ADIKAVI NANNAYA UNIVERSITY

RAJAMAHENDRAVARAM

M.Sc. Microbiology

Course Structure and Syllabus

2016-17 Onwards

ADIKAVI NANNAYA UNIVERSITY

M.Sc. DEGREE EXAMINATION IN MICROBIOLOGY - SYLLABUS
(Effective from 2016-2017 Batch)

Synoptic note

1) BoS meeting for all PG Courses with effect from 2016-17 admitted batches
2) Syllabi last revised in 2012-13
3) There are about 25 different courses
4) The syllabus is proposed to be revised in accordance to the emerging concepts, industry and market needs.

Proposed Guidelines:

5) All Arts and Commerce PG courses have 5 subjects in each of the four semesters, with 100 marks for each paper and a total of 2000 marks.
6) All Science PG courses have 4 subjects in each of the four semesters with theory and practical in each of 100 and 50 marks respectively for each of the four semesters, all of which makes a total of 2400 marks. An additional 100 marks are allotted for project dissertation and presentation in all PG courses [except MBA/MCA/MA (SW) and M.Tech]. Thus the grand total for the science PG courses is 2500 marks.
7) Out of 100 marks for each subject, 75 marks (75%) in each paper are assigned for Semester End Examinations and 25 marks (25%) for internal / continuous assessment for all PG courses.
8) Each subject will have four units of syllabi in all PG courses (except MBA, which will have five units of syllabus for each subject).
9) Each subject will have 4 - 5 periods of class per week with 5 credits.

10) Semester end examination question paper has two sections, viz. section A with four essay questions, with internal choice a) or b) - one question from each unit of syllabus; section B has eight short answer questions, two from each unit of syllabus, with choice to answer any five.

For MBA the question paper consist of 3 sections; viz. section 'A' has 8 short answer questions, with a choice to answer any five for 20 marks. Section 'B' consist of 5 long answer question with internal choice; one question from each unit of syllabus for 40 marks and section 'C' is case study with no choice for 15 marks.

11) For all PG courses including MBA, the brake up for 25 marks (25 %) of internal examination / continuous assessment is as follows;

    a) 15 marks for written examination; two written examinations are to be conducted and an average of both examinations is considered for awarding final score
    b) 5 marks for attendance
    c) 5 marks for assignment preparation and presentation

    (The proportionate may be followed for 50 marks paper / practical)

12) There will be project work for all PG courses except MBA, MCA, M.Tech and MA (Social work) for 100 marks (50 marks for dissertation and 50 marks for presentation and viva-voice. The project work is to be done during summer vacation i.e. after II semester and before III semester. The dissertation of the project work is to be submitted by the student to the respective department during 2nd year study. The presentation and viva-voce examination of the project work is to be conducted at IV semester end examination. The project presentation and vive-voce examination is to be conducted by external examiner. For affiliating colleges, University teachers will be the external examiner and for University Department, external examiner is to be invited from other university. MCA / MBA /M.Tech/ MA (SW) will continue the extant system. The external examiner TA / DA and remuneration will be borne by the respective College / Department strictly as per the approved norms to be notified from time to time.

13) There may be comprehensive Viva-Voce at the end of every semester being conducted by all subject teachers, together assigning suitable credit from internal marks to be taken. This is intending to prepare and boost the student interview facing skills and comprehension of subject. This is proposed for PG courses.

M.Sc. MICROBIOLOGY

Scheme of Examination

Code	Title of the paper	Total Marks	Credits
I SEMESTER			
MB101	General Microbiology	100	4
MB102	Bacteriology and Virology	100	4
MB103	Biomolecules	100	4
MB104	Analytical Techniques	100	4
	Lab Course		
MB105	General Microbiology lab	50	2
MB106	Bacteriology and Virology lab	50	2
MB107	Biomolecules lab	50	2
MB108	Analytical Techniques lab	50	2
II SEMESTER			
MB201	Microbial Physiology and Metabolism	100	4
MB202	Cell Biology and Enzymology	100	4
MB203	Molecular and Microbial Genetics	100	4
MB204	Immunology	100	4
	Lab Course		
MB 205	Microbial Physiology and Metabolism lab	50	2
MB 206	Cell Biology and Enzymology lab	50	2
MB 207	Molecular and Microbial Genetics lab	50	2
MB 208	Immunology lab	50	2
III SEMESTER			
MB301	Molecular Microbiology	100	4
MB302	Genetic Engineering	100	4
MB303	Bioinformatics, Microbial Genomics and Proteomics	100	4
MB304	Medical Microbiology	100	4
	Lab Course		
MB305	Molecular Microbiology lab	50	2
MB306	Genetic Engineering lab	50	2
MB307	Bioinformatics, Microbial Genomics and Proteomics lab	50	2
MB308	Medical Microbiology lab	50	2
IV SEMESTER			
MB401	Fermentation Technology and Industrial Microbiology	100	4
MB402	Environmental Microbiology	100	4
MB403	Food and Agriculture Microbiology	100	4
MB404	Biostatistics & Research Methodology	100	4
	Lab Course		
MB405	Fermentation Technology and Industrial Microbiology lab	50	2
MB406	Environmental Microbiology lab	50	2
MB407	Food and Agriculture Microbiology lab	50	2
MB408	Biostatistics & Research Methodology lab	50	2
MB 409	Project work	100	4
	Total	**2500**	**100**

ADIKAVI NANNAYA UNIVERSITY: RAJAMAHENDRAVARAM

BOARD OF MICROBIOLOGY

Date: 08-07-2016

AGENDA:

1. Syllabus for theory papers
2. Syllabus for practicals
3. Number of teaching hours / Periods theory / Practicals
4. Credits / Evaluation
5. Eligibility and Entrance Examinations
6. Scheme of Valuation
7. List of Examiners for papers setting and Model Question Papers
8. List of Practical Examiners

Members present:

Dr. A. Matta Reddy

Dr. K. Sarala

Dr. M. Padmaja

Dr. Sunila Rani

Dr. P.Vijaya Nirmala

Dr. D. Kalyani

Dr. K. Satish Kumar

Dr. I.J.N.Padmavathi

RESOLUTION:

The common Board consisting of the above members have met in the Department of Zoology, Adikavi Nannaya University, Rajamahendravaram and considered the enclosed agenda. After thorough deliberations and discussions, the Board members have resolved as follows.

1. The members formulated the syllabus for M.Sc Microbiology, 2 years course on par with other Universities in the Country to be implemented from 2016-17 academic year.
2. The syllabus for practical for the above courses formulated on par with UGC model curriculum.
3. There shall be 4 to 5 periods per week for each theory paper & 3 periods for each practical.
4. A B.Sc Graduate with any subject in biology is eligible to apply for admission into M.Sc Microbiology.
5. Marks and credits are allotted to theory & practical papers in each semester. There will be 100 marks for each theory and 50 marks for each practical and a total of 600 marks for each semester. So 2400 marks for the four semesters (600 x 4). 100 marks for Project work. A grand total of 2500 marks for the 2 year M.Sc. Microbiology course.
6. **Examination pattern will be as follows.**
   a) 75% of marks for Semester end Examination while the remaining 25% of marks for continuous Internal assessment which includes 5 marks for attendance (5 marks 95 % above, 4 marks 85-94%, 3 marks 75 – 84%, 2 marks 65-74%, 1 mark 55-64%), 5 marks for Assignment and Presentation and 15 marks for Mid-Examination, with one essay (10 marks) & one short question (5 marks) with internal choice.
   b) The Semester End Examination question paper comprises of two sections –Section A & Section B. Section A consists of 4 questions, one question from each unit of syllabus with internal choice ‘a’ or ‘b’. Section-B consists of 8 short questions two from each unit of the syllabus, with a choice to attempt only 5 out of 8 questions.
   c) In practical, 75% of marks for semester end examination (38 Marks) and Internal Semester Examination 25% (12 Marks) for continuous assessment for Practical paper (9 + Record-3).
7. There will be Project work for Microbiology for 100 marks (50 marks for Dissertation & 50 marks for Presentation & Viva-voce). The Project work is to be done during summer vacation i.e. after II Semester & before III Semester. Dissertation should be submitted by the students, during 2^{nd} year of study, Presentation and Viva-voce is to be conducted by External Examiner. For affiliating colleges, University teachers will be the external examiner and for University Department, external examiner is to be invited from other university. The External Examiner TA/DA & Remuneration will be borne by the respective College/Department as per the approved norms.
8. A comprehensive Viva-voce to be conducted for students at the end of every semester in the presence of all subject teachers with 20 marks in order to prepare & boost the students to face the interview in future. The marks are adjusted from the internal presentation marks (5 marks in each subject i.e. 4x5=20 marks).

ADIKAVI NANNAYA UNIVERSITY

M.Sc. MICROBIOLOGY

Examination pattern:

Theory: 75% is End Semester Examination

25% is Internal Assessment

Practical: 75% is End Semester Examination

25% is Internal Assessment – Continuous Assessment

ADIKAVI NANNAYA UNIVERSITY
M.Sc. MICROBIOLOGY
SEMESTER END EXAMINATION

Model question paper

Time: 3 hrs Max. Marks: 75

Section-A **4x15=60**

Answer all the questions. Each question carries 15 marks

Q1. **Unit-1**

a or b

Q2. **Unit-2**

a or b

Q3. **Unit-3**

a or b

Q4. **Unit-4**

a or b

Section-B **5x3=15**

Q5. It contains 8 short note questions with at least two from each unit, carrying 3 marks. 5 questions are to be answered at least one from each unit.

I SEMESTER

MB101 GENERAL MICROBIOLOGY

Unit I:
Discovery, Evolution and development of Microbiology**;** Contributions of Van Leeuwenhock, Joseph Lister, Pasteur, Koch, Jenner, Winogradsky, Beijerinck; Identification, characterization and classification of microorganisms; Bergy's manual, Hackel's three kingdom concept, Whittaker's five kingdom concept, three domain concept of Carl Woese; Major characteristics used in Taxonomy; the kingdoms of organisms and phylogenetic trees - Distinguishing characteristics between prokaryotic and eukaryotic cells; Structure and function of cell organelles of microorganisms.

Unit II:
Methods of sterilization- Physical methods, chemical methods and their application; Microbial cultures- pure culture isolation, Enrichment culturing techniques, single cell isolation, and pure culture development; Chemical structure of peptidoglycan, protoplasts, spheroplasts, microsomes and ribosomal RNAs, Microscopic identification characteristics, staining methods; Growth media and types; Preservation and maintenance of Microbial cultures.

Unit III:
Ecological identification methods; Bacterial nutrition and growth kinetics - synchronous, stock, batch and continuous cultures; Growth measurement methods – Metabolic diversity; Cultivation of aerobes and anaerobes; Reproduction in bacteria & spore formation; Morphology, Ultra structure and chemical composition of bacteria, actinomycetes, spirochetes, rickettsiae, mycoplasma, Chlamydiae – TRIC agents and LGV Archaebacteria.

Unit IV:
General characteristics, reproduction and economic importance of fungi; Classification, structure, composition, reproduction and other characteristics of fungal divisions; Structure, reproduction and characteristics of algal divisions, Distribution of algae; Classification of algae by Fritsch; Characteristics of blue green algae, dinoflagellates, thallus organization, products of algae and their economic importance; emphasis on Spirulina; Characteristics, morphology, reproduction, lifecycle and pathology of protozoans.

Recommended Books:

1. Bergey's Manual of Systematic Bacteriology volumes I to VI
2. Methods for General and Molecular Bacteriology by GERHARDT (Editor–in-Chief)
3. Microbiology PELCZAR, CHAN & KRIEG.
4. Brock Biology of Microorganism by MADIGAN, MARTINKO & PARKER.
5. Introduction to Microbiology by ROSS.
6. Basic Microbiology by VOLK & WHEELER.
7. Fundamental Principles of Bacteriology by SALLE.
8. Introduction to Algae by Morris, I.
9. Products and Properties of Algae by Zizac.
10. Introductory Mycology, by Alexopolus, C.J.

MB102 BACTERIOLOGY AND VIROLOGY

Unit I:

Biology of bacteria: Staphylococcus, streptococcus, Pneumococcus, Nesseria, Corynebacterium; Bacillus, Clostridium, Proteus, Shigella, Salmonella, Vibrio, Pseudomonas, Yersinia, Haemophilus, Bordetella, Brucella, Mycobacterium, Spirochetes, Mycoplasmas, rickettsiae and chlamydiae.

Bacterial growth- Measuring bacterial growth- Spectrophotometric method, microscopic counting, serial dilution and viable cell count, MPN, and filtration technique; Bacterial reproduction-fission, budding and endospore formation

Unit II:

Economic importance of bacteria: A brief account on the economic importance of bacteria in Agriculture- Nitrogen fixing organisms; ecological importance-bioremediation and biopesticides; Industrial importance- source of antibiotics, production of recombinant proteins- growth factors, hormones, vaccines etc.; Normal flora in the GIT and their advantages.

Antibacterial agents: Mode of action of antibiotics and chemotherapeutic drugs; Antibiograms; Antibiotic sensitivity assays- disc method; replica plating technique; Ames test; Antibiotic resistance in bacteria- various factors that contribute to the development of resistance, Bacterial quorum sensing, Biofilms.

Unit III:

Concept and scope of virology:

History and Discovery of Viruses, Nature, origin and evolution of viruses, New emerging and re-emerging, viruses, Nomenclature, classification and structure of viruses, recent ICTV classification of viruses infecting animals, humans, plants, bacteria, algae, fungi; Major characteristics of different virus families/genera/groups; Properties of Viruses, chemical composition of viruses; Biological properties of viruses – host range, transmission-vector, non-vector; Isolation, cultivation, assay and maintenances of viruses; Viruses culture – organ culture, primary and secondary cell cultures, suspension and monolayer cell cultures, cell strains, cell lines, embryonated eggs.

Unit IV:

Viral genome and transmission:

Structure and complexity of viral genomes, diversity among viral genomes – DNA and RNA genomes, positive and negative sense of RNA genomes; Replication of viruses – replication strategies of DNA, RNA viruses and regulation of viral genome expression. Transmission of viruses – Vertical (Direct) transmission, Horizontal (Indirect) transmission Vector-arthropod, non-arthropods, virus and vector relationship; Diagnosis of viral diseases, prevention and control of viruses, vaccines and immunization, chemoprophylaxis, chemotherapy, interferon therapy.

Recommended Books:

1. Virology: Frankel-Conrat; Prentice-Hall
2. Principles of Virology S.J.Flint et al., ASM press
3. Introduction to Modern Virology: Dimmock et al., Blackwell Sci.Publ
4. Principles of Molecular Virology, A.Cann. Academic Press
5. Basic Virology, Waginer and Hewelett, Black Well Science Publ
6. Medical Virology, D.O.White and F.J.Fenner, Academic Press.
7. Plant Virology, R.Hull, Academic Pres.
8. Fundemental Virology, D.M.Knipe and P.M.Howley.

MB103 - BIOMOLECULES

Unit I:

Carbohydrates – Classification, chemistry, properties, and function – mono, di, oligo and polysaccharides; bacterial cell wall polysaccharides; Conjugated polysaccharides– glycoproteins and lipopolysaccharides; Lipids – classification, chemistry, properties and function – free fatty acids, triglycerides, phospholipids, glycolipids & waxes; Conjugated lipids – lipoproteins; Major steroids of biological importance – prostaglandins.

Unit II:

Amino acids and proteins – classification, structure and function; Essential amino acids & amphoteric nature of amino acids and reactions and functions of carboxyl and amino groups and side chains; Peptide structure; Ramachandran's plot; Methods for isolation and characterization of proteins; Structural levels of proteins – primary, secondary, tertiary and quaternary, denaturation of proteins; Hydrolysis of proteins; Protein sequencing using various methods.

Unit III:

Nucleic acids **–** structure**,** function and their properties; Structural polymorphism of DNA, RNA; Structural characteristics of RNA; Vitamins – Sources, Chemistry and biochemical functions of water-soluble and fat soluble vitamins; Chemistry of Porphyrins – Heme, Cytochromes, Chlorophylls, xanthophylls, Bacteriochlorophylls & algal pigments, Carotenoides.

Unit IV:

Biological oxidation, Biological redox carriers, biological membranes, electron transport, oxidative phosphorylation and mechanism; Bacterial photosynthesis, photosynthetic electron Transport; Mineral metabolism – phosphorus, potassium, calcium and Trace elements – molybdenum, zinc, manganese, cobalt and copper; Influence of minerals on the production of toxins; Role of trace elements on microbial enzymes**.**

Recommended Books:

1. Biochemistry by Voet & Voet.
2. Outlines of Biochemistry Conn, Stumpf, Bruening & Doi.
3. Biochemistry by Stryer.
4. Biochemistry by Zubay.
5. Principles of Biochemistry by Lehninger, Nelson & Cox.

MB104 - ANALYTICAL TECHNIQUES

Unit I:
Microscopy – Principles of light, phase, fluorescent & electron microscopes; Microtomy – sectioning; Microscopic techniques- Basic principles and applications of phase – contrast microscopy, fluorescent microscopy and electron microscopy, types of electron microscopy – scanning and transmission, sample preparations - fixing of specimens, preparation of blocks, microtomy and staining, negative staining techniques of biological samples, cytometry and flow cytometry; Principles of Centrifugation – Centrifugation techniques- preparative and analytical methods, density gradient centrifugation.

Unit II:
General principles and applications of chromatography – Paper, Column, Thin layer, Gas, Ion exchange, Affinity chromatography, HPLC, FPLC and Gel filtration; Electrophoresis – moving boundary, zone (Paper Gel) electrophoresis; Immunoelectrophoresis; Immunoblotting; Isoelectric focusing, 2-D electrophoresis

Unit III:
Laws of absorption and radiation; Principles, instrumentation and applications of Visible, ultraviolet, infrared and mass spectrophotometry; Absorption spectra, fluorescence flame photometry, NMR, ESR, Principles of colorimetry, Turbidometry, Viscometry; Determination of size, shape and molecular weight of macromolecules – osmotic pressure, flow birefringence, optical rotatory dispersion; Light scattering, diffusion, sedimentation and X-ray diffraction.

Unit IV:
Radio isotopic tracers – methodology, problems of experimental design, radiometric analysis, stable and radioactive isotopes, preparation, labeling, detection and measurement of isotopes; RIA; Kinetics of radioactive disintegration; Manometric techniques; Freeze drying and its application in biological systems.

Recommended Books:
1. Instrumental Methods of Chemical Analysis by Chatwal & Anand.
2. Practical biochemistry: principles and techniques by Wilson & Walker.
3. Biochemical methods by Sadasivam & Manickam.
4. Biophysical chemistry: principles and techniques by Upadhyay, Upadhyay & Nath.

I SEMESTER PRACTICALS

MB105 - GENERAL MICROBIOLOGY LAB

1. Pour plate, Streak plate and Dilution methods.
2. Staining methods
3. Detection of motility by hanging drop method.
4. Crystal violet blood agar, Salt nutrient agar.
5. Quantitative estimation of microorganisms – total and viable counts.
6. Bacterial growth measurement.

MB106 - BACTERIOLOGY AND VIROLOGY LAB

1. Culturing of anaerobic microorganisms.
2. Biochemical tests – Catalase and Oxidase tests; Indole reaction; Methyl red and Voges-Proskauer reactions.
3. Isolation of phage from soil
4. Cultivation of animal viruses in embryonated chicken eggs.
5. Mechanical inoculation of plant viruses – TM.
6. Measurement of size of spores and cells.
7. Isolation and culturing of fungi (yeasts and molds) and algae.
8. Observation of specimen and permanent slides.

MB107 - BIOMOLECULES LAB

1. Qualitative tests of carbohydrates
2. Qualitative tests of proteins.
3. Estimation of reducing sugar-Anthrone method
4. Estimation of sugar by titration method –Benedict's method
5. Estimation of Ninhydrin method, Micro kjeldhal method, Ultraviolet spectroscopy of proteins.
6. Determination of saponification value of fats
7. Determination of iodine number of oils
8. Estimation of cholesterol.
9. Estimation of DNA by DPA method.
10. Estimation of RNA by orcinol method.

MB108 - ANALYTICAL TECHNIQUES LAB

1. Determination of pKa and pI values of amino acids.
2. Paper Chromatography of amino acids and sugars.
3. Colorimetric determination of any one amino acid.
4. Separation of pigments by adsorption chromatography.
5. Thin Layer chromatography separation – sugars & lipids.
6. Molecular weight determination of enzymes / proteins by Gel filtration, SDS-PAGE.
7. Subcellular fractionation by differential centrifugation.
8. Demonstration of GM counter.

II SEMESTER

MB201 MICROBIAL PHYSIOLOGY AND METABOLISM

Unit I:
Nutritional types – autotrophic bacteria, chemosynthetic and photo synthetic microorganisms; Heterotrophic bacteria – saprophytes, parasites and mixotrophs; Respiration in bacteria – aerobic and anaerobic types of respiration, obligate aerobes, facultative anaerobes and obligate anaerobes; Toxic effect of oxygen on anaerobes; Bioluminescence in microorganisms; Energy yields; Microbial growth- The concept of growth and definition, Cell cycle in microbes and generation time- Growth phases of bacteria –survival of microbial cells; Importance of each growth phase; Synchronous cultures – methods of synchronous culturing, Continuous culturing methods, factors effecting growth; Methods of growth measurement; Physiology and biochemistry of sporulation and germination of spores.

Unit II:
Carbohydrate metabolism in microbes – synthesis of carbohydrates in photosynthetic, chemosynthetic and heterotrophic microbes; Fermentation of carbohydrates by microorganisms –Embden-Meyerhof-Parnas pathway, Entner-Doudoroff (ED) pathway, C2-C4 split pathway; Kreb's cycle, glyoxylate cycle, hexose monophosphate shunt (HMP), gluconeogenesis, anaplerotic reactions, synthesis of peptidoglycans and glycoproteins; Anaerobic respiration -Fermentation, Biochemical mechanisms of lactic acid, ethanol, butanol and citric acid fermentations; Nitrate and sulphate respiration.

Unit III:
Metabolism of amino acids –Biosynthesis of amino acids and their regulation with emphasis on tryptophan and histidine by microorganisms; Protein metabolism - Assimilation of inorganic nitrogen and sulphur, Biochemistry of nitrogen fixation; Urea cycle; Signal transduction with reference to nitrogen metabolism; Catabolism of amino acids, transamination, decarboxylation and oxidative deamination; Porphyrin biosynthesis and catabolism.

UNIT IV:
Lipid metabolism - Biosynthesis of triacylglycerols, phospholipids and sphingolipids; Oxidation of saturated and unsaturated fatty acids; Microbial metabolism of aromatic and aliphatic hydrocarbons (camphor, 2,4-D and toluene); Nucleotide metabolism - Biosynthesis of purine and pyrimidine nucleotides, biosynthesis of deoxyribonucleotides; Regulation of nucleotide synthesis, catabolism of purine and pyrimidines; Secondary metabolism - Utilization of secondary metabolites for production of vitamins, toxins(aflatoxin and corynebacterial), hormones (GA), and antibiotics (penicillin and streptomycin).

Recommended Books:

1. An introduction to bacterial physiology by Price and Stevens.
2. Microbial energetic by Dawes.
3. Principles of Biochemistry by Lehninger, Nelson and Cox.
4. Microbial physiology and Metabolism by D.R.Caldwell, Wm.C.Brown Publ.
5. Microbiology by Prescott et al. Wm.C.Brown Publ.
6. Molecular Cell Biology by Lodish *et al*.

MB202 CELL BIOLOGY AND ENZYMOLOGY

Unit I:
Structure & function of chloroplast and mitochondria, mesosomes, lysosomes and cytoskeletal system; Photosynthesis in bacteria; Physicochemical properties of bacteria – intracellular osmotic pressure, permeability of the bacterial cell; Nutrient transport – simple diffusion, active, passive and facilitated diffusion; Purple green photosynthetic bacteria; Photosynthesis - Oxygenic and anoxygenic photosynthesis, structure of synthetic pigments of PS I and PS II, and photosynthetic electron transport, CO_2 fixation, halobacterial photosynthesis.

Unit II:
Cell cycle – Mitosis and Meiosis; cell cycle regulation mechanism; Signal transduction-Protein kinases, phosphorylation cascades, Ras pathway, MAP kinase pathway, etc; Cyclic nucleotides, G proteins; Mechanisms of protein translocation across membranes in prokaryotes, coated vesicles, membrane receptors.

Unit III:
Outlines of enzyme classification, nomenclature, assay of enzymes and kinetics of enzyme catalyzed reactions – Michaelis – Menton equation, determination of Km, Vmax and Kcat values; Factors affecting enzyme reaction – pH, temperature, radiation, enzyme and substrate concentrations, activators, coenzymes and metalloenzymes; Ribozymes and abzymes.

Unit IV:
Enzyme inhibitors, competitive and noncompetitive inhibition; Active site determination; Mechanism of action of ribonuclease, lysozyme and chymotrypsin; Isoenzymes, Regulatory enzymes – covalent modification, zymogen activation, Allosteric enzymes – ATCase, Glutaminesynthetase; Hemoglobin& Myoglobin; Enzyme purification - Methods of isolation, purification; Recovery and yield of enzymes; Criteria for testing purity of enzyme preparations; Immobilised enzymes - Methods of immobilisation; Applications of immobilized enzymes.

Recommended Books:

1. Cell and Molecular Biology by E.B.P. De Robertis, Lippincott Williams & Wilkins.
2. Molecular Cell Biology by Lodish& Baltimore.
3. Fundamentals of Enzymology, Nicholas C. Price, Lewis Stevens, Oxford University Press.
4. Principles of Biochemistry by Lehninger, Nelson and Cox.
5. Biochemistry by LubertStryer.
6. Enzymes by Dixon and Webb.
7. Introduction to Experimental Cell Biology by Ahern, Mc. Graw Hill, USA.
8. Cell Biology by Alberts, Bay Johnson.

MB203 MOLECULAR AND MICROBIAL GENETICS

Unit I:
Molecular organization of chromosomes in Prokaryotes and Eukaryotes; Centromeres and telomeres; Recombination at molecular level, heteroduplex analysis; Fine Structure analysis; Organisation of genomes – Repeated sequences - C value – cot curves" Multigene families; Molecular markers(RFLP and RAPD) Polymorphisms; Yeast & Drosophila as model organisms; Complementation and functional allelism.

Unit II:
Plasmids – types, plasmid DNA properties; Sex plasmid, F and its derivatives, drug resistance (R) plasmids; The Ti plasmid of Agrobacterium; Hybridization in yeast, control of mating type loci in yeast; Transposable elements – transposition; Types of bacterial transposons, duplication of target sequence at an insertion site; Deletion and inversion caused by transposons; Transposable elements in yeast and Drosophila; Retroposons.

Unit III:
Mutations –types of mutations, Molecular basis of mutations, isolation & analysis of mutants; Mutagenesis – base analogue mutagens, chemical mutagens, intercalating substances, mutator gene; Site directed mutagenesis, mutational hot spots, Reversion, second site revertants, frame shift mutations, carcinogens, screening of mutants; UV damage of DNA and repair.

Unit IV:
Bacterial genetics – Inheritance of characteristics and variability; Phenotypic changes due to environmental alterations; Genotypic changes; Bacterial recombination; Bacterial conjugation; Transduction – Generalized and specialized transductions; Bacterial transformation; Tetrad analysis in eukaryotic microbes – Neurospora and yeast; Mapping of bacterial chromosome by interrupted mating and transduction; Recombination in bacteriophages; Benzer's studies on r-II locus of T4 bacteriophage; Complementation test.

Recommended Books:

1. Cell and Molecular Biology by E.B.P. De Robertis, Lippincott Williams & Wilkins.
2. Molecular Cell Biology by Lodish& Baltimore.
3. Molecular Biology of the Gene by Watson Roberts, Steitx Wainer, Benjamin/Cummings Publishing Company Inc.
4. Genes – VII by Benjamin Lewen.
5. Essentials of Genetics by Russell.
6. Genetics by Gardener.
7. Molecular Genetics of Bacteria, J.W. Dale, Wiley Publ.
8. Modern Genetic Analysis by Griffith.

MB204 IMMUNOLOGY

Unit I:
History and scope of immunology, cells involved in immune system – T-lymphocytes, B-lymphocytes, monocytes, macrophages, APC, Neutrophils, mast cells; Types of immunity-Adaptive immunity, innate immunity; Lymphoid organs, Thymus, bone marrow, spleen, lymph nodes; Antigen-Antibody reactions - Ag-Ab binding, agglutination, blood groups, immunoflourescence and important immunological diagnostic tests - ELISA, RIA, immunoblot, Immunodiffusion, Immunoelectrophoresis, Complement fixation test (CFT).

Unit II:
Nature of antigens; antibody structure, classification of antibodies, functions of IgG, IgA, IgM, IgD and IgE; primary and secondary immune response; serological analysis of antibodies –isotypes, allotypes and idiotypes; Antibody diversity, antigen receptors on B and T lymphocytes; Phagocytosis, opsination, Opsonins and polyclonal and monoclonal antibody production (Hybridoma techniques) – Applications of monoclonal antibodies in biomedical research, clinical diagnosis and treatment; The complement system - components of classical and alternative complement pathways, complement receptors, biological, consequences of complement activation.

Unit III:
Humoral and cell-mediated immunity**,** ontogeny of B and T lymphocytes, generation of memory B cells and affinity maturation; T and B cell interactions, cytokines, lymphocyte mediated cytotoxicity (CTL); Antibody-dependent cell-mediated cytotoxicity; Reactions of immunity – antitoxins, neutralization of toxin with antitoxin; Immune response to infectious diseases: viral infections, bacterial infections, and protozoan diseases.

Unit IV:
Graft versus host reactions - Major Histocompatibility Complex (MHC); Human leucocyte antigen (HLA) restriction, Hypersensitive reactions – Auto immunity, transplantation immunity, Tumor immunology, immunological tolerance and immunosuppression; Immunodeficiency diseases - Primary immunodeficiency (genetic) diseases due to B-cell and T-cell and combined defects (hypogammaglobulinemia, thymic aplasia, SCID); Secondary immunodeficiency (acquired); Vaccines – development and production, vaccine expression system; Production of DNA vaccines; Immunotherapy of infectious diseases; Principles of immunization; vaccinoprophylaxis, vaccinotherapy, serotherapy.

Recommended Books:

1. Cellular and Molecular Immunology by Abul K. Abbas et al.
2. Textbook of Immunology by Barret.
3. Essential Immunology by Roitt, Brostoff, Male, Harcourt Brace & Company, Mosby
4. Immunology by J.Kuby, Richard A. Goldsby, Thomas J. Kindt, Barbara A. Osborne, Freeman & Company Mosby publishers.

II SEMESTER PRACTICALS

MB205 MICROBIAL PHYSIOLOGYAND METABOLISM LAB

1. Estimation of proteins by Biuret method and FolinCiocalteau method.
2. Estimation of DNA by Diphenyl amine method.
3. Estimation of RNA by Orcinol method
4. Estimation of Inorganic and organic phosphates by Fiske-SubbaRow method.
5. Estimation of Ammonical nitrogen and nitrates.
6. UV Survival curve of E.coli. or any other bacteria.

MB206 CELL BIOLOGYAND ENZYMOLOGY LAB

1. Protoplast preparation and regeneration.
2. Observation of mitosis in Onion root tips.
3. Observation of meiosis in Flower buds.
4. Assay of microbial enzymes (any two) – Amylase, protease, catalase, urease and pectinase.
5. Production, isolation, purification and assay of any one of the above enzymes
6. Enzyme Kinetics: (any one of the above enzymes):
   a) Effect of substrate and enzyme concentration on enzyme activity; Determination of K_m and Vmaxvalues.
   b) Effect of pH, temperature and inhibitors on enzyme activity.

MB207 MOLECULAR AND MICROBIAL GENETICS LAB

1. Demonstration of Ames test.
2. Strain improvement using chemical mutagens.
3. Isolation of mutants using EMS.
4. Study of the repair mechanism for the damage caused by UV radiation.
5. Chromosome isolation, banding and Karyotyping.
6. Bacterial conjugation

MB208 IMMUNOLOGY LAB

1. Separation of Serum - Immunoelectrophoresis.
2. Ouchterlony double diffusion.
3. Radial immunodiffusion.
4. Immunoprecipitation and precipitin curve.
5. ELISA.
6. Western blotting.
7. Agglutination inhibition test.
8. Blood grouping, Rh typing, VDRL, WIDAL

III SEMESTER

MB301 MOLECULAR MICROBIOLOGY

Unit I:
DNA & RNA as genetic material; Transformation experiments, Blenders experiments, properties of genetic material; Modern concept of gene structure; Overlapping genes, split genes, constitutive genes, jumping genes, Oncogenes; Types of tumors, physical, chemical and biological Carcinogens, chromosomal changes induced by Carcinogens.

Unit II:
DNA replication –various modes of replication, Meselson-Stahl's studies on replication; Enzymes and Proteins involved in replication Mechanism of replication – Initiation, polymerization and termination; Topoisomerases, DNA ligases; Prokaryotic and Eukaryotic promoters; Mechanism of transcription and transcriptional activators; Posttranscriptional modifications.

Unit III:
The genetic code- Deciphering the genetic code; theory of triplet code, elucidation of base composition of codons; Protein synthesis- Mechanism and role of various factors involved in Initiation, elongation and termination of Protein Synthesis, Inhibitors of protein synthesis; Post translational processing of proteins, protein channelling, role of RNA in protein synthesis.

Unit IV:
Regulation of gene expression at the levels of transcription and translation; Operon concept; Regulatory genes, structural genes and repressors; Negative and Positive regulation; Regulation of *lac, ara* and *trp* operons; Catabolite repression; Regulation of gene expression in lambda and *nif* operon.

Recommended Books:

1. Molecular Biology of the Cell by B.Alberts, D Bray, J.Lewis, M.Raff, K.Robertsand J.D. Watson, Garland Publishing Inc., New York.
2. Molecular Biology of the Gene by J.D. Watson, W.A. Benjamin Inc., New York.
3. Genetics- from genes to Genomes by Hartwell, L., Hood, L., Goldberg, M.L.,Reynolds, A.E., Silver, L.M and Veres, R.C.1st Edition WCB –McGraw Hill.
4. Molecular Cell Biology by Lodith.H.,Berk.A., Zipursky, S.I.Matsudira.P.,Baltimore, D and Darnell, J W.H. Truman & Co.
5. Lehinger: Principles of Biochemistry by Nelson D.L. and Cox, M.M.,Worth Publishers.
6. Recombinant DNA Watson Gilman, Scientific American Books.
7. A Passion for DNA Genes, Genomes and Society by James D Watson, CSHL Press.
8. Molecular Biology by Friefelder.

MB302 GENETIC ENGINEERING

Unit I:
r-DNA technology- Isolation of nucleic acids, DNA sequencing, Maxam-Gilbert and Dideoxy methods; Restriction endonucleases, restriction maps, Southern, Northern and western blotting; DNA finger printing, PCR- principle, types, application.

Unit II:
Cloning vectors- Plasmids, Cosmids and bacteriophages; Ligases- DNA ligases, ligation of fragments with cohesive ends & blunt ends; homopolymer tailing, Cloning strategies – shot gun experiments, gene libraries; Isolation of poly mRNA, synthesis of c-DNA, cloning of c-DNA in bacteria; Isolation of cloned genes, identification of recombinants, structural and functional analysis of recombinants.

Unit III:
Gene expression- expression of cloned genes in bacteria, yeast, plant and animal cells; Applications of recombinant DNA technology in biology, plant, medicine, genetic diseases, gene therapy.

Unit IV:
Nucleic acid probe technology, DNA micro array – printing of oligonucleotides and PCR products on glass slides, nitrocellulose paper; Whole genome analysis for global patterns of gene expression using fluorescent-labeled c-DNA or end labeled RNA probes; Analysis of single nucleotide polymorphisms using DNA chips; Protein micro array, advantages and disadvantages of DNA and protein micro arrays.

Recommended Books:

1. Molecular Biotechnology by Glick &Palturah.
2. Molecular Cell Biology by Lodish et al.
3. Principles of Gene Manipulation: An introduction to genetic engineering by Old & Primrose.
4. Recombinant DNA by J.D. Watson et al.
5. Molecular Biology &Biotechnology by J.M. Walker.
6. DNA micro arrays by M.Schena.
7. Molecular Biology by David &Freifelder.
8. Molecular Biology of Gene by Watson.

MB303 BIOINFORMATICS, MICROBIAL GENOMICS AND PROTEOMICS

Unit I:

Introduction to Biological Databases - Types of databases, Nucleic Acid Sequence databases, Protein sequence database; Genomics, Transcriptomics, Proteomics and Metabolomics.

Bioinformatics and its applications - Structure-function relationship; Sequence assembling using computer; Computer applications in molecular biology, Protein domains and human genome analysis program (BLAST, FASTA, GCC etc.); Databases for nucleic acid and protein sequences (EMBL, GenBank), database for protein structure (PDB), accessing information (Network expasy, EMB Net, ICGEB Net).

Unit II:

Proteomics - Proteome, metaproteome, structural proteomics, functional proteomics; Protein structure analysis, sequence based protein prediction; Homology or comparative modeling- Remote homology (Threading), Protein function prediction- Introduction to the concepts of molecular modeling; Drug discovery, Structure based drug designing and virtual screening by automated docking, de novo sequence; Molecular docking, evaluation of docking prediction.

Unit III:

Genomics - Whole genome analysis-Preparation of ordered cosmid libraries, bacterial artificial chromosomal libraries, shotgun libraries and sequencing, conventional sequencing (Sanger, Maxam and Gilbert Methods), automated sequencing; Sequence analysis - Computational methods, homology algorithms (BLAST) for proteins and nucleic acids, open reading frames, annotations of genes, conserved protein motifs related structure / function (PROSITE, PFAM, Pro Scan); DNA analyses for repeats (Direct and inverted), palindromes, folding programmes; Benefits of Pharmacogenomics.

Unit IV:

Integration of omic approaches - Application of omic technologies in bioprospecting, biodegradation and medicine; Systems approaches using high through put technologies for biomining microorganisms; Strategies for the analysis of bacterial biodegradation path ways, Concept of Laboratory-on-a-chip (LOC); Omic tools - 2DE, MALDI – TOF, LC – MS/MS analysis, ICAT, ITRAQ, AQUA, ESI –Q-IT-MS, SELDI – TOF-MS, yeast two hybrid analysis.

Recommended Books:

1. Manuel Fuentes and Joshua LaBaer; Proteomics- Targeted Technology, Innovations and Applications; Caister Academic Press.
2. Stephen M&Krawez SA; Bioinformatics- Methods and Protocol
3. Sorensen; Genomics and proteomics-karine element A; CRC publishers
4. Nicholson; The handbook of metabonomics and metabolomics; Willey publishers.
5. Supratim Choudhart & David B; Genomics-Fundamentals and Applications; Carlson.
6. Mark Pagel and Andrew Pomiankowski; Evolutionary Genomics and Proteomics; W.H. Freeman and Company.
7. Robert S. Matson; Applying Genomic and Proteomic Microarray Technology in Drug Discovery; CRC Press.
8. D. M. Dziuda; Data Mining for Genomics and Proteomics-Analysis of Gene and Protein Expression Data; Willey publishers.

MB304 MEDICAL MICROBIOLOGY

Unit I:
Normal microbial flora of human body, host-microbe interactions; Infection and infection process- routes of transmission of microbes in the body; Description and pathology of diseases caused by bacteria; Streptococcus, Pneumococcus, Gonococcus, Enterobacteriaceae, E. coli, Salmonella, Shigella, Pseudomonas, Klebsiella, Proteus, Vibrio cholera; Brucella, Haemophilus, influenzae; pathogenic anaerobes, Tetanus, Clostridia, Corynebacteria, Mycobacteria, Spirochaetes**.**

Unit II:
Description and pathology of diseases caused by Aspergillus, Penicillium, Mucomycosis, Blastomycosis, Microsporosis, Rhinosporidium, Epidermophyscosis; Description and pathology of diseases caused by hemoflagellates; Leishmaniadonavani, L.tropica, Trypanosoma gambiense; intestinal flagellates; Trichomonas, Giardia, Entamoeba histolytica, malarial parasites, Helminthes; Ascaris lumbricoides, Hook worm, pinworm, Filarial parasites.

Unit III:
Laboratory diagnosis of Common infective syndromes and parasitic manifestations; Methods of transmission and role of vectors- biology of vectors; (1) House fly (2) Mosquitoes(3) sand fly; Need and significance of epidemiological studies; Epidemiological investigations to identify a disease, Principles of chemotherapy, Mode of antibiotics - Penicillin, streptomycin, sulfonamides and Polymyxins; Antifungal drugs (Nystatin), Antiviral agents (Robovirin); Problems of drug resistance and drug sensitivity; Drug resistance in bacteria.

Unit IV:
Viral diseases- Description, pathology and lab diagnosis of diseases caused by poxviruses; herpes virus (chicken pox- zoster); orthomyxo and paramyxo viruses; adenovirus, otherrespiratory viruses, (Influenza, Rhino) viruses affecting nervous system (ex: Polio virus, Rabiesvirus), enterovirus, reovirus, viral hepatitis, HIV; Interferon – Nomenclature, types &classification, Induction of interferon, types of inducers.

Recommended Books:

1. Medical Microbiology by MIMS, Play Fair, Roitt& Mosby Publishers.
2. Parasitology by Elmer R.Noble& Lea & Fibiger Publishers.
3. Medical Virology by D.O. White & F.J. Fenner, Academic press.
4. Textbook of Microbiology by Ananthanarayan, C.K.J.Panikar, Oreint Longman Ltd.
5. Mackie & Mc. Cauetrey: Practical Medical Microbiology edited by J.G.Gollee, Published by: Churchill Livingstone.
6. Textbook of Medical Parasitology by C.K.Jaya Ram Paniker, Published by 'Jaypee Brothers'.
7. Textbook of Diagnostic Microbiology by Coloratlas, edited by Eimer.W. Koneman, published by Lippinett.
8. Diagnostic Microbiology by Bailey and Swotts, published by Mosby.
9. Medical Microbiology – A Clinical perspective by J.B.Sharma, paras publishing.
10. Medical Microbiology by Jawetz.

III SEMESTER PRACTICALS

MB305 MOLECULAR MICROBIOLOGY LAB

1. Isolation of genomic DNA (from bacteria/fungi)
2. Isolation of RNA.
3. Recovery of DNA from gels – Electro elution and extraction of DNA from low meltinggels.
4. Bacteriophage titration – Plaque forming Units (PFU)
5. Induction of mutations in Bacteria by physical / chemical agents.
6. Demonstration of conjugation and Transformation in bacteria

MB306 GENETIC ENGINEERING LAB

1. Isolation of plasmid DNA from Bacteria.
2. Southern blotting.
3. Transformation of E. coli with recombinant plasmid DNA, Curing of plasmids.
4. Restriction Enzyme digestion – ligation of lambda DNA.
5. Polymerase Chain Reaction (PCR).
6. Demonstration of nucleic acid sequencing.
7. Mapping of bacterial genes by conjugation / transformation (problems).
8. Preparation of primary cell cultures and secondary cell cultures from animal and plant samples.

MB307 BIOINFORMATICS, MICROBIAL GENOMICS AND PROTEOMICS LAB

1. Using DNA sequence, identifying the protein through database
2. Using amino acid sequence of a protein, identifying the gene through database
3. Alignment of DNA and protein sequence using BLAST, FASTA
4. Multiple sequence alignment (MSA) of proteins and nucleic acids
5. Phylogenetic tree construction using CLUSTAL tools
6. Demonstration of 2D electrophoresis

MB308 MEDICAL MICROBIOLOGY LAB

1. Preparation of different media used in diagnostics Microbiology.
2. Microbiological examinationof sputum for pus cells and predominant bacteria.
3. Ziehl-Neelsen staining to detect acid fast bacilli culturing the specimen.
4. Examination of urine for pathogenic microorganisms.
5. Medical Parasitology – E. histolytica, G. lamblia, Trypanosoma, Leishmania andPlasmodium (Permanent Slide Observation).
6. Serological Tests: Hemoglobin estimation, RBC Count, WBC Count, Bleeding time,Clotting time, Erythrocyte Sedimentation Rate (ESR), Packed Cell Volume (PCV).

IV SEMESTER

MB401 FERMENTATION TECHNOLOGY AND INDUSTRIAL MICROBIOLOGY

Unit I:
An introduction to fermentation processes – the range of fermentation processes; Microorganisms used in industrial microbiological processes – isolation, preservation and strain improvement of industrially important microorganisms, screening methods, isolation of autotrophic mutants; Media and materials required for industrial microbiological processes – Antifoams.

Unit II:
Microbial growth kinetics, batch culture, continuous culture, fed batch culture and Dual or multiple fermentations; Inoculum development for large-scale processes; Design of fermenter-Construction and maintenance of aseptic conditions; Control of various parameters; Sterilization of media; Types of fermenters; Computer application in fermentation technology; Recovery and purification of fermentation products; Fermentation Economics.

Unit III:
Production of ethyl alcohol, beer & wine; Enzyme probe biosensors, biochips, biofilms, bio surfactants, Biotransformation, Petroleum Microbiology; Microbial leaching- role of microorganisms in the recovery of minerals (uranium, copper) from ores.

Unit IV:
Microbial products from genetically modified (cloned) organisms ex: insulin; Microbial groups involved in biogas production, design of digester; Patenting- Concept and its composition & protection of right and their limitation, intellectual property rights (IPR); patenting biotechnology inventions.

Recommended Books:

1. Industrial Microbiology by Waiter.
2. Industrial Microbiology by Patel.
3. Principles of Fermentation technology by Whitaker.
4. Industrial Microbiology by Prescot& Dunn.
5. Microbial Technology by J.H. Peppler& D. Perlman.
6. Industrial Microbiology by L.E.Casida.
7. Industrial Microbiology by B.M. Miller &W.Litsky.
8. Advances in Applied Microbiology by Ed.Perlman, Series of volumes.

MB402 ENVIRONMENTAL MICROBIOLOGY

Unit I:
Basic concepts of Ecology and Environment – Biological spectrum at levels of organization & realm of ecology; Ecosystem – Concept, components, food chains, food webs and tropic levels; Energy transfer efficiencies between tropic levels; Biological factors influencing the growth and survival of microorganisms- inter reactions of microbial population and community dynamics – Growth in closed environments and in open environments; The kinetic properties of competition between microbial populations; Kinetic principles of prey-predator relationship.

Unit II:
Aquatic environment- Fresh water microorganisms, their zonation and characteristics- Salt water, oceans, estuaries, microorganism their zonation and characteristics-Faecal pollution of waters – water borne diseases, indicator organisms; IMVIC test, sanitary examination of water; Atmospheric Environment- Dispersal of airborne microorganisms; Air Sampling principles and techniques; Air spora- Concepts and components, indoor and outdoor air spora; Diurnal periodicity patterns; Seasonal periodicity patterns; Vertical profiles.

Unit III:
Microorganisms and pollution- Microbial production of methyl mercury, trimethyl arsine, hydrogen sulphide, acid rain water, carbon monoxide, ammonia, nitrate, nitrogen oxides, nitrosamines, Eutrophication, algal toxins; Microorganisms and sewage treatment- COD, BOD & DO, trickling filters, activated sludge process, oxidation ponds; sludge treatment (anaerobic digestion).

Unit IV:
Bioremediation Technology – Microbial degradation of oil spills, pesticides and detergents, Biofouling; Fate of genetically engineered microorganisms in the environment; Environmental impact assessment studies; Deterioration of materials – paper, textiles, painted surfaces, prevention of microbial deterioration.

Recommended Books:

1. Extremophiles by B.N.Johri, Springer Verlog, New York.
2. Microbial Diversity by D.Cdwd, Academic press.
3. Manual at Environmental Microbiology, by C.J. Hurst, Editor in Chief, ASM Press.
4. Microbial Ecology: Fundamentals and Applications, Atlas, RM &Barta, R.
5. Environmental Microbiology by Ralph Mitechell.
6. Bioremediation principles by Eweis.
7. Techniques in Microbial Ecology by Buruage.
8. Environmental Microbiology, by W.P. Grant and P.E. Long.

MB403 FOOD AND AGRICULTURE MICROBIOLOGY

Unit I:
Microbiology of foods – Microbial flora of fresh foods, grains, fruits, vegetables, milk, meat, eggs and fish and their infestation by bacteria, fungi and viruses; Microbiological examination of foods- microscopic techniques and cultural techniques; Direct microscopic examination, total colony counts and differential enumeration; Identification of specific groups – Bacteria, Viruses, Fungi and Protozoa; Microbial spoilage of milk, food, types of spoilage organisms, food poisoning, mycotoxins and bacterial toxins.

Unit II:
Food processing & preservation- Methods of food preservation, Aseptic handling, pasteurization of milk, refrigeration and freezing, dehydration, osmotic pressure, chemicals – organic acids, nitrates, nitrites and cresols; Radiation – UV light, Y-irradiation; Fermented foods – preparation of Yogurt, streptococcus species, Lactobacillus bulgaricus; Manufacture of cheese, Pencillium; Fermented soybean products; Microorganisms as food – single cell protein, yeast, algae and fungal biomass production.

Unit III:
Soil Environment- Microorganisms, soil structure, soil profile, Physico-chemical conditions, Microbial composition, sampling techniques, role of microorganisms in organic matter decomposition (cellulose, Hemicellulose, Lignins) Bio-geo chemical cycles – Carbon cycle, Nitrogen cycle – Nitrogen fixation, nitrification, denitrification, sulphur, iron and phosphorus cycles; Rhizosphere – Rhizosphere Microorganisms, Biochelators (Siderophores).

Unit IV:
Biofertilizers – Introduction, biofertilizers using nitrogen fixing microbes – phosphate solubilization- Rhizobium, Azatobacter, Azospirillum, Azolla; Anabaena Symbiosis, blue green algae, Mycorrihiza, Biopesticides – toxins from Bacillus thuringiensis, Psuedomonassyringae, Biological Control – Use of Baculovirus, NPV virus, protozoa & fungi in biological control.

Recommended Books:

1. Food Microbiology: Fundamentals & Frontiers, by M.P. Dayle et al, ASM press.
2. Food Microbiology by Adams, M.R. and Moss M.O. Royal Society of Chemistry Publication, Cambridge.
3. Food Microbiology by Frazier W.C. and West haff D.C. Tata Mc.Graw Hill Publishing Company Limited, New Delhi.
4. Food Poisoning and Food Hygiene by Hobbs BC and Roberts.D, Edward Arnold (A division at Hodder and Strong hton) London.
5. Agricultural Microbiology by G.Rangaswamy and Bagyaraj, Prentice Hall India.
6. Bio-fertilizers in Agriculture and Forestry, by N.S. SubbaRao.
7. Soil Microbiology and Plant Growth, by N.S. SubbaRao.

MB404 BIOSTATISTICS AND RESEARCH METHODOLOGY

Unit I:

Elements of Biostatistics: Introduction to Biostatistics; Methods of representation of statistical data; Data - Data types, collection of data, classification and tabulation, population and sample designs; Random and Non- random sampling methods, Handling of bulky data- construction a histogram- interpretation of histogram; Measures of Central tendency and distribution – mean, median, mode, Measures of variation - Range, quartile deviation, mean deviation and standard deviation; Coefficient of variation; Concept of Probability-Basic principles of probability theory, Bayes theorem, Normal distribution, statistical inference – Addition and multiplication theories, conditional probability and probability distributors; Binomial, poission and normal distribution.

Unit II:

Statistical applications in biology- Experimental designs; measures of dispersion- standard deviation, standard error; Concept of correlation and linear regression; Regression coefficients and properties; Types of errors and levels of significance; Tests of significance- Comparison of variance (F-test), small sample test, Student's "t" test, Paired and unpaired t test, chi square test; Analysis of variance (ANOVA) – one way and two way, multiple comparisons; Introduction to hidden Markov models.

Unit III:

Basics of Research Methodology - Literature survey, origin and identification of problem, Formulation hypothesis based on existing information, Validation of hypothesis, Designing experimental techniques for validating the hypothesis, Execution of designed experiments, Analysis of data, Interpretation of research findings, Preparation of PhD thesis, Oral presentation.

Unit IV:

Methodology for writing science report- Compilation of experimental record, program of writing, use of vocabulary, art of illustration, technical report writing, editing and correcting, manuscript writing for publication in peer reviewed scientific journals.

Research Project submission and execution- Preparation of informal proposal, modified proposal and formal proposal; Experimental design and Collection of results, submission of progress report (year wise) and submission of technical report (Format- Title page, Introduction, Aims of the proposal/research, methodology, results, references, acknowledgments, budgetary preparation); Submission of final technical report, Patenting and intellectual property rights.

Recommended Books:

1. Green. R. H. Sampling Design and Statistical Methods for Environmental Biologists John Wiley & Sons.
2. Snedecor G. W. & Cochran W. G. Statistical methods. 8th ed. Iowa State Press.
3. Thomas Glover, Kevin Mitchell. Introduction to Biostatistics. 1st ed. McGraw –Hill Science.
4. Matthews. Successful Scientific writing: A step-by- step Guide for Biomedical Scientists. 2nd ed. Cambridge University Press.
5. Jerrold H. Zar. Biostatistical Analysis. Pearson Education.
6. Statistical methods. S.P. Gupta.
7. Fundamentals of mathematical statistics. S.C Gupta & Kapoor .
8. Statistical methods in biological and Health Science. J. S. Milton & J.O. Tsokan.

IV SEMESTER PRACTICALS

MB405 FERMENTATION TECHNOLOGY AND INDUSTRIAL MICROBIOLOGY LAB

1. Production of citric acid by A.niger. Recovery & Fermentation.
2. Estimation of Ethanol by dichromate method.
3. Production of Ethanol by fermentation and recovery.
4. Preparation of Wine from grapes by fermentation.
5. Production of glutamic acid by fermentation.
6. Microbiological Assay of Vitamin B12.

MB406 ENVIRONMENTAL MICROBIOLOGY LAB

1. Estimation of bacteria, actinomyceles and fungi in soil by dilution – Plating method.
2. Observation of air-borne microflora by petriplate exposure.
3. Effect of pesticides on pure cultures of bacteria.
4. DO Estimation.
5. BOD Estimation.
6. COD Estimation

MB407 FOOD AND AGRICULTURE MICROBIOLOGY LAB

1. Microbiological examination of milk & milk products.
2. Preparation of Yoghurt
3. Microbiological examination of fresh & canned foods.
4. Microbiological quality testing of milk (MBRT test)
5. Isolation of yeasts from grapes.
6. Culturing of Mushrooms.
7. Isolation of Rhizobium from root nodules.
8. Isolation of Azotobacter from soil.

MB408 BIOSTATISTICS AND RESEARCH METHODOLOGYLAB

1. Classification of data, computation of mean and standard deviation.
2. Simple statistical analysis with Excel.
3. Correlation and regression coefficients.
4. Fitting of straight line, a parabola, a power curve and an exponential curve.
5. Analysis of data using Student’s "t" test
6. One way ANOVA with equal number of observations and with unequal number of observations and ANOVA with two way classified data.
7. Preparation of model research article
8. Preparation of model project proposal.

Adikavi Nannaya University, Rajamahendravaram
M.Sc Microbiology I Semester
Model Question Paper: Paper-I
MB101 General Microbiology

Time: 3hours **Max. Marks: 75**

Answer ALL questions.
All questions carry equal marks

Section-A

1. a) Discuss the various kingdoms of organisms and classification criteria of phylogenetic tree.

   (OR)

   b) Explain the importance of Bergy's Manual classification in bacterial taxonomy.
2. a) Write the sterilization techniques for the control of microorganisms.

   (OR)

   b) Explain the different staining and culturing methods of microorganisms.
3. a) Explain the growth kinetics of microbial cells.

   (OR)

   b) Discuss the ultrastructure and chemical composition of spirochetes and rickettsiae.
4. a) Discuss the economic importance of fungi with examples.

   (OR)

   b) Write Fritsch's classification of algae with their economic importance.

Section-B

5. Answer any **FIVE** of the following:

   a) Numerical Taxonomy
   b) Flagella
   c) Microsomes
   d) Enrichment media
   e) Synchronous culture
   f) Mycoplasma
   g) Slime mold
   h) Plasmodium

Adikavi Nannaya University, Rajamahendravaram
M.Sc Microbiology I Semester
Model Question Paper: Paper-II
MB102 Bacteriology and Virology

Time: 3hours **Max. Marks: 75**

Answer ALL questions.
All questions carry equal marks

Section-A

1. a) Explain the reproduction modes of bacteria.

   (OR)

   b) Discuss the ultrastructure, chemical composition and life cycle of Mycobacterium.
2. a) Brief out the industrial and ecological importance of bacteria.

   (OR)

   b) List the bacterial sensitivity tests and the factors contributing for the antibiotic resistance.
3. a) Discuss the physicochemical and biological properties of viruses.

   (OR)

   b) Explain the isolation, cultivation and maintenance of viral culture.
4. a) Discuss the structure, complexity and diversity of viral genomes.

   (OR)

   b) Explain the expression and vector mediated viral genome transmission.

Section-B

5. Answer any **FIVE** of the following:

   a) streptococcus
   b) Serial dilution
   c) Bio pesticides
   d) Antibiogram
   e) Viral envelope
   f) Monolayer cell culture
   g) Positive sense of RNA genome
   h) Interferon therapy

Adikavi Nannaya University, Rajamahendravaram
M.Sc Microbiology I Semester
Model Question Paper: Paper-III
MB103 Biomolecules

Time: 3hours **Max. Marks: 75**

Answer ALL questions.
All questions carry equal marks

Section-A

1. a) Explain the physicochemical properties and biological role of monosaccharides.

(OR)

b) Describe the classification, structure and properties of fatty acids.

2. a) Write the different structural confirmations of proteins.

(OR)

b) Explain protein sequencing and characterization by various methods.

3. a) Write the chemical structure, dietary sources, biochemical function and deficiency diseases of vitamins.

(OR)

b) Explain the structure, function and properties of DNA.

4. a) Describe the bacterial photosynthesis and the photosynthetic electron transport system.

(OR)

b) Describe the role of trace elements in Microbial enzymes.

Section-B

5. Answer any **FIVE** of the following:

a) stereoisomerism
b) Prostaglandins
c) Denaturation
d) Isoelectric point
e) cytochromes
f) Cot curve
g) Redox carriers
h) Trace elements

Adikavi Nannaya University, Rajamahendravaram
M.Sc Microbiology I Semester
Model Question Paper: Paper-IV
MB104-Analytical Techniques

Time: 3hours **Max. Marks: 75**

Answer ALL questions.
All questions carry equal marks

Section-A

1. **a)** Explain the principle, instrumentation, and applications of Microscopy.

   (OR)

   b) Describe the principle, instrumentation and applications of preparative and analytical ultracentrifugation.
2. a) Describe the principle, and application of ion exchange and affinity chromatography.

   (OR)

   b) What is vertical electrophoresis? Write the principle, instrumentation, and applications of SDS PAGE.
3. a) Write the principle, instrumentation, and uses of UV, visible, infrared spectroscopy.

   (OR)

   b) Describe the principle and applications of X ray diffraction.
4. a) What is radioactive? Explain about liquid scintillation counter.

   (OR)

   b) What is freeze drying? Explain its applications in biological systems.

Section-B

5. Answer any **FIVE** of the following:

   a) Fluorescence
   b) NMR
   c) TLC
   d) Lyophilization
   e) Agarose
   f) Isoelectric focusing
   g) Isotope
   h) Density gradient centrifugation

Adikavi Nannaya University, Rajamahendravaram
M.Sc Microbiology II Semester
Model Question Paper: Paper-I
MB201 Microbial Physiology and Metabolism

Time: 3hours **Max. Marks: 75**

Answer ALL questions.
All questions carry equal marks

Section-A

1. a) Discuss the modes of respiration and nutritional types in microorganisms.

   (OR)

   b) Describe the growth kinetics and methods of growth measurement in microorganisms.
2. a) Discuss the fermentation of microorganisms by Embden –Meyerhof pathway.

   (OR)

   b) Explain the synthesis of peptidoglycans and glycoproteins.
3. a) Discuss the synthesis of histidine by microorganisms.

   (OR)

   b) Explain the mechanism of transamination reactions.
4. a) Explain the bio synthesis of fatty acids.

   (OR)

   b) Describe the *denovo* pathway of purine biosynthesis.

Section-B

5. Answer any **FIVE** of the following:

   a) Synchronous culture
   b) Germination of spores
   c) Glyoxylate cycle
   d) Chemosynthetic microbes
   e) Decarboxylation
   f) Signal transduction
   g) Unsaturated fatty acids
   h) Aflatoxin

Adikavi Nannaya University, Rajamahendravaram
M.Sc Microbiology II Semester
Model Question Paper: Paper-II
MB202 Cell Biology and Enzymology

Time: 3hours **Max. Marks: 75**

Answer ALL questions.
All questions carry equal marks

Section-A

1. a) Discuss the structure and function of mitochondria.

(OR)

b) Write about plasma membrane structure, composition and its functions.

2. a) Discuss the mechanism of G proteins and their signal transduction.

(OR)

b) Explain the process of meiotic division in a cell.

3. a) Describe the kinetics of enzyme substrate reaction.

(OR)

b) Explain the methods to determine the enzyme activity.

4. a) Discuss the mechanism of ribonuclease enzyme catalysis.

(OR)

b) Give a brief description on different types of enzyme inhibitions.

Section-B

5. Answer any **FIVE** of the following:

a) Mesosomes
b) PS I & PS II
c) Ras pathway
d) Cyclic nucleotides
e) Vmax and Kcat
f) Coenzymes
g) Myoglobin
h) Immobilized enzymes

Adikavi Nannaya University, Rajamahendravaram
M.Sc Microbiology II Semester
Model Question Paper: Paper-III
MB203 Molecular Microbial Genetics

Time: 3hours **Max. Marks: 75**

Answer ALL questions.
All questions carry equal marks

Section-A

1. a) Discuss the molecular organization of chromosomes.

(OR)

b) Write about molecular workers to detect gene polymorphisms.

2. a) What are plasmids? Give an explanation on drug resistance (R) plasmids.

(OR)

b) Describe about transposable elements and their functions

3. a) Discuss about molecular basis of gene mutations.

(OR)

b) Describe the site directed mutagenesis and methods to screen mutants.

4. a) Explain the process of bacterial conjugation.

(OR)

b) Describe the mapping of bacterial chromosome by interrupted mating and transduction.

Section-B

5. Answer any **FIVE** of the following:

a) Cot cures
b) Telomere
c) Sex plasmid
d) Retroposons
e) Intercalating substances
f) Carcinogens
g) Inheritance
h) Tetrad analysis

Adikavi Nannaya University, Rajamahendravaram
M.Sc Microbiology II Semester
Model Question Paper: Paper-IV
MB204 Immunology

Time: 3hours **Max. Marks: 75**

Answer ALL questions.
All questions carry equal marks

Section-A

1. a) Write about various immune cells of the body.

(OR)

b) Discuss about ELISA test to diagnose immune cells.

2. a) Describe the structure, classification and function of immunoglobulins .

(OR)

b) Explain the components and function of the compliment system.

3. a) Write about the differentiation and maturation of T-Lymphocytes.

(OR)

b) Discuss the anti-body dependent cell mediated cytotoxicity.

4. a) Describe hypersensitive types of classes and their effects.

(OR)

b) What is auto immunity? Discuss with types and examples.

Section-B

5. Answer any **FIVE** of the following:

a) Neutrophils
b) Immune diffusion
c) Phagocytosis
d) Mono clonal anti bodies
e) Memory B-cell
f) CTL
g) Immuno suppression
h) SCID

Adikavi Nannaya University, Rajamahendravaram
M.Sc Microbiology III Semester
Model Question Paper: Paper-I
MB301 Molecular Microbiology

Time: 3hours **Max. Marks: 75**

Answer ALL questions.
All questions carry equal marks

Section-A

1. a) Discuss the expression to show that DNA as genetic material.

(OR)

b) Write about oncogenes, with their biological effects.

2. a) Describe DNA replication in prokaryotes.

(OR)

b) Write about transcription mechanism in micro organisms

3. a) Discuss about genetic code and its rules to code amino acids.

(OR)

b) Discuss the mechanism of translation.

4. a) Explain the regulation of gene expression at by lac operon.

(OR)

b) Discuss the gene regulation in lambda.

Section-B

5. Answer any **FIVE** of the following:
   a) Carcinogens
   b) Split genes
   c) Meselson – Stahl's studies
   d) Promoters
   e) Triplet code
   f) Inhibitors of protein synthesis
   g) Structural genes
   h) Catabolite repression

Adikavi Nannaya University, Rajamahendravaram
M.Sc Microbiology III Semester
Model Question Paper: Paper-II
MB302 Genetic Engineering

Time: 3hours **Max. Marks: 75**

Answer ALL questions.
All questions carry equal marks

Section-A

1. a) Describe DNA sequencing by Maxam-Gilbert and dideoxy methods.

   (OR)

   b) Explain PCR with its principle, types and applications.
2. a) What are cloning vectors? Explain plasmids, cosmids and bacteriophages.

   (OR)

   b) Write about isolation of poly mRNA, synthesis of c-DNA and cloning of c-DNA in bacteria.
3. a) Write the expression of cloned genes in bacteria and yeast.

   (OR)

   b) Discuss the biological applications of recombinant DNA technology.
4. a) Explain DNA micro array technology.

   (OR)

   b) Explain the analysis of SNPs using microarray technology.

Section-B

5. Answer any **FIVE** of the following:

   a) Restriction endonucleases
   b) DNA finger printing
   c) DNA ligases
   d) Recombinants
   e) clone
   f) Transgenic animals
   g) Molecular markers
   h) Single nucleotide polymorphisms

Adikavi Nannaya University, Rajamahendravaram
M.Sc Microbiology III Semester
Model Question Paper: Paper-III
MB303 Bioinformatics, Microbial Genomic and Proteomics

Time: 3hours **Max. Marks: 75**

Answer ALL questions.
All questions carry equal marks

Section-A

1. a) Discuss protein domains and human genome analysis program (BLAST, FASTA, GCC etc.) search.

   (OR)

   b) Describe data bases for nucleic acid and protein sequences and structure determination.
2. a) Explain Homology or comparative modeling.

   (OR)

   b) Write about molecular docking technology.
3. a) Describe whole genome analysis.

   (OR)

   b) Explain computational methods for sequence analysis.
4. a) Discuss system approaches using high through put technologies for biomining microorganisms.

   (OR)

   b) Write about applications of omic tools in biodegradation and medicine.

Section-B

5. Answer any **FIVE** of the following:

   a) Database
   b) Metabolomics
   c) Threading
   d) Drug discovery
   e) Gilbert method of sequencing
   f) PFAM
   g) Biodegradation
   h) ICAT

Adikavi Nannaya University, Rajamahendravaram
M.Sc Microbiology III Semester
Model Question Paper: Paper-IV
MB304 Medical Microbiology

Time: 3hours **Max. Marks: 75**

Answer ALL questions.
All questions carry equal marks

Section-A

1. a) What is infection? Explain the mode of infection and routes of transmission into the body.

   (OR)

   b) Discuss about the pathology of disease caused by Salmonella.
2. a) Explain the pathology of disease caused by Penicillium.

   (OR)

   b) Describe the pathology of disease caused by Trypanosoma gambiense.
3. a) What are the methods of transmission and role of vectors in disease transmission?

   (OR)

   b) Explain the problems of drug resistance and drug sensitivity.
4. a) Describe the pathology and diagnosis of disease caused by poxviruses.

   (OR)

   b) Describe the nomenclature, types, classification and role of interferons.

Section-B

5. Answer any **FIVE** of the following:

   a) Normal flora
   b) Tetanus
   c) Aspergillus
   d) Entamoeba histolytica
   e) Nystatin
   f) Drug resistance
   g) Reovirus
   h) HIV

Adikavi Nannaya University, Rajamahendravaram
M.Sc Microbiology IV Semester
Model Question Paper: Paper-I
MB401 Fermentation Technology and Industrial Microbiology

Time: 3hours **Max. Marks: 75**

Answer ALL questions.
All questions carry equal marks

Section-A

1. a) Describe the methodology involved in fermentation process of microorganisms.

   (OR)

   b) Explain the screening, isolation, maintenance and preservation of microorganisms.
2. a) Discuss the different types of fermenters and their designs used in fermentation technology.

   (OR)

   b) Explain the recovery and purification process of fermented products.
3. a) Describe the production of ethyl alcohol by microorganisms.

   (OR)

   b) Write about role of microorganisms in petroleum industry.
4. a) Discuss about genetically modified organisms and their role.

   (OR)

   b) Explain the concept of patenting biotechnology inventions.

Section-B

5. Answer any **FIVE** of the following:

   a) Antifoam
   b) strain preservation
   c) Fed batch culture
   d) Inoculum development
   e) Biosensors
   f) Microbial leaching
   g) Biogas production
   h) IPR

Adikavi Nannaya University, Rajamahendravaram
M.Sc Microbiology IV Semester
Model Question Paper: Paper-II
MB402 Environmental Microbiology

Time: 3hours **Max. Marks: 75**

Answer ALL questions.
All questions carry equal marks

Section-A

1. a) Discuss the various levels of organization of organisms in ecosystem with their energy transfers in the food chains.

   (OR)

   b) Explain the growth kinetic properties and prey-predator relationships.
2. a) Describe the characteristics of fresh water and salt water organisms.

   (OR)

   b) Explain the techniques and principles of air sampling.
3. a) Describe the microbial production of environmental pollutants.

   (OR)

   b) Explain the various methods of sewage treatment.
4. a) Discuss about bioremediation technology.

   (OR)

   b) Write about deterioration of material and their impact on the environment.

Section-B

5. Answer any **FIVE** of the following:

   a) Tropic levels
   b) Growth in closed environment
   c) IMVIC test
   d) Diurnal periodicity
   e) BOD
   f) Eutrophication
   g) Biofouling
   h) Microbial deterioration

Adikavi Nannaya University, Rajamahendravaram
M.Sc Microbiology IV Semester
Model Question Paper: Paper-III
MB403 Food and Agricultural Microbiology

Time: 3hours **Max. Marks: 75**

Answer ALL questions.
All questions carry equal marks

Section-A

1. a) Discuss the microbial flora of various food components.

(OR)

b) Explain the techniques for the microbial examination of foods.

2. a) Describe the methods used for processing and preservation of foods.

(OR)

b) Write about the preparation of Yogurt from microbial species.

3. a) Describe the soil structure, soil profile physic chemical conditions and microbial composition of soil environment.

(OR)

b) Describe Nitrogen cycle and the role of microorganisms in this cycle.

4. a) Discuss the role of microorganisms as bio fertilizers.

(OR)

b) Explain the importance of microorganisms in biological control.

Section-B

5. Answer any **FIVE** of the following:

   a) Total colony counts
   b) Mycotoxins
   c) Pasteurization
   d) Single cell protein
   e) Cellulose decomposition
   f) Biochelators
   g) Rhizobium
   h) Biopesticides

Adikavi Nannaya University, Rajamahendravaram
M.Sc Microbiology IV Semester
Model Question Paper: Paper-IV
MB404 Biostatistics and Research Methodology

Time: 3hours **Max. Marks: 75**

Answer ALL questions.
All questions carry equal marks

Section-A

1. a) Discuss the scope of statistics in handling the population data.

   (OR)

   b) Describe the concept of probability.
2. a) Discuss the types of errors and levels of significance used in statistics.

   (OR)

   b) Explain parametric tests of significance.
3. a) Discuss the methodology of conducting research experiment.

   (OR)

   b) Explain the analysis of raw data and the interpretation of the results.
4. a) Describe the methodology in writing a research paper.

   (OR)

   b) Explain the process involved in communicating a project proposal.

Section-B

5. Answer any **FIVE** of the following:

   a) Histogram
   b) Standard deviation
   c) Linear regression
   d) Chi square test
   e) Hypothesis
   f) Experimental design
   g) Budget proposal
   h) Impact factor