

తెలంగాణ విశ్వవిద్యాలయం


M.Sc. Microbiology

**Course Curriculum - Choice Based
Credit System (CBCS)**

TELANGANA UNIVERSITY
Dichpally, Nizamabad
Telangana - 503322

TELANGANA UNIVERSITY
M. Sc MICROBIOLOGY

SEMESTER – I						
Code	Subject	Credits	Teaching Hours	Marks		
				Internal Assessment	Semester Exam	Total
THEORY						
MB 101	General Microbiology & Microbial Physiology (Core)	4	4	30	70	100
MB 102	Virology (Core)	4	4	30	70	100
MB 103	Research Methodology & Techniques (Core)	4	4	30	70	100
MB 104	Microbial Biochemistry (Core)	4	4	30	70	100
PRACTICALS						
MB 151	General Microbiology & Microbial Physiology	2	4			50
MB 152	Virology	2	4			50
MB 153	Research Methodology & Techniques	2	4			50
MB 154	Microbial Biochemistry	2	4			50
	Total	24	32	120	480	600



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SEMESTER – II						
Code	Subject	Credits	Teaching Hours	Marks		
				Internal Assessment	Semester Exam	Total
THEORY						
MB 201	Molecular Biology and Microbial Genetics (Core)	4	4	30	70	100
MB 202	Environmental & Agriculture Microbiology(Core)	4	4	30	70	100
MB 203	Immunology (Core)	4	4	30	70	100
MB 204	Pharmaceutical Microbiology (Core)	4	4	30	70	100
PRACTICALS						
MB 251	Molecular Biology and Microbial Genetics (Core)	2	4			50
MB 252	Environmental & Agriculture Microbiology (Core)	2	4			50
MB 253	Immunology	2	4			50
MB 254	Pharmaceutical Microbiology (Core)					
	Total	24	32	120	480	600



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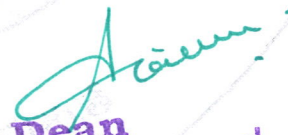

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M. Sc MICROBIOLOGY

SEMESTER – III						
Code	Subject	Credits	Teaching Hours	Marks		
				Internal Assessment	Semester Exam	Total
THEORY						
MB 301	Food Microbial Technology (Core)	4	4	30	70	100
MB 302	Medical Bacteriology (Core)	4	4	30	70	100
MB 303	DSE A. Industrial Microbiology (or) B. Microbial Proteomics	4	4	30	70	100
MB 304	DSE A. Microbial Ecology & Plant Microbe Interactions (or) B. Advances in Biotechnology	4	4	30	70	100
PRACTICALS						
MB 351	Food Microbial Technology (Core)	2	4			50
MB 352	Medical Bacteriology (Core)	2	4			50
MB 353	DSE A. Industrial Microbiology (or) B. Microbial Proteomics	2	4			50
MB 354	DSE A. Microbial Ecology & Plant Microbe Interactions (or) B. Advances in Biotechnology	2	4			
	Total	24	32	120	480	600



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SEMESTER – IV						
Code	Subject	Credits	Teaching Hours	Marks		
				Internal Assessment	Semester Exam	Total
THEORY						
MB 401	Cell & Molecular Biotechnology (Core)	4	4	30	70	100
MB 402	Medical Virology & Parasitology (Core)	4	4	30	70	100
MB 403	GE (IDSE) A. Microbial Biotechnology (or) Bioinformatics and Nanotechnology	4	4	30	70	100
MB 404	DSE A. Applied Microbiology (or) B. Project work	4	4	30	70	100
PRACTICALS						
MB 451	Cell & Molecular Biotechnology	2	4			50
MB 452	Medical Virology & Parasitology	2	4			50
MB 453	A. Microbial Biotechnology (or) B. Bioinformatics and Nanotechnology	2	4			50
MB 405	A. Applied Microbiology (or) B. Project	2	4			
	Total	24	32	120	480	600
	Grand Total		128	480	1920	2400


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Semester-I

Paper I: General Microbiology & Microbial physiology

Unit I:

- 1.1 History, pioneers and scope of Microbiology
- 1.2 Ultra structure of microbial cell- Prokaryotic cell and eukaryotic cell, organization and function of cellular organelles, Bacterial endospore structure, biochemistry and genetics of sporulation
- 1.3 Microscopy- Principle, working and applications of compound microscope, fluorescent microscope, phase contrast microscope and electron microscope
- 1.4 Stains, Different methods of microbial staining.
- 1.5 Specimen preparation for light and electron microscopy.

Unit II:

- 2.1 Methods of sterilization and disinfection- physical and chemical methods.
- 2.2 Microbiological media- Autotrophic media, defined synthetic mineral media, heterotrophic media.
The concept of phototrophs and auxotrophs, phototrophic (minimal media), complex (undefined media)
- 2.3 Cultivation of bacteria, fungi and algae: Routine and special culture methods.
- 2.4 Isolation of pure cultures.
- 2.5 Preservation and maintenance of microbial cultures- Routine methods, liquid nitrogen preservation and lyophilization

Unit III:


- 3.1 Identification and classification of bacteria
- 3.2 Microscopic identification characteristics, ecological methods of identification, nutritional identification characters, biochemical methods of identification, immunological characteristics, molecular and genetic characteristics identification (16S r-RNA)
- 3.3 Principles of bacterial taxonomy and classification- Numerical taxonomy, Bergey's Manual and its importance, general properties of bacterial groups
- 3.4 Microbial nutrition and metabolism: Autotrophy- photoautotrophy and bacterial photosynthesis, chemoautotrophy and heterotrophic metabolism

Unit IV:

- 4.1 Microbial growth- Concept of growth, kinetics of microbial growth, microbial cell cycle and generation time
- 4.2 Bacterial growth curve and its phases.
- 4.3 Physical and chemical factors that affect the microbial growth.
- 4.4 Methods of bacterial growth measurement.
- 4.5 Synchronous cultures- Methods of synchronous and continuous culture methods.



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Semester-I
Practical Paper I: General Microbiology & Microbial physiology

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

Recommended books:

1. Microbiology by Pelczar M.J., Ried, RD and Chan, ECS.
2. Microbiology by Gerard J. Tortora, Berdell Ra. Funke and Christine L. Case. Publ: Pearson Education Inc.
3. Text book of Microbiology by M. Burrows
4. General Microbiology by Stainier, Deudroff and Adelberg
5. Review of medical microbiology by Jawitz, melnick and Adelberg
6. Bacterial and Mycotic infections of man. Ed. Dubos and Hirst Lipincott
7. Principles of Microbiology and Immunology by Davis, Dulbecco , Eison, Ginsberg and Wood.
8. Structure and Reproduction of Algae, Vol. I & II by Fritsch, F.E.
9. Introduction to Algae by Morris, I.
10. Products and Properties of Algae by Zizac.
11. Fresh water algae of the United States by Smith, GM.
12. Introductory Mycology, by Alexopolus, C.J.
13. Dispersal in Fungi by Ingold, CT
14. Microbial Physiology by Moat,
15. Laboratory Experiments in Microbiology by Gopal Reddy et al
16. Microbes in Action by Seoley HW and Van-Demark, PJ
17. Brock's Biology of microorganisms by Madigan, MT et al



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Semester-I
Paper II: Virology

Unit I:

- 1.1 History of virology, Viral nomenclature and classification (Baltimore and ICTV system of classification).
- 1.2 Viral structure and morphology.
- 1.3 Detection of viruses- Physical, biological, immunological, serological and molecular methods .
- 1.4 Propagation, isolation, purification, characterization, identification and quantification of bacteriophages, plant and animal viruses.
- 1.5 Sub-viral particles- Discovery, structure, replication and diseases caused by satellite virus, viroids, and prions, role of cyanophages, actinophages and mycophages.
- 1.6 Evolutionary importance of viruses, Metagenomics for virus characterization, RNA DNA hybrid virus

Unit II:

- 2.1 Virus replication strategies: Principle events involved replication- adsorption, penetration, uncoating nucleic acid and protein synthesis, intracellular trafficking, assembly, maturation and release.
- 2.2 Viral-host interaction, host response to viral infection, cellular interactions-clathrin coated pits, lipid rafts, endocytosis and virus uncoating mechanisms
- 2.3 Comparison of life cycle of viruses- lytic and lysogeny (T2 Bacteriophage and lambda phage)
- 2.4 Morphology, ultrastructure, genome organization and replication strategies of Group I- Adenovirus, Group II- Banana bunchy top virus, Group III- TMV, Group IV- Reovirus, Group V- Influenza, Group VI- HIV, Group VII- HBV.

Unit III:

- 3.1 Recombination in phages, multiplicity reactivation and phenotypic mixing.
- 3.2 General account of tumour viruses (RNA and DNA).
- 3.3 Viral interference and interferons, nature, source, classification and induction of interferons.
- 3.4 Antiviral agents(chemical and biological) and their mode of action.

Unit IV:

- 4.1 Introduction to viral vaccines, preparation of vaccines.
- 4.2 Viruses as vectors, vectors used for cloning and sequencing- λ phage, M-13, retroviruses, CaMV 35S promoter and its application
- 4.3 Baculovirus system for insect cell lines and its importance.
- 4.4 Silver lining: Viruses as therapeutic agents, viruses for gene delivery, viruses to destroy other viruses.
- 4.5 Importance of studying modern virology.



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Semester-I
Practical Paper II: Virology

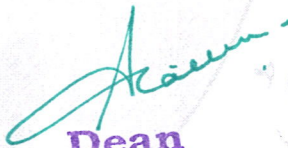
1. Isolation of phage from different soil samples using laboratory bacterial cultures (*Staphylococcus, Bacillus*)
2. Isolation of phage from sewage using *Pseudomonas* and *E. coli* as host.
3. Cultivation and preservation of phages.
4. Quantification of phages
5. Growth phages of phage and burst size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

Recommended Books:

1. Recent publications: Research papers and review articles
2. General Virology by Luria and Darnel
3. Virology and Immunology by Jokli
4. Text book of Virology by Rhodes and Van Royen
5. Plant Virology by Smith
6. Genetics of bacteria and their viruses by W. Hayes
7. Molecular Biology of the gene by Watson, Roberts, Staitz and Weiner
8. A laboratory guide in virology by Chjarles H. Lunningham
9. Basic lab procedures in diagnostic virology by Marty Cristensen
10. Review of medical microbiology by Jawitz et al
11. Medical laboratory manual for tropical countries Vol I & II by Monica Cheesbrough
12. Text Book of Microbiology by Ananthanarayanan and Jayaram Paniker
13. Viral and Rickettsial infections of Man by Horsfall and Jam
14. Text book of Virology by Rhodes and Van Royan
15. Virological Procedures by Mitchal hasking
16. Virology by Wilson and Topley



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Semester- I
Paper III: Research Methodology and Techniques

Unit I:

- 1.1 Principle and applications of calorimetry and spectrophotometry, fluorimetry.
- 1.2 NMR and ESR spectroscopy.
- 1.3 Types of mass spectrometry.
- 1.4 Optical rotation and circular dichroism, X-ray diffraction.
- 1.5 Principle and application of electrophoresis- Agarose and SDS-PAGE electrophoresis.

Unit II:

- 2.1 Chromatography techniques- paper, thin layer, ion exchange, gel filtration and affinity chromatography.
- 2.2 Diffusion and dialysis.
- 2.3 Centrifugation techniques, cell free extracts and their use in metabolic studies.
- 2.4 Radio isotopes- detection and measurements of radioactivity, Scintillation counter, stable isotopes and their use, safety precautions, Autoradiography.
- 2.5 General method of study of intermediary metabolism in microbes, use of mutants in study of metabolism.

Unit III:

- 3.1 Variables, population, sample, sampling methods, frequency distribution
- 3.2 Measures of central tendency and dispersion
- 3.3 Concept of probability, laws of probability, normal distribution, binomial distribution and poisson distribution, t-distribution, f-distribution, correlation and linear regression
- 3.4 Chi-square test, 't' test, 'F' test, ANOVA, analysis of covariance.
- 3.5 DMRT and its uses in biological experiments, experimental designs using statistical tools.

Unit IV:

- 4.1 Introduction to computers.
- 4.2 Introduction to disk operating systems (DOS): Sample commands, DIR-CD-RD-DELCOPY-MOVE-REN-TYPE -EDIT (Editor) CE-DATE and TIME.
- 4.3 Introduction to windows: Word Processing; Electronic Spread Sheet.
- 4.4 Data collection, Data representation, Manuscript preparation, Plagiarism, Research ethics, QA, QC, GLP, GMP, Patents and IPR



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Semester: I
Practical Paper III: Research Methodology and Techniques

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

Recommended book:

1. Biochemistry by Lehninger
2. Outlines of Biochemistry by Cohn and Stumph
3. Biological Chemistry by Mullar and Cards
4. Biochemistry by White, Handler and Smith
5. Methods in Enzymology series
6. The Cell – Bratch and Mirsky series
7. Laboratory experiments in Microbiology by Gopal Reddy et al
8. Biochemistry lab manual by Jayaraman
9. Introduction to the theory of statistics by Alexander, M Mood and Franklin
10. Fundamentals of Biometry by L.N.Balam
11. Statistical methods by Snedecor and Cochran
12. Introduction to computer and its application by Chae C.Chien
13. Basic Programming language by Bajaraman
14. Biostatistics – A manual of statistical methods for use in Health, Nutrition and Anthropology by K. Vishveshwar Rao



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Semester- I
Paper IV: Microbial Biochemistry

Unit I:

- 1.1 PH and its biological relevance, determination of PH
- 1.2 Different types of buffers, Preparation of buffers
- 1.3 Concept of entropy, free energy changes, high energy compounds
- 1.4 Equilibrium constants, redox potentials, biological redox systems
- 1.5 Biological oxidation, Biological membranes
- 1.6 Electron transport and oxidative phosphorylation

Unit II:

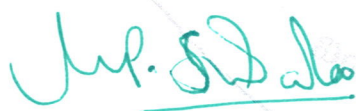
- 2.1 Carbohydrates: Classification, cyclic structures and stereoisomerism of monosaccharides, anomers and epimers, sugar derivatives-deoxy sugars, amino sugars and sugar acids
- 2.2 Lipids: classification, structure and function of bacterial lipids and prostaglandins, Major steroids of biological origin
- 2.3 Nucleic acids: Chemical structure- nitrogen bases, sugars, nucleosides and nucleotides
- 2.4 Metabolism of purines and pyrimidines- biosynthesis and degradation

Unit III:

- 3.1 Proteins: structure and properties of amino acids
- 3.2 Conformation and properties of proteins
- 3.3 An overview of biosynthesis and degradation of amino acids
- 3.3 Enzymes: Nomenclature and classification
- 3.4 Methods for determination of enzyme activity
- 3.5 Isolation and purification of enzymes
- 3.6 Kinetics of enzymes, Factors effecting the enzyme activity

Unit IV:

- 4.1 Mechanism of enzyme action- action of hydrolases, oxidases and reductases
- 4.2 Coenzyme catalysis (pyridoxal phosphate and thymine pyrophosphate), isoenzymes
- 4.3 Enzyme inhibition- competitive and uncompetitive
- 4.4 Methods for increased enzyme production and activity, enzyme engineering
- 4.5 Regulation of enzyme activity- allosteric enzymes and feedback mechanisms
- 4.6 Metabolic compartmentalization of enzymes, enzymes and secondary metabolites



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Semester-I
Practical Paper IV: Microbial Biochemistry

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

Recommended Books:

1. Biochemistry by Lehninger
2. Outlines of Biochemistry by Cohn and Stumph
3. Biochemistry of Nucleic acids by Davidson
4. Biological Chemistry by Mullar and Cards
5. Biochemistry by White, Handler and Smith
6. Methods in Enzymology series
7. The Cell – Bratch amd Mirsky series
8. Biochemistry lab manual by Jayaraman


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Semester-II
Paper I: Molecular Biology and Microbial Genetics

Unit I:

- 1.1 Double helical structure of DNA, forms of DNA-A, B and Z, denaturation and melting curves of DNA
- 1.2 Genome organization in prokaryotes and eukaryotes
- 1.3 Models of DNA replication, enzymes involved in replication and mechanism of semiconservative mechanism of DNA replication
- 1.4 Plasmids: nature, classification, properties and replication
- 1.5 Eukaryotic telomere and its replication

Unit II:

- 2.1 Structure and processing of m-RNA, r-RNA, t-RNA, ribozyme
- 2.2 Prokaryotic and eukaryotic transcription
- 2.3 Features of genetic code and wobble hypothesis
- 2.4 Translation in prokaryotes and eukaryotes, post translational modifications
- 2.5 Gene regulation and expression of lac operon, arabinose and tryptophan operons
- 2.6 Gene regulation in eukaryotes-promoters and enhancers, repetitive DNA, gene rearrangements

Unit III:

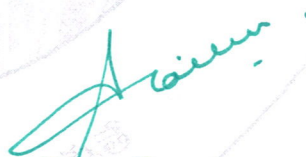
- 3.1 Types of mutations, molecular mechanisms of mutagenesis
- 3.2 Physical and chemical mutagenic agents
- 3.3 Detection and analysis of mutations (Replica plating, antibiotic enrichment, Ames test)
- 3.4 DNA damage and repair mechanisms, global response to DNA damage
- 3.5 Transposable elements- Types of bacterial transposons and their applications

Unit IV:

- 4.1 Bacterial recombinations- Discovery, gene transfer, molecular mechanism, detection, efficiency calculation and applications
- 4.2 Bacterial transformation, competency and resistance
- 4.3 Bacterial conjugation, sex factor in bacteria, F and HFR transfer, linkage mapping
- 4.4 Phenomenon and methods of bacterial transduction, co-transduction
- 4.5 Generalized and specialized and abortive transduction, sex-ductions



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Semester- II
Practical Paper I: Molecular Biology and Microbial Genetics

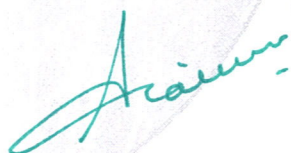
1. Isolation of genomic DNA from E. coli and Yeast.
2. Estimation of DNA and RNA (colorimetry)
3. Determination of molecular weight of DNA, resolved on agarose gel electrophoresis
4. Induction of Lac operon
5. Induction of mutations by physical/chemical mutagens, screening and isolation of mutants, Replica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

Recommended books:

1. Molecular biology by Robert Weaver
2. Molecular Biology By Upadhyay and Upadhyay
3. Molecular biology by David and Freifelder
4. Microbial genetics by David and Freifelder
5. molecular biology malacinski
6. Molecular biology of the gene by Watson et al
7. The Lehninger Biochemistry
8. Molecular biotechnology by Primrose
9. Molecular Biotechnology by Bernard R. Glick and Jack J Pasternak
10. Molecular Genetics of Bacteria by Larry Snyder and Wendy Champness



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Semester- II
Paper-II: Environmental and Agricultural Microbiology

Unit I:

- 1.1 Microorganisms in air and their importance
- 1.2 Microorganisms and water pollution, Water-borne pathogenic microorganism and their transmission
- 1.3 Sanitary quality of water
- 1.4 Water pollution due to degradation of organic matter
- 1.5 Aerobic sewage treatment- oxidation ponds, trickling filters, activated sludge treatment, anaerobic sludge treatment-septic tank

Unit II:

- 2.1 Soil properties (physical, chemical and biological)
- 2.2 Soil microorganisms, methods of enumeration and activity of microbes in environment/soil
- 2.3 Microbes and plant interactions-Rhizosphere, Phyllosphere and mycorrhizae
- 2.4 Strategies for bioremediation technologies
- 2.5 Microbial degradation of organic pollutants with a special emphasis on pesticides like DDT and 2,4-D

Unit III:

- 3.1 Degradation of carbonaceous material in soil- cellulose, hemicellulose and lignin decomposition
- 3.2 Factors governing the decomposition and biochemistry of decomposition, soil humus formation
- 3.3 Ammonification, nitrification, microbes involved, factors influencing nitrification, nitrifying bacteria and biochemical mechanism
- 3.4 Denitrification, microbes involved and factors influencing and the mechanism of denitrification
- 3.5 Nitrate pollution

Unit IV:

- 4.1 Nitrogen fixation-symbiotic and asymbiotic nitrogen fixation
- 4.2 Microorganisms involved, biochemistry and genetics of nitrogen fixation
- 4.3 Measurement of nitrogen fixation
- 4.4 Ecological and economical importance of nitrogen fixation
- 4.5 Biofertilizers- bacterial fertilizers and production of rhizobial inoculants and blue green algae, quality control tests



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Semester- II
Practical Paper II: Environmental and Agricultural Microbiology

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

Recommended Books:

1. Recent Published papers on advances in relevant area to be referred
2. Soil Microbiology by Alexander Martin
3. Microbial ecology, Fundamentals and Applications Ed. Benjamin-Cummings
4. Environmental Biotechnology-Fundamentals and applications. By Parihar (Agrobios india – publishers)
5. Soil Microbiology by Singh, Purohit, Parihar published by student edition.
6. Soil Biotechnology by JM Lynch
7. Microbial Ecology: Organisms, Habitats, and Activities by Stolp, H.
8. Soil Microbiology and Biochemistry by Paul E. and PE Clank
9. Microbial Ecology: Principles, Methods and Applications by Lavin, Seidler, Rogul
10. Biological Nitrogen Fixation by Quispel
11. Soil Microorganisms and Plant Growth by N.S, Subba Rao.
12. Laboratory experiments in microbiology by Gopal Reddy et al
13. Experiments in Microbiology, Plant pathology, Tissue culture and Mushroom production technology by K R Aneja
14. Biofertilizers for sustainable Agriculture by Arun K. Sharma
15. Environmental Microbiology by K. Vijaya Ramesh (MJP Publishers)
16. Brock Biology of Microorganisms by Madigan et al
17. Waste water microbiology by Bitton, G.
18. Waste water treatment – Biological and chemical process by Henze, M.
19. Biodegradation and Bioremediation second edition by Martin Alexander (Academic Press 2001)
20. Bioremediation - Principles and Applications by Ronald L Crawford and Don L Crawford , Cambridge University Press
21. J.M. Helawell - Biological indicators of freshwater pollution and environmental management.
22. Elsevier Applied Science Publishers, London. (1986). 546p
23. F. Mason - Biology of freshwater pollution. Third edit. Longman Group (1996). 356p


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Semester-II
Paper III: Immunology

Unit I

- 1.1 History of immunology. Hematopoiesis, Cell lineage, components of immune system, cells and organs of immune system
- 1.1 Antigen – Nature, properties and types. Haptens, Adjuvants and super antigens
- 1.3 Antibody -Structure, functions and classification. Isotypes, allotypes and idiotypes. Immunoglobulin genes. Generation of antibody diversity. Clonal nature of the immune response – clonal selection theory.
- 1.4 Generation of T cell receptor diversity by genomic rearrangement Antigen
- 1.5 Structure of B and T cell receptors

Unit II:

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


Unit III:

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

Unit IV:

- 4.1 Types of conventional vaccines and principles of Immunization.
- 4.2 Modern vaccines; peptide, DNA, recombinant / vector, and anti-idiotypic vaccines Schedules of common vaccination, Benefits and adverse consequences of vaccination.
- 4.3 Production of polyclonal antibodies; Animals models for production of antibodies Hybridoma techniques and monoclonal antibody production. Applications of monoclonals in biomedical research, clinical diagnosis and treatment, Chimeric Antibodies.
- 4.4 Immunosuppression and its mechanism of action.
- 4.5 Immune evasion by bacteria and viruses.
- 4.6 Tumour immunology. Immuno diagnosis and immune therapy of cancer





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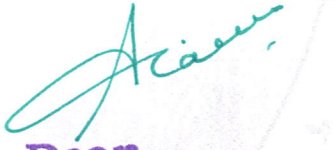
Semester- II
Practical Paper III: Immunology

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

Recommended Books:

1. Kuby Immunology
2. Cellular and molecular immunology by Abul K. Abbas et al
3. Test book of Immunology by Barret
4. Immunology – The science of self-non self discrimination by Jan Klein
5. Essential Immunology by Roitt, IM
6. Immunology by Tizard
7. The elements of Immunology by Fahim Halim Khan
8. Immunology and immunopathology by Stewart Sell


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Semester-II
Paper IV: Pharmaceutical Microbiology

Unit I:

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

Unit II:

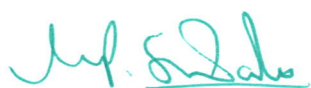
- 1.1 History of chemotherapy – plants and arsenicals as therapeutics, Paul Ehrlich and his contributions, selective toxicity and target sites of drug action in microbes.
- 1.2 Development of synthetic drugs – Sulphanamides, antitubercular compounds, nitrofurons, nalidixic acid, metronidazole group of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

Unit III:

- 3.1 Principles of chemotherapy – Clinical and lab diagnosis, sensitivity testing, choice of drug, dosage, route of administration, combined/mixed multi drug therapy, control of antibiotic/drug usage.
- 3.2 Mode of action of important drugs – Cell wall inhibitors (Beta lactam – eg. Penicillin)
- 3.3 Membrane inhibitors (polymyxins)
- 3.4 Macromolecular synthesis inhibitors (streptomycin), antifungal antibiotics (nystatin)

Unit IV:

- 4.1 The drug resistance – The phenomenon, clinical basis of drug resistance, biochemistry of drug resistance, genetics of drug resistance in bacteria.
- 4.2 Microbiological assays: Assays for growth promoting substances, nutritional mutants and their importance, vitamin assay, amino acid assay
- 4.3 Assay for growth inhibiting substances – Assay for non-medicinal antimicrobials (Phenol coefficient/RWC)
- 4.4 Drug sensitivity testing methods and their importance. Assay for antibiotics –Determination of MIC, the liquid tube assay, solid agar tube assay, agar plate assay (disc diffusion, agar well and cylinders cup method).
- 4.5 Introduction to pharmacokinetics and pharmacogenomics.



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Semester- II
Practical Paper IV: Pharmaceutical Microbiology

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

Recommended Books:

1. Disinfection, sterilization and preservation. Block, S.S. (ed). Lea and Febigor, Baltimore
2. Pharmaceutical Microbiology. Hüge, W.B. and Russel, AD. Blackwell Scientific, Oxford
3. Principles and methods of sterilization in health sciences. Perkins, JK. Pub: Charles C. Thomos, Springfield.
4. Compendium of methods for the microbiological examination of foods. Vanderzant, C. and Splittstoesser, D. Pub: American Public Health Association, Washington, D.C.
5. Disinfectants: Their use and evaluation of effectiveness. Collins, CH., Allwood, MC., Bloomfield, SF. And Fox, A. (eds). Pub: Academic Press, New York
6. Inhibition and destruction of microbial cell by Hugo, WB. (ed). Pub: Academic Press, NY
7. Manual of Clinical Microbiology. Lennette, EH. (ed). Pub: American Society for Microbiology, Washington.
8. Principles and Practices of disinfection. Russell, AP., Hugo, WB., and Ayliffe, GAJ. (eds). Publ. Blackwell Sci.
9. Biochemistry of antimicrobial action. Franklin, DJ. and Snow, GA. Pub: Chapman & Hall.
10. Antibiotics and Chemotherapy. Garrod, L.P., Lambert, HP. And C'Grady, F. (eds). Publ: Churchill Livingstone.
11. Antibiotics. Lancini, G. and Parenti, F. publ: Springer-Verlag.
12. The Molecular Basis of antibiotic action. Ga.e, EF. Et al. Publ: Wiley, New York.
13. Antimicrobial Drug action. Williams, RAD., Lambart, PA. & Singleton, P. Pub: Bios Sci.
14. Microbiological Assays. Hewitt.
15. Antiviral Drugs. Kargor, S.
16. Burger's Medicinal chemistry Vol. I – III. Ed. Nanfield E. World.
17. The control of antibiotic resistant bacteria. Stuart, Harris and Harris.
18. Indian Pharmacopea; United States Pharmacopea; British Pharmacopea


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SEMESTER-III
Paper I: Food Microbial Technology

Unit I:

- 1.1 Introduction to fermented foods; Health aspects of fermented foods; Fermented vegetables;
- 1.2 Processing and fermentation of Sauerkraut and pickles; Cereal and legume based fermented products-bread, Soya Sauce, Tempeh; Microbiology of bread and idly;
- 1.3 Production and significance of Silage;
- 1.4 Mushrooms – production and cultivation of different types

Unit II:

- 2.1 Dairy Microbiology - Types of microorganisms in milk, significance of microorganisms in milk,
- 2.2 Microbial products of milk- Acidophilus Milk, Bifidus Milk, Bulgarian milk, Kefir, Kumiss,
- 2.3 Microbiology of cheese, butter, yogurt
- 2.4 Microbiological examination of milk, control of microbial flora of milk;
- 2.5 Probiotics and Prebiotics: Properties and beneficial effects of probiotics and prebiotics
- 2.6 Screening methods of Probiotics; Genetically Modified Probiotics

Unit III:

- 3.1 Spoilage of foods and factors governing the spoilage
- 3.2 Microbial Food poisoning, risks and hazards
- 3.3 Mycotoxins: Groups of mycotoxins, effects on human and animal health
- 3.4 Detoxification Methods (Physical, Chemical and biological) and Mechanism of toxicity
- 3.5 Food preservation methods and food safety issues

Unit IV:

- 4.1 Food Quality: Importance and functions of quality control
- 4.2 Methods of quality assessment of foods-Sampling, qualitative and quantitative microbiological analysis
- 4.3 Bacteriological examination of fresh and canned foods
- 4.4 Screening and enumeration of spoilage microorganisms.
- 4.5 Detection of pathogens in food





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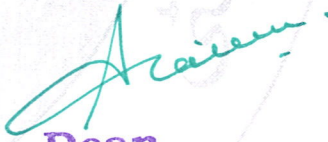
Semester- III
Practical Paper I: Food Microbial Technology

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

Recommended books:

1. Food Microbiology by Frazier
2. Biotechnology: Food Fermentation : Microbiology, Biochemistry, and Technology by VK Joshi and Ashok Pandey
3. Bibek Ray and Arun Bhunia (2008) Fundamental Food Microbiology 4th Ed. CRC Press.
4. Adams M R and Moss M O (2008) Food Microbiology 3rd Ed. RSC Publishing.
5. Microbial Ecology – A conceptual approach by Lynch and Poole
6. Basic food microbiology (Abridged edition) by George J. Banwart
7. Brock's Biology of Microorganisms by Madigan et al
8. Probiotics 3 by R. Fuller, G. Perdigon (Kluwer Academic Publishers)
9. Probiotics and Prebiotics: Scientific Aspects by Gerald W. Tannock University of Otago, Dunedin, New Zealand (Caister Academic Press)
10. Biotoxicology by Kamal narayan and Vohra. Laboratory experiments in microbiology by Gopal Reddy et al
11. Food Quality Assurance: Principles and Practices by Inteaz Alli (CRC Press)
12. Foodborne Pathogens and Food Safety by Md. Latiful Bari, Dike O. Ukuku (CRC Press)
13. Recent Published papers on advances in relevant area to be referred


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Semester-III
Paper II: Medical Bacteriology

Unit I:

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

Unit II:

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

Unit III:

- 3.1 Systematic bacteriology – Detailed study of morphology, cultural characteristics, antigenic structure, pathogenesis, diagnostic lab tests (conventional and molecular), epidemiology, prevention and treatment of the following bacterial pathogens.
Bacterial air borne infections – B-Haemolytic streptococci, Pneumococci, *Corynebacterium diphtheriae*, *Mycobacterium tuberculosis*, *Mycobacterium leprae*, *Neisseria meningitidis*, *Haemophilus influenzae*.
Sexually transmitted diseases caused by bacteria, *Treponema pallidum*, *Neisseria gonorrhoea*

Unit IV:

- 4.1 Systematic bacteriology – Detailed study of morphology, cultural characteristics, antigenic structure, pathogenesis, diagnostic lab tests (conventional and molecular), epidemiology, prevention and treatment of the following pathogenic bacteria:
Water borne infections – *E.coli*, *Salmonella typhi*, *Shigella dysenteriae*, *Vibrio cholerae*.
Wound infections – *Staphylococcus aureus* & MRSA, *Clostridium tetani*, *Clostridium welchi*, *Pseudomonas*



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Semester-III
Practical Paper II: Medical Microbiology

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

Recommended Books:

1. Review of Medical Microbiology by Jawitz, Melnick and Adelberg
2. Diagnostic Microbiology by Bailey and Scott
3. Medical Microbiology by Cruickshank et al Vol I & II
4. Text book of Microbiology by Ananthanarayanan and Jayaram Paniker

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Semester-III
Paper III: Industrial Microbiology

Unit I:

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

Unit II:

- 2.1 Inoculum media, inoculum preparation
- 2.2 Raw materials Saccharides, starchy and cellulosic materials
- 2.3 Fermentation media and sterilization.
- 2.4 Types of fermentations processes – Solid state, surface and submerged fermentations

Unit III:

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

Unit IV:

- 4.1 Strain development strategies. Environmental factors and genetic factors for improvement.
- 4.2 Immobilization methods – Absorption, covalent linkage, entrapment and cross linkage, types of carriers, advantage and disadvantages



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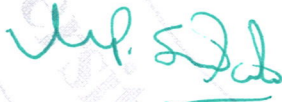
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Semester-III
Practical Paper II: Industrial Microbiology

1. Screening for amylase producing organisms
2. Screening for organic acid producing microorganisms
3. Isolation of antibiotic producing microorganisms by crowded plate technique
4. Isolation and culturing of yeasts
5. Separation of amino acids by chromatography
6. Estimation of glucose by DNS method
7. Estimation of ethanol by dichromate method
8. Estimation of maltose
9. Immobilization of microbial cells by entrapment method

Recommended Books:

1. Industrial Microbiology by Casida, LE
2. Industrial Microbiology by Patel, AH
3. Industrial Microbiology by Miller, BM and Litsky
4. Industrial Microbiology by Prescott and Dunn
5. Microbial Technology by Pepler, JH and Perlman, D.
6. Biochemistry of Industrial Microorganisms, by Rainbow and Rose
7. Economic Microbiology by Rose Vol I – V
8. Microbial Enzymes and Biotechnology by Fogarty WM and Kelly, CT
9. Comprehensive Biotechnology, All volumes Ed. Murray Moo-Yong
10. Biotechnology (A text book of industrial Microbiology) Ed. Cruger & Cruger
11. Advances in Applied Microbiology Ed. Perlman Series of volumes


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Semester-III
Practical Paper III: Microbial Proteomics

Unit I:

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

Unit II:


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

Unit III:

- 3.1 Microbial pathogenesis at the proteome level
- 3.2 Proteomics of *Saccharomyces cerevisiae*-cell wall & transport, differential expression in stress
- 3.3 Proteomics of probiotic lactobacilli-intestinal epithelial cells interactions
- 3.4 Lantibiotics and Immunomodulators
- 3.5 Proteomic Identification of *Mycobacterium tuberculosis*

Unit IV:

- 4.1 Protein-Protein interaction, Protein-DNA interactions
- 4.2 Yeast two hybrid system
- 4.3 Protein microarrays- Protein Markers, Clinical Proteomics, Small peptides
- 4.5 Personalized medicine
- 4.5 Protein engineering, Drug design. Proteomic strategies in Cancer, Prions


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Semester- III
Practical Paper III: Microbial Proteomics

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

Reference Books:

1. Principles of Protein structure, Schultz, G. E., and Schirmer, R. H. Dr. Shakti Sahi
2. Proteomics, Daniel C. Leibler
3. Microbial Proteomic, Marjo Poutanen
4. Proteins: Structures and Molecular Principles (2d ed.), TE Creighton
5. Organic spectroscopy, William Kemp
6. Proteome Research: Two-Dimensional Gel Electrophoresis and Detection Methods (Principles and Practice), T. Rabilloud (Editor), 2000, Springer Verlag
7. Introduction to Protein Architecture: The Structural Biology of Proteins, M.Lesk, 2001, Oxford University Pres
8. PGPR: biocontrol and biofertilization by Zaki A. Siddiqui
9. Plant-bacteria interactions: strategies and techniques to promote plant growth by Iqbal Ahmad, John Pichtel, S. Hayat
10. 10.Plant Growth and Health Promoting Bacteria by Dinesh K. Maheshwari
11. Microbes For Sustainable Agriculture by K.V.B.R. Tilak, K.K. Pal, Rinku Dey
12. Biochemical and genetic mechanisms used by plant growth-promoting bacteria by Bernard R.Glick
13. Plant-microbe interactions, Volume 1 by Gary Stacey and Noel T. Keen
14. Biological control of crop diseases Volume 89 of Books in soils, plants, and the environment by S.S. Gnanamanickam
15. Plant-microbe interactions and biological control Volume 63 of Books in soils, plants, and the environment by Greg J. Boland, L. David Kuykendall
16. New Perspectives and Approaches in Plant Growth-Promoting Rhizobacteria Research by Philippe Lemanceau, Peter Bakker & Jos Raajmakers


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Semester-III
Paper IV: Microbial Ecology and Plant Microbe Interactions

Unit I:

- 1.1 Microbial ecology: Concept of habitat and niche.
- 1.2 Concept of population and community.
- 1.3 Development of microbial communities. Microbial growth curve representing r and k reproductive strategies.
- 1.4 Planktonic growth and Biofilm formation. Concept of plant probiotics (Seed endophytes and plant endophytes).

Unit II:

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

Unit-III:

- 3.1 Plant-microbe beneficial interactions: Pseudomonas-Plant Interaction and Bacillus Plant Interactions and Trichoderma-Plant Interactions.
- 3.2 Role of biotic and abiotic factors in plant- microbe interactions. Molecular plant microbe interactions:
- 3.3 Impact of root-beneficial microbe interactions on aboveground plant phenotypic plasticity.
- 3.4 Two-component signal transduction system (Gac S and Gac A) in plant growth promoting bacteria

Unit-IV:

- 4.1 Cell signaling and Quorum sensing in Gram negative bacteria, acylated homoserine lactones (AHLs), Gram positive bacteria (peptides), yeast (Farnesols), Fungi (Oxylipins).
- 4.2 Intra and inter species communication, Inter-kingdom signaling.
- 4.3 Host- pathogen interactions.
- 4.4 Basic concept of plant immunity (MAMPs, PAMPs).
- 4.5 Plant defense mechanisms (induced systemic resistance (ISR); systemic acquired resistance (SAR).



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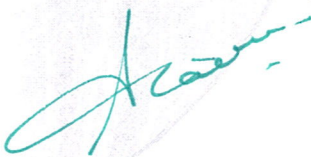
Semester-III
Practical Paper IV: Microbial Ecology and Plant Microbe Interactions

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

Reference Books:

1. PGPR: biocontrol and biofertilization by Zaki A. Siddiqui
2. Plant-bacteria interactions: strategies and techniques to promote plant growth by Iqbal Ahmad,
3. John Pichtel, S. Hayat
4. Biochemical and genetic mechanisms used by plant growth-promoting bacteria by Bernard R. Glick
5. Plant-microbe interactions, Volume 1 by Gary Stacey and Noel T. Keen
6. Biological control of crop diseases Volume 89 of Books in soils, plants, and the environment by S.
7. S. Gnanamanickam
8. Plant-microbe interactions and biological control Volume 63 of Books in soils, plants, and the
9. environment by Greg J. Boland, L. David Kuykendall
10. New Perspectives and Approaches in Plant Growth-Promoting Rhizobacteria Research by
11. Philippe Lemanceau, Peter Bakker.


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Semester-III
Paper IV: Advances in Biotechnology

Unit-I:

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

Unit-II:

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

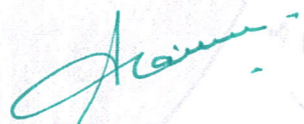
Unit-III:

- 3.1 Introduction to nanoparticles/nanotechnology, Properties of nanomaterials.
- 3.2 Synthesis of nanostructures - physical, chemical and biological, microbiological methods.
- 3.3 Biomolecules as nanostructures.

Unit-IV:

- 4.1 Gene therapy-concept, vectors, gene targeting and tissue-specific expression, Antisense Technology
- 4.2 Introduction to Pharmacogenetics and toxicogenomics
- 4.3 Genetic counselling, Social- genetic discrimination: insurance and employment, human cloning, foeticide, Sex determination,
- 4.4 Tissue Engineering, Methods of Synthesis, Biomolecular Engineering


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Semester-III
Practical Paper IV: Advances in Biotechnology

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

Reference Books:

1. The genetic manipulation of plants,2005,A.Slater ,N.Scott & M.Fowler, Oxford Univ Press, Oxford.
2. Introduction to Plant Biotechnology(3rd Edtn), H.S. Chawla
3. Roberta Smith, Plant Tissue Culture: Techniques and Experiments,2nd Edtn, Academic Press,2000
4. H.K.Das Textbook of Biotechnology,Wiley India,2004
5. J.H.Hammond, P.Mcgarvey, and V.Yusibov(eds), Plant Biotechnolgy, Springer Verlag,Heidelberg,2000
6. B.B.Buchanan, W.Gruissen and R.L.Jones(eds), Biochemistry and Molecular Biology of
7. Plants,American Society of Plant Biology,Rockville,USA,2000.
8. Plant Biotechnology and Agriculture: Prospects for the 21st Century, Arie altman ,Paul
9. Michael Hasegawa.
10. 8.Plant Biotechnology and Genetics:Principles, Techniques & Applications, Stewart, C.Neal, June 2008,John
11. Wiley & Sons
12. Animal Cell Culture by Ian Freshney
13. Basic Cell Culture. Ed.J.M.Davis 2nd.Ed 2007. Oxford press
14. Animal Cell Culture Sudha Gangal
15. Principles of biotechnology and applications-Glick and Pasternack
16. Nanobiotechnology by David Goodsell. John Wiley
17. Handbook of Nanostructured biomaterials and their applications in nanobiotechnology by Nalwa HS 2005.
18. American scientific publishers
19. Nanobiotechnology by Niemeyer CM & Mirkin CA 2005 .Wiley Interscience
20. Jogdand S. N., Medical Biotechnology, Himalaya Publishing House, Mumbai, (2008)
21. Judit Pongracz, Mary Keen, Medical Biotechnology, Churchill Livingstone, Elsevier (2009)
22. Pratibha Nallari & V. Venugopal Rao, Medical Biotechnology, Oxford University Press,
23. India (2010)
24. U. Satyanarayana. Biotechnology



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Semester-IV
Paper I: Cell and Molecular Biotechnology

Unit I:

- 1.1 Cell cycle: Cell division regulation and cancer. Role of protein Kinases in cell cycle. Programmed cell death. Geno toxicity assays.
- 1.2 Signal transduction: G- Protein linked receptors. Concept of second messenger, cAMP & cGMP.
- 1.3 Steroid/peptide hormone regulation, tissue specific regulation.
- 1.4 Protein folding and the roles of Molecular chaperones.

Unit II:


- 2.1 DNA modifying enzymes-Restriction endonucleases, Ligases, Kinases, Phosphatases
- 2.2 Vector for gene cloning-Plasmid vectors, Phage vectors, Cosmids, Phagemids, Phasmids, Yeast vectors
- 2.3 Construction of Genomic and c-DNA libraries
- 2.4 Cloning Techniques: cloning in *E-coli*, Cloning in *Bacillus subtilis*, Cloning in Yeast promoters, cloning strategy
- 2.5 Transformation, Identification of recombinant clones
- 2.6 Expression and detection of cloned genes.
- 2.7 DNA and Protein sequencing


Unit III:

- 3.1 Molecular techniques: Analysis of Protein-protein and protein-DNA interactions
- 3.2 Biochips (DNA chips and Protein chips)
- 3.3 Polymerase chain reaction and Quantitative real time PCR
- 3.4 DNA fingerprinting and DNA markers: RAPD, RFLP, AFLP, Simple sequence repeat (SSR) markers.
- 3.5 Site directed mutagenesis
- 3.6 Reverse Genetics, Gene knock out – RNAi and Gene silencing,
- 3.7 Gene therapy

Unit IV:

- 4.1 Introduction to Bioinformatics and Molecular Databases, Primary Databanks – NCBI, EMBL, DDBJ; Secondary Databases – UNIPROT; Structural Database –PDB;
- 4.2 Database similarity search (FastA, BLAST); Alignment: Pairwise and Multiple sequence alignment; Whole genome sequence;
- 4.3 Genome Annotation and Gene Prediction; Primer Designing; Phylogenetics analysis and Tree construction; Protein Sequence Analysis;
- 4.4 Approaches for Protein Structure Prediction-Homology modeling of protein; Energy Minimization Methods; Active site identification;
- 4.5 Structure Based Drug Design and Ligand Based drug Design; Docking studies; ADMET and Toxicity calculations.


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Semester- IV
Practical Paper I: Cell and Molecular Biotechnology

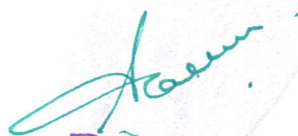
1. Isolation of Plasmid DNA, RNA and Proteins from *E.coli*.
2. Restriction mapping
3. PCR technique.
4. Preparation of competent cells and transformation
5. Gene cloning in bacteria (Demonstration).
6. Recombinant confirmation (Gel shift assays, blue white selection).
7. Southern blotting – demonstration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

Recommended Books:

1. Molecular biology by Robert Weiver
2. Molecular biology by David and Freifelder
3. Microbial genetics by David and Freifelder
4. Molecular biotechnology by Chanarayppa
5. Methods in Molecular Cloning by Sambrook.
6. Genetics of bacteria and their viruses by William Hayes
7. Molecular biology of the gene by Watson et al
8. The Biochemistry of nucleic acids by Davidson JN
9. Molecular biotechnology by Primerose
10. Molecular Biotechnology by Bernard R. Glick and Jack J Pasternak
11. DNA Microarrays Ed. M. Schena



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Semester-IV
Paper II: Medical Virology and Parasitology

Unit I:

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

Unit II:


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

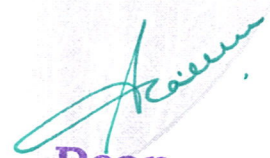
Unit III:

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

Unit IV:

- 4.1 Structure, cultivation, pathogenicity, lab diagnostics, prevention and control of Malaria, Amoebiasis, Trichomoniasis, Helminthic infections (Round worms, Hook worms).
- 4.2 Medical Mycology – Dermatormycosis, Systemic mycosis


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Semester-IV
Practical Paper II: Medical Virology and Parasitology


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

Recommended Books:

1. Review of medical microbiology by Jawitz et al
2. Medical laboratory Manual for tropical countries Vol I & II by Monica Cheesbrough
3. Text Book of Microbiology by Ananthanarayanan and Jayaram Paniker
4. Viral and Rickettsial infections of Man by Horsfall and Jam
5. Text book of Virology by Rhodes and Van Royan
6. Virological Procedures by Mitchal Hasking
7. Virology by Wilson and Topley


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Semester-IV
Paper-III: Microbial Biotechnology

Unit I:

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

Unit II:


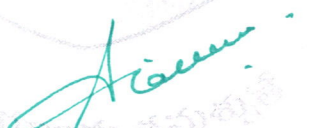
- 2.1 Fermentative production of citric acid, uses, microorganism, inoculum preparation, medium preparation, fermentation, recovery and mechanism of citric acid production.
- 2.2 Fermentative production of vitamin B12 – Uses, structure of vit-B12, microorganisms, inoculum preparation, medium preparation, fermentation and recovery.
- 2.3 Fermentative production of glutamic acid – Uses, microorganism, inoculum preparation, production medium, fermentation and downstream processing

Unit III:

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

Unit IV:

- 4.1 Production and application of microbial enzymes. – Amylases and proteases, uses, microorganisms, inoculum preparation, production medium, fermentation and recovery
- 4.2 Steroid transformations – Substrates, typical structures, microorganisms, inoculum preparation, 11-hydroxylation, process and recovery.
- 4.3 Principles of vaccine production and types of vaccines
- 4.4 Microbial biopesticides
- 4.5 Microbial products from genetically modified (cloned) organisms eg. Insulin




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Semester-IV
Practical Paper III: Microbial Biotechnology

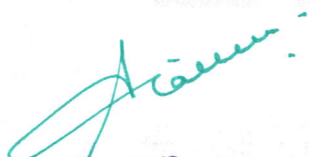
1. 1.Production of ethanol by flask fermentation, recovery of ethanol by distillation and calculation of fermentation efficiency
2. Preparation of wine from grapes/fruits by fermentation
3. Production of citric acid by fungal fermentation, recovery and estimation
4. Production of amino acid (Glutamic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

Recommended Books:

1. Industrial Microbiology by Casida, LE
2. Industrial Microbiology by Patel, AH
3. Industrial Microbiology by Miller, BM and Litsky
4. Industrial Microbiology by Prescott and Dunn
5. Microbial Technology by Pepler, JH and Perlman, D.
6. Biochemistry of Industrial Microorganisms, by Rainbow and Rose
7. Economic Microbiology by Rose Vol I – V
8. Microbial Enzymes and Biotechnology by Fogarty WM and Kelly, CT
9. Comprehensive Biotechnology, All volumes Ed. Murray Moo-Yong
10. Biotechnology (A text book of industrial Microbiology) Ed. Cruger & Cruger
11. Advances in Applied Microbiology Ed. Perlman Series of volumes



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Semester-IV
Paper-III: Bioinformatics and Nanotechnology

Unit I:

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

Unit II:

- 2.1 Transcriptomics and sequencing a transcriptome, microarrays
- 2.2 Proteomics and sequencing a proteome
- 2.3 Protein folding *in vivo* and the roles of Molecular chaperones.
- 2.4 Protein Sequence Analysis; Approaches for Protein Structure Prediction (folding *in silico*)- Homology modelling of protein; Energy Minimization Methods; Active site identification;
- 2.5 Protein engineering
- 2.6 Structure Based Drug Design and Ligand-based drug Design; Docking studies

Unit III:

- 3.1 Nanoparticles -Origin and their classification, Nanoscale systems
2. Nano structures-Carbon nanotubes, quantum dots, Semiconductor nanoparticles, metal based nanostructures, nanowires- polymer based nanostructures, gold nanostructures.

Unit IV:

- 4.1 Nano particles: Synthesis and Characterization
- 4.2 Synthesis of nanostructures – physical, chemical and biological
- 4.3 Methods of biological synthesis- Use of plants, bacteria, algae, fungi, actinomycetes for nanoparticle synthesis.
- 4.4 Characterization techniques for nanomaterials: Optical- UV–Visible spectroscopy, X-ray diffraction Imaging and Size- Scanning Electron Microscope (SEM), Transmission Electron Microscopy (TEM), Atomic Fluorescence Microscopy (AFM),



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Semester-IV
Practical Paper III: Bioinformatics and Nanotechnology

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

Recommended Books:

1. Lesk M.A. (2008) Introduction to Bioinformatics. Oxford Publication, 3rd International Student Edition
2. Rastogi S.C., Mendiratta N. and Rastogi P. (2007) Bioinformatics: methods and applications, genomics, proteomics and drug discovery, 2nd ed. Prentice Hall India Publication
3. Primrose and Twyman (2003) Principles of Genome Analysis & Genomics. Blackwell
4. Ghosh, Z. and Mallick, V. (2008) Bioinformatics- Principles and Applications. Oxford University Press.
5. Bionanotechnology: Lessons from Nature by David S. Goodsell
6. Handbook of Nanostructured Biomaterials and Their Applications in Nanobiotechnology -
7. Hari Singh Nalwa
8. Nanomaterials for Biosensors, Cs. Kumar, Wiley – VCH, 2007



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Semester-IV
Paper IV: Applied Microbiology

Unit I:

- 1.1 Respiration (Aerobic and anaerobic). Glycolysis (EMP, HMP and ED) pathways.
- 1.2 TCA Cycle and its integration.
- 1.3 Exploitation of metabolic pathways in fermentation technology
- 1.4 Strain improvement.

Unit II:


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

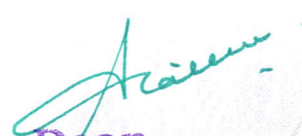
Unit III:

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

Unit IV:

- 4.1 Nanobiotechnology-Introduction. Development of nanobiotechnology. Nanoparticular carrier systems, Micro and Nanofluidics.
- 4.2 Applications: Biosensors, drug and gene delivery systems, chip technologies, nanoimaging, Nanomedicine and Cancer diagnostics and treatment.


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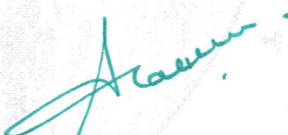
Semester-IV
Practical Paper IV: Applied Microbiology

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

Recommended Books:

1. Microbiology by Prescott
2. Medical Microbiology by Ananthnarayan
3. Text book of Microbiology by Pelczar
4. Industrial Microbiology by A.H.Patel
5. Food Microbiology by Frazier
6. Food Microbiology by Casida
7. Handbook of Nanostructured Biomaterials and Their Applications in Nanobiotechnology by Hari Singh Nalwa
8. Nanomaterials for Biosensors, Cs. Kumar, Wiley – VCH, 2007
9. Nanostructures and Nanomaterials: Synthesis, properties and applications. Ghuzang G.Cao . Imperial College Press, 2004
10. Biosensors: A Practical Approach, J. Cooper & C. Tass, Oxford University Press, 2004
11. Nanotoxicology: Characterization, Dosing and Health Effects, Informa Healthcare.
12. Nancy A. Monteiro – Riviere and C. Lang Tran, 2007.
13. Nanomedicine, Vol. IIA: Biocompatibility by Robert A. Freitas
14. Biological control of crop diseases Volume 89 of Books in soils, plants, and the environment by S. S. Gnanamanickam


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Telangana University
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M. Sc Microbiology Examination
Semester: I/II/III/IV
Paper: I/II/III/IV

Time: 3 hrs

Max Marks: 70

Section-A

I. Answer the following (5x4=20M)

1. Unit-I
2. Unit-II
3. Unit-III
4. Unit-IV
5. Unit-I/II/III/IV

Section-B

II. Answer the following (5x10=50M)

1. A) or B) Unit-I
2. A) or B) Unit-II
3. A) or B) Unit-III
4. A) or B) Unit-IV
5. A) or B) Unit-I/II/III/IV



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Telangana University
Faculty of Science
M. Sc Microbiology Internal Examination-I/II
Semester: I/II/III/IV
Paper: I/II/III/IV

Time: 30 Min

Max Marks: 30

I. Choose the appropriate answer (Multiple Choice Questions) (10x1/2=5M)

II. Fill in the blanks (10x1/2=5M)

III. Answer the short questions (5X2=10M)

IV. Seminar (10M)

(Students seminars with power point presentations should be conducted separately for Internal assessment-I and II)

Note:

For Internal assessment-I, the questions must be from I and II units of the paper.

For Internal assessment-II, the questions must be from III and IV units of the paper.



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