BACHELOR OF SCIENCE (B.Sc.)

(THREE YEAR DEGREE COURSE)

SUBJECT

MICROBIOLOGY
B.Sc. (MICROBIOLOGY)

COURSE STRUCTURE

FIRST YEAR

PAPER – 101: General Microbiology 50 MARKS
PAPER – 102: Basic Bio-Chemistry 50 MARKS
PAPER – 103: Principles of Bioinstrumentation and Techniques 50 MARKS
PAPER – 104: PRACTICAL 50 MARKS

SECOND YEAR

PAPER – 201: Microbial Physiology and Genetics 50 MARKS
PAPER – 202: Molecular Biology & Genetic Engineering 50 MARKS
PAPER – 204: PRACTICAL 50 MARKS
THIRD YEAR

PAPER – 301: Food & Industrial Microbiology 50 MARKS

PAPER – 302: Medical Microbiology 50 MARKS

PAPER – 303: Environmental & Agricultural Microbiology 50 MARKS

PAPER – 304: PRACTICAL 50 MARKS
B.Sc. (MICROBIOLOGY)  
FIRST YEAR DETAILED SYLLABUS  
PAPER – 101  
General Microbiology  

UNIT-I  
Scope and historical development in microbiology (contributions of pioneers), microbiology and human health, beneficial harmful microbes.  

UNIT-II  
Microbial taxonomy – principle of classification, classification of viruses, bacteria (including cyanobacteria) and fungi.  

UNIT-III  
Methods of studying micro organisms – origin of microbes, microscopy, pure culture technique, sterilization, aseptic techniques, isolation of pure culture, conditions and media for growth of micro organisms in the laboratory.  

UNIT-IV  
Characterization, Classification and identification of micro organisms by Morphological, Serological, Biochemical and Molecular examination.  

UNIT-V  

References:  

B.Sc. (MICROBIOLOGY)
FIRST YEAR DETAILED SYALLBUS

PAPER – 102

Basic Bio-Chemistry

UNIT-I
Biochemistry of Microbes, Chemical elements, structure of atoms, molecule and chemical bonds, chemical reactions, molecules of living systems, pH pK buffers, thermodynamics.

UNIT-II
Classification of Biomolecules with their structure and properties- Carbohydrates, Proteins, Lipids, nucleic acids.

UNIT-III
Metabolism of carbohydrates, lipids, proteins and nucleic acids.

UNIT-VI

UNIT-V
Membrane transport- kinetics of active and passive transport shuttle system

References
B.Sc. (MICROBIOLOGY)
FIRST YEAR DETAILED SYLLABUS
PAPER – 103
Principles of Bioinstrumentation and Techniques

UNIT-I
Basic rules of a Microbiology Laboratory - Basic requirements

Microbiology Laboratory- Basic principles, operating mechanism and applications of an autoclave, hot air oven, Laminar air flow and pH meter

Decontamination, Sterilization and disinfection

UNIT-II
Microscopy: light, phase contrast, fluorescence, dark field, electron microscopy Laser confocal microscopy and digital image analysis

Centrifugation and ultracentrifugation

Biosensors

UNIT-III
Spectrophotometric methods- Beer’s Lambert’s Law- Principles, Operating mechanism and application of colorimeter, Spectrophotometer and Fluorescence spectroscopy.

UNIT-VI
Chromatography: adsorption, gas ion exchange, gel filtration, affinity, HPLC. Radioisotope technique, nature of radioactivity, detection measurements, counters, safety aspects.
UNIT-V

Important molecular techniques like RFLP, RAPD, AFLP, DNA finger printing, PCR and Probe hybridization, Blotting techniques – Southern, Western and Northern blotting. Electrophoreses – Basic principles and their applications – Agarose gel Electrophoresis – SDS PAGE.

References:


UNIT I

Bacterial Morphology and Ultra structure :
Composition, Structure and Biosynthesis of cell wall in Gram positive and Gram negative bacteria, Physiology of bacterial growth phases of growth, growth conditions. Differentiations in bacterial cells – sporulation germination. Bacterial cell division, replication of bacterial chromosome, co-ordination of cell division with replication of chromosome, portioning of chromosome into daughter cells.

UNIT II

Primary and Secondary Metabolism.

UNIT III

Bacterial Plasmids :
Structure and properties, replication, incompatibility, plasmids amplifications.

Bacteria phages :
Lytic development cycle – T4, lytic and lysogenic development of phase 2, single standard DNA phages.

Transposition :
Structure of bacterial transposes, types of bacterial transposes. Mechanism of antibiotic resistance and spread of antibiotic resistance.

UNIT IV
Genetic Recombination:
Requirement, molecular basis, genetic analysis of recombination in bacteria.

Bacterial Genetics:
Concepts of haploid genomes, genetic exchange through conjugation, transformation and transduction (generalized and specialized).

Transformation:
Natural transformation, competence, DNA uptake, role of natural transformations, artificially induced competence, electroporation.

Conjugation:
Self transmissible plasmids, F factor, Tra genes, on T,F, and H frastrains, steps in conjugation, chromosome mobilization, transfer systems in Gram Positive bacteria.

D.N.A. repair and restriction:
Types of repair systems, restriction endonuclease, various types of restriction enzymes, their properties and uses Methylation – dependent restriction enzymes, dam and dam methylases.

Gene expression transcription, translation and control of expression in microbes.

UNIT V
Mutations:
Spontaneous and induced, base pair changes, frame shifts, deletions, inversions, tandem duplications, insertion, useful phenotypes (autotrophic, conditional lethal, resistant) reversions suppression, Ames test.

Microbial Physiology and Genetics:
Determination of growth phase of E.coli by measurement of OD and colony forming units, Relationship between OD and CFU measurements. Measurement of growth by dry weight and wet weight – Pencillium spp. Determination of antibiotic resistance by plating method.
Isolation of E.coli plasmid DNA rapid method and separation by agarose gel electrophories.

**Transformation of E.coli:**

Preparation of competent cells determination of viable counts, efficiency of plasmids transformation. Infection of E.coli with phage T4, determination of phage titer by plating method.

**Induction of Lac Operon :**

Culture of E.coli, induction by IPTG, measurement of b-galactosidase activity over a time period of 2 hour. Conjugation in E.coli using plate method.

**Reference:**


B.Sc. (MICROBIOLOGY)
SECOND YEAR DETAILED SYALLBUS

PAPER – 202

Molecular Biology and Genetic Engineering

UNIT I

History of molecular biology, model systems, concepts of molecular biology, early history of genetic, engineering, genetic engineering concepts, ethical issues.

UNIT II

Structure of biological macromolecules proteins, lipids and carbohydrates, nucleic acids, chemical structure of bases, phosphodiester bond, hydrogen bond, higher order structure, proteins, amino acid structure, folding of proteins, proteins with subunits, enzymes.

UNIT III

Function of macromolecules, early observation on the mechanism of heredity, DNA as genetic material, basic mechanism of replication, enzymes involved in replication, enzymes involved in transcription mechanism, translation, genetic code, regulation of genes expression, transcripts, translation and control of expression in microbes.

UNIT IV

DNA repair and restriction, types of repair systems, restriction modifications systems, types of restrictions enzymes, properties and uses, methylation. Biology of plasmids bacteriophages, lytic vsolysogenic phages single standard DNA phages MI3, restriction modification systems, restriction enzymes.

UNIT V

Plasmids and phage vectors, restriction and ligation of vector and passenger DNA, transformation of host cells selection vs screening of recombinant colonies,
analysis of recombinant clones, DNA sequencing protein separation and identification methods.

**Practical:**

Characterization of genetic markers of known bacterial strains.

Phage growth curve.

Isolation of DNA from bacteria.

Isolation of DNA and plasmids DNA and restriction analysis.

Simple Cloning using plasmids DNA as vector and transformation of competent E.coliul cells.

Electrophoretic Analysis of proteins.

**References:**


B.Sc. (MICROBIOLOGY)
SECOND YEAR DETAILED SYLLABUS
PAPER – 203

Bio – Statistics & Computer Application

UNIT I
Nature and scope of statistical methods and their limitations compilation, classification, tabulation and applications in life sciences – graphical representation measures of averages and dispersion stem and leaf plots. Box and Whisker plots, coplots, introduction to probability theory and distributions (concepts without derivations) binomial, Poisson and normal (only definition and problems).

UNIT II
Correlation and Regression – concepts of sampling and sampling distribution – tests of significance based on t-chi square and F for means, properties, variances and correlation efficient, theory of attributes and tests if independence of contingency tables.

UNIT III
Sampling Methods – Simple random, stratified, systematic and cluster sampling procedures, sampling and non-sampling errors, principles of scientific experiments – analysis of variance – one way and two way classifications – CRD, RBD and Latin Square design.

UNIT IV
Introduction to computers – classification of computer generation – row, median and high level languages – software and hardware – operating system compliers and interpreters – personnel, frame and super computers, their characteristics and applications, BIT, BYTE, WORD, character memory and its types, data representation and storage – binary codes, binary system and its relationship to Boolean Operations.
UNIT V

Microsoft Excel – Data entry graphs aggregate function formations and functions different number systems and conversions input output devices, secondary storage media. Important molecular techniques Lipo, PFLP, RAAD, AFLP, DNA finger printing, PCR and prove hybridization.
B.Sc. (MICROBIOLOGY)
THIRD YEAR DETAILED SYLLABUS
PAPER – 301
Food & Industrial Microbiology

UNIT I
Food as a substance for micro – organism, micro organisms important in food microbiology – molds yeasts and bacteria, brief account of each group, general characteristics and importance principles of food preservation – asepsis removal of microorganisms, anaerobic conditions high and low temperature drying chemical preservatives food additives.

UNIT II
Food spoilage and food borne infections, general principles underlying food spoilage and contamination, canned food sugar products, vegetables, fruits, meat and meat products, milk and milk products, fish, seafood and poultry spoilages, food poisoning infective and toxic bacterial.

UNIT III
General concepts of industrial microbiology, principles of exploitation of micro-organisms and their products, screening, strain development strategies, immobilization methods, adsorption covalent linkages – advantages and disadvantages, raw materials used in media production industrial sterilization fermentation equipment and its uses, types of fermentation single, batch, continuous, dual or multiple, surface, submerged and solid state fermentation.

UNIT IV
Food fermentation and food produced by microbes, bread, cheese, vinegar, fermented dairy products and oriental fermented foods, microbial cells as food single cell proteins - Mushrooms cultivation, production of alcohol and fermented beverages, beer and wine.
UNIT V

Industrial products derived from microbes, industrial ezymes – amylase proteinase, cellulose, amino acid production – gluamic acid and lysine production of antibiotics penicillin’s, streptomycin, vitamins riboflavin, cyanocobalamin. Vaccines genetic recombinant vaccines.

Practical:

Bacteriological analysis of food products: Direct microscopic studies and standard plate count in milk.

Reduclase test of milk: dye reduction test.

Isolation of micro organisms from common food items such as a curd. Pan masala and bread.

References:


B.Sc. (MICROBIOLOGY)
THIRD YEAR DETAILED SYLLABUS
PAPER – 302
Medical Microbiology

UNIT I
Historical background, innate acquired immunity, humeral and cell medicated immunity, organs and cells involved in immune response, identification and characterization of T and B cells, cell surface respects, cellular cooperation, MHC restriction antigen, characterized types of antigens, adjutants, immunogenicity, antigenicity antigen-antibody reactions.

UNIT II
Humeral immune response, immunoglobulin structure and properties theories of antibody diversity, isotope switching monoclonal antibodies antigen-antibody reactions, complement, complement activation.

UNIT III
Characterization and types of T-cells macrophage activation, cytokines types of hypersensitivity, antibody dependent cell medicated cytotoxicity, principles of serological test methods with examples.

UNIT IV
Diseases caused by certain specific pathogens Staphylococcus aureus, streptococcus, phenmoniae, mpeobacterium mbereclosis, salmonella typhi, vibria cholerae, human hnmuno, deficiency virus, hepartius virus, entamoeba histoytica, plasmodium species, dermatophiles, collection and transport of appropriate clinical samples for clinical diagnostics.
UNIT V

Elements of chemotherapy, principles, drug microbe host interaction, basic mechanism of drug action, drug resistance, major antimicrobial agents, non automated in vitro drug susceptibility testing, rapid test for antimicrobial susceptibility, general principles and clinical use of antimicrobial testing, rapid test for antimicrobial susceptibility, general principle and clinical use of antimicrobial drugs.

Practical:

Selection, collection and transport of specimens, blood samples, sera for microbiological and immunological investigations.

Preparation of different types of culture media for growing pathogenic bacteria.

Staining techniques such as Gram’s staining, AFB staining, Albert’s staining and Giemsa’s staining.

Preparation of buffers, regents.

Tissue culture techniques and demonstration of handling of animals.

Separation of lymphocytes from blood and counting in hemocytometer.

Agglutination Tests (Haemagglutination and Haemolysis Technique), blood grouping and widal test.

Perception test – single radial immune diffusion, immuno electrophoresis, separation of serum proteins by electrophoresis.

Enzyme linked immunosorbant assay.

Isolation and identification of major bacterial pathogens such as staphylococcus aureus and E.coli.

References:


B.Sc. (MICROBIOLOGY)

THIRD YEAR DETAILED SYLLABUS

PAPER – 303

Environmental & Agricultural Microbiology

UNIT I

Aerobiology:
Definition – droplet nuclei-aerosol – assessment of air quality – some important air borne disease caused by bacteria fungi, virus their symptoms and preventive measures.

UNIT II

Soil Microbiology:
Physical and chemical characteristics and micro flora of various soil types, orhizosphere phyllosphere brief account of microbial interactions symobsis mtualism commensalism competition amensalism synergism parasitism predation rumen microbiology, bio-fertilizers biological nitrogen fixation nitrogenous enzymes nif symbiotic nitrogen fixation (Rhizobium, Frankia) non symbiotic nitrogen fixation (Azotobacter – Azospirillum), VAM ecto endo – ectendomycomzae.

UNIT III

UNIT IV

Aquatic Microbiology:

Eco-systems – fresh water (ponds, lakes, streams, marines, mangroves, deep sea), water zonations upwelling eutrophication food chain, portability of water microbial assessment water quality water purification brief account of water borne diseases and preventive measures.

UNIT V

Waste Treatment:


Practical:

Enumeration and isolation of soil micro organisms agar plate technique, direct microscopic and enrichment culture technique – bacteria, fungi, virus, protozoa from different soil types, preparation of Winogradsky column to study various soil micro flora, isolation of Rhizobium Frankia.

Techniques for microbial sampling of air from various sources, assessment of air quality by solid liquid impingement techniques and enumeration of them by plating technique and turbidometric method.

Bacterial examination of water for portability, micro – organisms, E-colis Staphyloccoci Faecalis as indicators of pollution, MPN index – IMVIC test – Endo agar.

Testing of water, soil and sewage for physico – chemical parameters including COD and BOD anaerobiosis biomethanation.

Field trip to ponds, coastal areas and surveying the area for various above said characters.
References:


2. Bagymaj and Rangasamy, Agricultural Microbiology.

