNA enrichment, reverse transcription, Linkers, Adaptors, Screening of cDNA and genomic library, Sequencing and mapping: Sequencing vector, fluorescent tagging, Automated DNA sequencing, Pyrosequencing. Restriction mapping and map construction, Application of sequence information for identification of defective genes.

Molecular Mapping of Genome Genetic and physical mapping, Genome sequencing: genome size, organelle genome, YAC, BAC libraries, strategies of genome sequencing, Analysis of genetic variations: RAPD, RFLP, AFLP and other molecular marker techniques, application of RFLP in forensic studies, disease prognosis, genetic counselling, pedigree analysis etc.

Strategies of gene delivery Agrobacterium mediated transformation, electroporation, particle bombardment, microinjection, Gene therapy: Target gene replacement, gene knockout technique, computer aided drug designing. Gene expression DNA and protein microarray technology, RNase protection assay, Reporter gene assay, northern blotting and S1 nuclease assay, Heterologous gene expression in bacteria, yeasts, insects, mammals and plants. codon optimization.

### ***Suggested Readings***

1. Molecular Cloning: a Laboratory Manual, J. Sambrook. E.F. Fritsch and T. Maniatis, Cold Spring Harbor Laboratory Press, New York, 2000.
2. DNA Cloning: a practical Approach, D. M. Glover and B.D. Hames, IRL Press Oxford, 1995.
3. Molecular and Cellular Methods in Biology and Medicine, P. B. Kaufman, W. Wu., D. Kim and L.J: Cseke, CRC Press. Florida, 1995.

4. An Introduction to Genetic Engineering. Edited by Desmond S.T. Nicholl, Cambridge University Press, February 2002.
5. Manipulation and Expression of Recombinant DNA. Sue Carson and Dominique Robertson, Second edition, Academic Press, December 2005.
6. Principles of Gene Manipulation and Genomics. Primrose and Twyman, (7 edition). Blackwell Publishers, 2006.
7. RNA interference Technology- From basic science to drug development. Edited by Krishnarao Appasani. Forewords by Andrew Fire and Marshall Nirenberg, Cambridge Press, 2005.
8. Methods in Enzymology Vol.152, Guide to Molecular Cloning Techniques, S. L. Berger and A. R. Kimmel, Academic Press, Inc. San Diego, 1998.
9. Methods in Enzymology Vol.185, Gene Expression Technology, D. V. Goeddel, Academic Press, Inc., San Diego, 1990.
10. DNA Science. A First Course in Recombinant Technology, D.A. Mickless and G.A. Greyer, Cold Spring Harbor Laboratory Press, New York, 1990
11. Molecular Biotechnology (2nd Edition), S.B. Primrose, Blackwell Scientific Publishers, Oxford, 1994.
12. Milestones in Biotechnology. Classic papers on genetic Engineering, J.A. Davies and W.S. Roznikoff, Butterworth-Heinemann, Boston, 1992

## MMI 013A MICROBIAL TECHNOLOGY

Credits: 04

Industrial production of organic feed stocks- ethanol, acetone/ butanol fermentations, organic acids- citric acid, acetic acid, amino acids- glutamic acid, lysine, vitamins- riboflavin. Microbial transformation of steroids.

Industrial application of microorganism- Industrial uses of molds. Industrial production of antibiotics- penicillin, streptomycins, tetracyclines, polyketides and polyketide antibiotics.

Enzymes as fermentation products- amylases, proteases. Techniques of enzyme immobilization. Microbial cells as fermentation products- commercial production of bakers yeast, food and feed yeast, mushrooms and algae.

Introduction to food fermentation technology. Microorganisms responsible for spoilage.

General Principle underlying spoilage. Elementary idea of canning and packing, Sterilization and pasteurization of Food Products, Food preservation by Radiations, low and high Temperature. Chemical preservation and naturally occurring antimicrobials. Fermented foods (Soya sauce, bread, Sauerkraut, idly), fermented beverages (wine, Beer) Microbiological examination of food.

Industrial Dairy fermentations. Classification of various groups of microorganisms associated with dairy industry. Starter cultures for fermented dairy products (*Streptococcus thermophilus*, *Lactobacillus bulgaricus*), Acid fermented milks (Yoghurt, Cultured butter milk, Kefir). Cheese production. Alcoholic beverages and alternative energy sources: Commercial production of beer, wines.

### ***Suggested Readings***

- 1) Industrial Biotechnology, L.E.Casida Jr. New Age International Pvt Ltd. Publishers 2005.
- 2) Food Microbiology, W.C.Frazier and D.C.Westhoff . Tata McGraw Hill

Publishing Company Ltd, New Delhi 1998

3) Food Poisoning and Food Hygiene B.C.Hobbs and D. Roberts Edward Arnold (A division of Hodder and Stoughton London) 1993

4) Dairy Microbiology , R.K. Robinson Elsevier Applied Sciences, London.

5) Principles of Fermentation Technology by P.F. Stanbury, A. Whittaker & Hall. Pergamon. McNeil & Harvey Publications. 1990.

6) Concepts in Biotechnology Ed by D. Balasubramanian, C.F.A. Bryce, K. Dharmalingam, J. Green , K. Jayaraman. Universities Press 2004

7) Food Biotechnology Ed by Dietrich Knorr, M Dekker Inc. New York.2005.

## **MMI 014A APPLIED ENVIRONMENTAL MICROBIOLOGY**

**Credits: 04**

Waste management: Treatment of industrial effluents and municipal waste through micro-organisms. Aerobic Processes: Oxidation pools, Rotating Biological Discs, Rotating Drums,

Anaerobic Processes: Anaerobic digestion, Anaerobic filter, upflow anaerobic sludge

blanket reactors. Indicator microorganisms. Solid wastes: Sources and management composting, vermiculture and Methane Production.

Biodegradation of natural compounds (cellulose, hemicelluloses, lignin, chitin,). Biodegradation of xenobiotics in environment – Organisms involved in degradation of chlorinated hydrocarbons, substituted simple aromatic compounds, polyaromatic hydrocarbons, pesticides, synthetic polymers, detergents and hydrocarbons Bioremediation- *ex situ* and *in situ*. bioaccumulation, biomagnifications.

Biodeterioration and Bioleaching: Definition, biodeterioration of paper, wood, paint, textiles, leather, metals (corrosion).Control of biodeterioration. Microorganisms and metal pollutants-metal bioavailability in environment, mechanism of microbial metal resistance and



detoxification, metal- microbe interaction, Bioleaching of metals, Microbial enhanced oil recovery.

Biofertilizers: Definition and types of biofertilizers, Mass cultivation and methods of inoculation of microbial inoculants – (Rhizobium, Azotobacter, & Asospirillum.) Cyanobacteria –Azolla– Anabaena association and its role in rice cultivation Quality control and ISI specifications for Rhizobium cultures. Mycorrhizal Relationship, Biopesticides and Bioplastics

### ***Suggested Readings***

1. Environmental Biotechnology – Basic concepts and applications, Indu Shekhar Thakur, I K International publications. 2006
2. Environmental Microbiology R.M Maier, I.L. Pepper and C.P.Gerba , Academic Press. (2000)
3. Introduction of Environmental Microbiology, Michel. R. 1999
4. Microbial Ecology- Fundamentals & Applications, 4 th Edition, Ronald M. Atlas, Richard Bartha, Pearsrson Publication. 2005.
5. Microbials in Integrated Pest Management, (special Indian edition) edited by Ignacimuthu S, SEN A, Oxford and IBH Publishing Co. Pv. Ltd. 2001
6. Introduction to Biodeterioration (2 nd edition) Allsopp D and Seal K J, Gaylarde C, Cambridge University Press, 2003
7. Biofertilizers in Agriculture, Subba Rao.
8. Introduction to soil microbiology. Alexander, M John, Wiley & Sons. Inc., New York. (1977)
9. Biofertilizers and Biopesticides Deshmukh AM, Technosciences Publications, 1998

## **MMI 015A Medical, Environmental Microbiology and Genetic Engineering Lab**

### **Credits: 12**

1. To enumerate the following in blood sample a. RBC b. WBC
2. To prepare blood smear and determine differential WBC count
3. To detect Antibiotic sensitivity of a given sample by disc method
4. To determine MIC of antibiotics
5. To immobilize cell using alginate
6. To isolate Lactobacillus species from curd.
7. To isolate rhizospheric microflora
8. To determine R : S ratio of soil.
9. To isolate microorganisms from soil, water and air
10. To detect coliforms for determination of the purity of potable water.
11. To determine biological oxygen demand (BOD) of sewage sample.
12. To determine chemical oxygen demand (COD) of sewage sample.
13. To isolate and identify common microorganisms spoiling food (Fungi and bacteria).
14. To prepare fermented foods (Sauerkraut).
15. To test quality of milk by MBRT
16. To isolate and identify Rhizobium from root nodules of leguminous plants.
17. To isolate and identify Azotobacter from soil.
18. To detect ammonification by bacteria.

## **SEMESTER IV**

### **MMI 016A Review Report**

**Credits: 08**

The review report of M.Sc. IV semester will be based on a detailed review of any one of the topics listed in syllabus in about 100 pages. This review will be evaluated by a supervisor, Head of the Department and any other person appointed by the Principal.

### **MMI 017A Dissertation**

**Credits: 18**

The dissertation work will involve practical work on a problem suggested by the supervisor of the candidate. The student will submit the dissertation report at the end of IV semester. This dissertation report will be examined by the supervisor of the student, Head of the Department and any other person appointed by Principal.