



# **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 – 203: Bio – Statistics & Computer Application	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 SYALLBUS**

### **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**

Micro organisms – The Morphology, fine structure, reproduction and growth of bacteria, Fungi, Viruses, General account on Protozoa and Algae.

##### **References:**

1. Pelczar (2003), Microbiology, Tata MacGraw Hill, Edition 902 pp.

2. Ronald M. Atlas (1989), Basic Experimental Microbiology, Prentice Hall 316 pp.
3. Roben F. Boyed (1984) General Microbiology, Times Mirror / Mosby College Publication.

# **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**

Enzymes Definition, classification of enzymes with one example. Mechanism of enzyme action. Lock and key mechanism, induced fit theory. Property: specificity Isoenzyme: Definition with one example. Factors affecting enzyme activity. pH, temperature and substrate concentration. Michaleis- Menton equation. Biological functions of enzymes.

##### **UNIT-V**

Membrane transport- kinetics of active and passive transport shuttle system

##### References

1. Stryer (1995) Biochemistry, W.H. Freeman & Co. 1064pp.
2. Nelson and Con (2000) Lehninger Principles of Biochemistry, Macmillan 1152pp.
3. U.Satyanarayana,(2002) Biochemistry, Books and Allied (p) Ltd. 652pp

4. Voet and Voet,(1995), Biochemistry, John Willey and Sons, 1361pp.

# **B.Sc. (MICROBIOLOGY)**

## **FIRST YEAR DETAILED SYLLBUS**

### **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:**

1. Wilson and Wilker (2000), Practical Biochemistry – Principles and Techniques, Cambridge University Press, 770pp.
2. K.R. Aneja (2001), Experiments in Microbiology Plant Pathology Tissues Culture and mushroom Production Technology, New age International Publishers.

# **B.Sc. (MICROBIOLOGY)**

## **SECOND YEAR DETAILED SYALLBUS**

### **PAPER – 201**

#### **Microbial Physiology and Genetics**

##### **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 phage 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.coil 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.coil plasmid DNA rapid method and separation by agarose gel electrophories.

**Transformation of E.coil:**

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

**Induction of Lac Operon :**

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

**Reference:**

1. Acamo, I.E. Laboratory Fundamentals of Microbiology, 2001 Jones and Bartlett Publishers.
2. Wolfgang K, Joklik (1995), Zinsers Microbiology, Mc Grw-Hill Companies, 1294pp.
3. Stanley R. Maloy, David Freifelder and John E. Cronan (1994), Microbial Genetics (2<sup>nd</sup> Ed.) Jones and Bartiett Publishers, 512pp.
4. Lany Smyder and Wendy Champness (1995), Molecular Genetics of Bacteria, ASM Press, 672pp.

# **B.Sc. (MICROBIOLOGY)**

## **SECOND YEAR DETAILED SYLLBUS**

### **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 vs lysogenic phages single standard DNA phages M13, 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.coli cells.

Electrophoretic Analysis of proteins.

**References:**

1. George M. Malacinski (1998) Essentials of Molecular Biology (3<sup>rd</sup> Ed.) Jones and Bratlett Publishers, 560pp.
2. Benjamin Lewin (1998), Genes VII, Oxford University Press, 100pp.
3. Philipp Gerhardt Manual of Methods for General Bacteriology, ASM, 536pp.

# **B.Sc. (MICROBIOLOGY)**

## **SECOND YEAR DETAILED SYLLBUS**

### **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 – low, median and high level languages – software and hardware – operating system compilers and interpreters – personal, 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 SYALLBUS**

### **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 enzymes – amylase, proteinase, cellulase, amino acid production – glutamic 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.

Reductase test of milk: dye reduction test.

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

### References :

1. Arnold L. Demain, Julian E. Davies (1998), Manual of Industrial Microbiology and Biotechnology, ASM Press, 500pp.
2. Whitaker and P.F. Stanbury (1995), Principles of Fermentation Technology Butterworth, Heinemann, 348pp.
3. William C. Frazier and Dennis Westhoff (1998), Food Microbiology, Mc Graw Hill Companies, 576pp.
4. Sneecar, G. W. and Cochran W.G. (1967), Statistical Methods, Oxford Press.
5. Danal, W.W. (1995), Biostatistics: A foundation for analysis in Health Sciences (6<sup>th</sup> Edition), John Wiley, 780pp.
6. Celton T. (1947), Statistics in Medicine, Little Brown, Boston.
7. Campbell R.C. (1989), Statistics for Biologists, Cambridge University Press, 464pp.
8. Bland, M. (1989), An Introduction to Medical Sciences, Oxford Medical Publication.

# **B.Sc. (MICROBIOLOGY)**

## **THIRD YEAR DETAILED SYALLBUS**

### **PAPER – 302**

#### **Medical Microbiology**

##### **UNIT I**

Historical background, innate acquired immunity, humeral and cell mediated 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, adjuvants, 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 mediated cytotoxicity, principles of serological test methods with examples.

##### **UNIT IV**

Diseases caused by certain specific pathogens Staphylococcus aureus, streptococcus, pneumoniae, mycobacterium tuberculosis, salmonella typhi, vibrio cholerae, human immunodeficiency virus, hepatitis virus, entamoeba histolytica, plasmodium species, dermatophytes, 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, reagents.

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:**

1. Ellenjo Bacon, (1994), Bailey and Scouts Diagnostic Microbiology (9<sup>th</sup> Edition), 958pp.

2. A Hand Book of practical and clinical immunology, G.H. Talwar and D.K. Gupta (2<sup>nd</sup> Edition), 1992, CBS Publication, New Delhi, India.
3. Mackie and McCartney, 14<sup>th</sup> Edition, Vol. II, Practical Medical Microbiology Ed., J.G. College, A.G. Fraser, B.P. Marmion A. Simmons: Churchill Livingstone, 1986.

# **B.Sc. (MICROBIOLOGY)**

## **THIRD YEAR DETAILED SYALLBUS**

### **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 – ectendomycormzae.

##### **UNIT III**

Major biogeochemical cycles and the organisms carbon – nitrogen – phosphorous and sulphur – a brief mention about biodegradation – xenobiotics – bioaccumulation – biopesticides – determination.

## UNIT IV

### **Aquatic Microbiology:**

Eco-systems – fresh water (ponds, lakes, streams, marines, mangroves, deep sea), water zonation 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:**

Types of wastes characterization of solid and liquid wastes treatment and useful by products, solids saccharification – gasification – composting – liquid waste treatment aerobic – anaerobic methods.

### **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-coli Staphylococci 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:**

1. Bkaer, K.H. and Herson, D.S. 1994, Bio Remediation, McGraw Hill Inc., New York.
2. Bagymaj and Rangasamy, Agricultural Microbiology.
3. Martin Alexander (1998)., Bio-degradation and Bio-remediation, Academic Inc., 14pp.
4. Standard Methods for ex. Of water and waste water – L.S. Clesceri, A.E. Greenberg, A.D. Eaton APHA, 1998.
5. Experimental Microbial Ecology, R.G. Burns and J.H. Slater (1982), Blackwell Scientific Publication.