

## **Department of Microbiology:**

### **B.Sc. Microbiology**

**Microbiology is the study of all living organisms that are too small to be visible with the naked eye. This includes bacteria, archaea, viruses, fungi, prions, protozoa and algae, collectively known as 'microbes'. Microbiology and its application also will be studied in Microbiology.**

#### **Programme outcome:**

##### **Knowledge outcomes:**

After completing B.Sc. Microbiology, Students will be able to:

- **PO 1:** know the understanding of microbes and its structure and cell sustainability
- **PO 2:** know about microscope working principle, different types and its application
- **PO 3:** get information about physiology and metabolism of microbes
- **PO 4:** Know the air and water microbiology
- **PO 5:** get knowledge of various related field like medical and clinical aspects
- **PO 6:** Understand the process of Fermentation, rDNA technology
- **PO 7:** Understand the terminology “ OMICS” of cell biomolecule

##### **Skill Outcomes:**

After completing B.Sc. Microbiology, Students will be able to:

- **PO 8:** understand the basic of microbiology laboratory practices
- **PO 9:** identify the different bacterial structure through different staining method
- **PO 10:** detect different water and food analysis ( Qualitative & quantative)
- **PO 11:** isolate and differentiate different microbed from environment sources
- **PO 12:** detect different physiological parameter which affect the microbial growth
- **PO 13:** perform different medical and clinical test and diagnosis of it.

##### **Generic outcomes:**

After completing B.Sc. Microbiology, Students will be able to:

- **PO 14:** enhance their understanding about life and life processes
- **PO 15:** Increase their way of communication , personal development
- **PO 16:** enhance their scientific knowledge and relate this applies knowledge for betterment of society

# **Course Outcomes**

## **Microbiology Semester 1**

### **BSC0C105: Introduction to Microbiology and microbial diversity**

#### **Unit 1: DIVERSE TYPES OF MICROBES**

**CO1:** Students will understand about eukaryotes and prokaryotes cell

**CO2:** Also learn about virus and scope relevant to microbiology

#### **Unit 2: THE HISTORY AND SCOPE OF MICROBIOLOGY**

**CO3 :**To understand the detail history about microbiology and origin of life.

**CO4:** Student will learn about application of microbiology relevant to micro world

**CO5:** Also get knowledge about “Nanotechnology” and most auspicious term “Bioinformatics

#### **Unit 3: THE STUDY OF MICROBIAL STRUCTURE: MICROSCOPY AND SPECIMEN PREPARATION**

**CO6:**One may get knowledge about working principle of different type of microscope used in various applications

**CO7:**Student get knowledge about highly research based electron microscope and its application

**CO8:** Also get information about dyes, stain and staining preparation, slide preparation and different staining procedure

#### **Unit 4: BIOMOLECULES:**

**CO9:** One may understood about biomolecules and its structure, classification and its significance

### **BSCOP105- MICRO-PR : PRACTICALS (MICROBIOLOGY)**

**CO1:** Students will understand about various Instruments used in microbiology laboratory and learn about various bacterial cell surface structure by preparing different staining techniques.

## Microbiology Semester 2

### BSC205 : Taxonomy and Bacteriology

#### **Unit 1: Classification of Microbes**

**CO1:** Students will understand about ancient to novel taxonomy of prokaryotic organisms and learn to differentiate between eubacteria and archaebacteria

#### **Unit 2: Prokaryotic Cell Structure and Function**

**CO2:** One may understand about prokaryotic cell structure and their importance and functions i.e. cell membrane, cell wall, capsule, slime layer etc.

**CO3:** Also learn about external cell structure i.e. pili, fimbriae, flagella.

#### **Unit 3: Microbial Nutrition and Growth**

**CO4:** One may understand about nutrition of microbes like media preparation, growth factor

**CO5:** Also learn about nutritional type of bacteria

**CO6:** Students will be ready to understand how to grow bacteria on different types of media and learn about pure culture techniques

**CO7:** Also learn about pattern of bacterial growth with respect to environment condition which is provided to them and factors affecting their growth

#### **Unit 4: Control Of Microbes: Physical Methods & Chemical Methods**

**CO8:** Students will understand about different physical and chemical agents which are used to control microorganisms.

### BSC 205 PRACTICALS (MICROBIOLOGY)

**CO1:** Students will learn to see different parts of bacteria by performing different staining methods

**CO2:** One can also get knowledge about different apparatus of microbiology laboratory and know to check qualitative as well as quantitative analysis of biomolecules

## Microbiology Semester 3

### BSCC305A: The Virology and Mycology

#### **Unit 1: The Viruses: Introduction and General Characteristics**

➤ **After completing this unit ,students will be able to :**

**CO1:** To know about early developments of Virology , General Properties of Viruses , The Structure of Viruses : Capsid symmetry, enveloped and non-enveloped viruses

**CO2:** To get knowledge about Virus Reproduction, Isolation and cultivation of viruses & Virus Purification and Assays

**CO3:**To get idea about Principles of Virus Taxonomy , Classification and nomenclature of different groups of viruses

#### **Unit 2: Viral Diversity**

➤ **After completing this unit ,students will be able to :**

**CO4:** Know about Animal virus , Plant virus and bacteriophages with their respective reference virus study

**CO5:** Get idea about importance of virus- human and plant diseases, vaccines, Use of viral vectors in cloning and expression, Gene therapy and Phage display

#### **Unit 3: The *Fungi* (*Eumycota*)**

➤ **After completing this unit ,students will be able to :**

**CO6:** Know about Morphology of fungi: thallus, hyphae –mycellium structure , hyphal modification

**CO7:** Get knowledge about Nutrition and Metabolism, Culture media used for fungal cultivation and Preservation of fungal cultures.

**CO8:** Understand the process of Reproduction : asexual, sexual, vegetative methods, parasexual cycle.

**CO9:**Know the importance of fungi: medical - mycosis and mycotoxins and economical importance

#### **Unit 4: Classification of fungi**

➤ **After completing this unit ,students will be able to:**

**CO10 :**Know the criteria used for classification of fungi

**CO11:** General characters, structure, habitat, reproduction, importance of

- i. Chytridiomycetes
- ii. Zygomycetes and Glomeromycetes
- iii. Ascomycetes
- iv. Basidiomycetes

## BSCC305B: Environmental Microbiology

### **Unit 1: Microbiology of air**

➤ **After completing this unit ,students will be able to:**

**CO1:** Know the Sources of microbes in air and sampling of air

**CO2:** Get idea about control of air microflora and its importance

**CO3:** Understand Air borne diseases

### **Unit 2: Microbiology of Soil**

➤ **After completing this unit ,students will be able to:**

**CO4:** Know the physicochemical characteristics of soil, soil as a culture medium and soil flora

**CO5:** Use the methods of studying soil micro flora:

i. Direct microscopic method, agar plate technique, and buried slide method

ii. Use of Winogradsky column in studying microbial diversity in soil

**CO6:** Understand microbial interactions in soil : Neutral, positive and negative associations

**CO7:** Get idea of biogeochemical cycles:

i. Nitrogen cycle

ii. Sulfur cycle

iii. Carbon cycle, humus and its significance

iv. Iron cycle

v. Phosphorus cycle

### **Unit 3: Microbiology of Water**

➤ **After completing this unit ,students will be able to:**

**CO8:** Understanding of : Freshwater Environments , marine environments , Hydrothermal Vents and Cold Seeps

**CO9:** Get idea of sources of water contamination & water purification individual & municipal

**CO10:** Know about microbial indicators of faecal pollution

i. Coliforms as indicator, need for differentiation

ii. Methods of differentiation: IMViC test and Elevated temperature test

iii. Microbial indicators other than coliforms

**CO11:** Determine Bacteriological examination of drinking water

i. Sampling

ii. Quantitative analysis: Standard plate count

iii. Qualitative analysis: Multiple tube fermentation method (presumptive, confirm and completed test), MPN, membrane filter technique, defined substrate test, P-A (Presence-Absence) test

#### **Unit 4: Microbiology of Wastewater, Waste management**

➤ **After completing this unit ,students will be able to:**

**CO12:** Differentiate BOD, COD and TOD as indicators of strength of wastewater, pollution problems due to disposal of untreated wastewater

**CO13:** Know information about of methods of wastewater treatment: solid/sludge and liquid waste

- i. Primary Treatment ,
- ii. Secondary Treatment ,
- iii. Tertiary Treatment ,
- iv. Septic Tanks,
- v. Landfills, composting, vermiculture

#### **BSCC305-MICRO PRA: Semester 3 Practical**

➤ **After performing given practical, Students will be able to:**

**CO1:** Study structure of important animal viruses (rhabdo, influenza, paramyxo, Hepatitis B & retroviruses) using electron micrographs

**CO2:** Study structure of important plant viruses (caulimo, gemini, tobacco ring spot, cucumber mosaic & alpha-alpha mosaic viruses) using electron micrographs

**CO3:** Study structure of important bacterial viruses ( $\lambda$ , T4 &  $\phi$ X174) using electron micrographs

**CO4:** Isolate and enumerate the bacteriophages from water/sewage sample using double agar layer technique

**CO5:** Study of cytopathic effects using photographs

**CO6:** Study of the vegetative and reproductive structures of following genera through temporary and permanent slides: Alternaria, Helminthosporium, Neurospora, Puccinia

**CO7:** Know slide cultivation method of fungi-molds.

**CO8:** Study of microbial quality of air by Koch's impregnation method For Enumeration of gram negative bacteria mac conkey Agar medium, blood agar media for Streptococci and for fungi PDA Agar medium plates

**CO9:** Perform direct microscopic method (buried slide) for studying soil fungal flora

**CO10:** Isolate Rhizobium, Azotobacter, actinomycetes from soil sample

**CO11:** Perform quantitative analysis of water: Standard plate count of water

**CO12:** Perform qualitative analysis of water: Detection of faecal coliforms

**CO13:** Perform multiple tube test for water analysis and BOD of water

## Microbiology Semester 4

### BSCC405A: Microbial Physiology: Metabolism

#### **Unit 1: Bioenergetics**

**CO1:** Students will learn about thermodynamics and its law, different key terminology and concept of metabolism in associated with thermodynamics of metabolic reaction

#### **Unit 2: Enzymes and Regulation**

**CO2:** One may know about concept and mechanism about enzyme and related information

**CO3:** Also learn about kinetics of enzymes with different enzyme activity and inhibition activity

#### **Unit 3: Metabolism: Energy Release and Conservation**

**CO4:** Students will understand about catabolism reaction through this unit

**CO5:** Also go through with catabolism of different biomolecules via specific pathway and cycle and its importance in microbes

#### **Unit 4: Metabolism: The Use of Energy in Biosynthesis**

**CO6:** One may understand about anabolism process

**CO7:** Take knowledge how energy is consumed by different anabolic reaction and used to synthesis different biomolecules via different pathways and cycles

### BSCC405B: Microbiology Of Food And Milk

#### **Unit 1: Microorganism Growth in Foods**

**CO1:** Students may know about microbes of food and factor required to spoil the food

**CO2:** Also learns about food spoilage mechanism and also know how to control food spoilage

#### **Unit 2: Food borne disease**

**CO3:** By this unit they will get idea about food intoxication and diseases causing by food intoxication

**CO4:** Also learn about pathogen detection test and diagnosed them

### **Unit 3: Starter Cultures**

**CO5:** Students learn about fermentation process and its application in food microbiology and preparation different fermented food e.g. chesse

### **Unit 4: Trends in food microbiology**

**CO6:** One may know about concept of predictive microbiology

**CO7:** Also know about use of food microbes as Prebiotic, probiotic and its importance

**CO8:** Understand about rapid method to detect food borne diseases

## **BSC0P404-MICRO PRA : SEMESTER 4 : PRACTICALS**

**CO1:** One can learn about factor affecting microbial growth and used to quantify/detect the protein, sugar and vitamins by specific methods

**CO2:** Also learns about kinetics of enzyme practically

**CO3:** Learns to detect pathogen in food and milk by various method

## **Microbiology Semester 5**

### **BSCC505A: Microbial Molecular Biology and Genetics**

#### **Unit 1: Microbial Genetics: Gene Structure, Replication, and Expression**

**CO1:** Students will understand about Nucleic acid (DNA,RNA) structure & different forms of it

**CO2:** Also learn about gene structure and central dogma of life and genetic code and its application

#### **Unit 2: Microbial Genetics: Regulation of Gene Expression**

**CO3:** To understand the regulation and control mechanism at cell processes

**CO4:** Also know about gene operon concept and its expressional mechanism

#### **Unit 3: Microbial Genetics: Mechanisms of Genetic Variation**

**CO5:** One may get knowledge about by chance change called mutation, its type and mutagenic agents

**CO6:** Also learn about DNA repair mechanism and jumping gene and its importance



#### **Unit 4: Creating Genetic Variability**

**CO7:** One may understand the genetic variability method like conjugation, transformation and transduction

**CO8:** One may learn about gene mapping with co-transduction method

### **BSCC505B : Immunology**

#### **Unit 1: Introduction to Immunity**

**CO1:** Students will learn adaptive and innate immunity

**CO2:** One may also know about different immune cell and their role in immunity

**CO3:** Also understand about antigen and antibody, their structure and function in immunity

#### **Unit 2: Generation of Immune Response**

**CO4:** By this unit students will learn how to generate response against foreign invader by different mechanism and immune system

**CO5:** Also know the function of importance of MHC molecule, important molecule of immune system

#### **Unit 3: Complement System and Immunological Techniques**

**CO6:** One may understand about complement system against antigen

**CO7:** Students will ready to understand antigen- antibody binding mechanism and its application to make different diseases detection methods like ELISA, RIA, blotting method etc.

#### **Unit 4: Immunological Disorders**

**CO8:** One may get idea about immunological disorder and how they arise and which kind of mechanism behind this type of disorder

**CO9:** Also get knowledge of consortium about cancer biology, immune therapy for it and get idea of transplantation immunity

### **BSCC505C : Bioprocess Technology**

#### **Unit 1: Introduction to Bioprocess**

**CO1:** Students will learn about bioprocess, industrial microbiology and fermentation technology

**CO2:** One may get knowledge about Screening and Isolation of industrial important organisms

## **Unit 2: Fermentation media and fermentation economics**

**CO3:** Students will get idea about formulation of media required in fermentation process like media ingredients, growth factor, buffering capacity etc

**CO4:** Also know about sterilization methods of media and inoculums preparation

## **Unit 3: Bioreactor Design**

**CO5:** Function, basic structure and parts to construct bioreactor will be discussed in this topic

**CO6:** Also will get knowledge about types of different types bioreactor appliances and most important Down Stream processes

## **Unit 4: Modes of Operations & Control parameters**

**CO7:** Through this unit one may get knowledge about operation and operating parameter of bioreactor

**CO8:** Also get knowledge about enzyme immobilization process I fermentation process

## **BSCC505D: Agriculture microbiology**

### **Unit 1: Role of Microorganisms in Soil Fertility**

**CO1:** One can get knowledge about Nitrogen fixing microbes and use of them as a biofertilizers, PGPR etc.

**CO2:** Also get to know about phosphate solubilizing bacteria and phytostimulation process

**CO3:** Know to get knowledge about pros and cons of soil microorganism like mycorrhiza and Entomopathogenic fungi

### **Unit 2: Plant Pathology**

**CO4:** Through this unit students get idea about plant pathogen, mode of pathogen in plant, transmission and control of this pathogen in plant diseases condition

### **Unit 3: Stages in development of a disease**

**CO6:** Concept of infection of disease by pathogen with respect to different stages of infection will be understood

**CO7:** Students will understand about constitutive and inducible biochemical defense mechanism in plant against pathogens and control mechanism will also be studied.

#### **Unit 4: Microbes in Sustainable Agriculture**

**CO8:** One can get knowledge about role of soil microorganism in production and control of green house gases for sustainability

**CO9:** Get idea about agricultural biotechnology application for sustainable agriculture and also get idea about transgenic plant and animal farming

### **BSCCSE505: Geomicrobiology**

#### **Unit 1: Microbial biodiversity**

**CO1:** Concept and understanding of biodiversity, Origin of life theory, microbial diversity and its uses in environment will be learned

#### **Unit 2: Methods of Assessing Biodiversity**

**CO2:** Students will learn to assess the biodiversity of microbes by different methods like microscopic , cultural, genomic and molecular methods and its uses

#### **Unit 3: Geomicrobial Interactions**

**CO3:** Students will learn about Biogenesis and Biodegradation of minerals

**CO4:** One can get idea about biooxidation, bioleaching, bioaugmentation, biosorption and bioremediation of metal and metal compound

#### **Unit 4: Geomicrobiology of Fossil Fuel**

**CO5:** Concept of fossil fuel and microbes used in petroleum and oil degradation will be understood by this unit

**CO6:** Students will learn about peat and coal formation and conversion by microbes

### **BSCC505 MICRO-PRA: Semester 5 :Practical**

**CO1:** Students will learn about different mutagen and its effect on growth of microbes

**CO2:** Also can identify the Blood group and enumerate total leucocytes and differential leucocytes from blood

**CO3:** Also perform various diseases detection immunological methods

**CO4:** Also learn to screen and isolate economically important strain from environment

## **Microbiology Semester 6**

### **BSCC605A : Recombinant DNA Technology**

#### **Unit 1: Introduction to Genetic Engineering**

**CO1:** Students will learn about genetic engineering and its application in genetic world

**CO2:** Also know about molecular cloning and its tools, cloning vector and expression vector

#### **Unit 2: Methods in Molecular Cloning**

**CO3:** Students will learn about molecular techniques like DNA transformation process and Gene delivery system

**CO4:** Different DNA, RNA & Protein analysis techniques will be learned by this topic

#### **Unit 3: DNA Amplification and DNA sequencing**

**CO5:** One will know about DNA amplification process ,PCR technique with its basics and appliances in molecular biology

**CO6:** Also learn the mechanism and different type of PCR e.g RT-PCR, Real Time PCR ,which is very useful in genetic engineering

**CO7:** Also learn about different DNA sequencing methods & its application to generate DNA libraries and screening of libraries

#### **Unit 4: Applications of Recombinant DNA Technology**

**CO8:** Students can get idea about application of rDNA technology to produced sustainable product which are very useful to make life easier and good

**CO9:** Also know about some famous/ well known product like isulin, transgenic plants and also get idea about gene therapy and vaccine development through process of rDNA technology

## BSCC605B : Advances in Microbiology

### **Unit 1: Microbial biotechnology: Commercial production**

**CO1:** Students will get idea about Biotechnological approach in microbial world , how is it useful in microbiology to produced some metabolites by using microbes

**CO2:** Also know about microbial cell as a single cell protein which have very well known nutritive value

**CO3:** Also get idea about screening of metabolites from microbes like primary and secondary metabolites

### **Unit 2: Plant, animal and marine biotechnology**

**CO4:** Students will learn about plant tissue culture technique and its applications

**CO5:** Also get idea about animal biotechnology, marine biotechnology and most important things to learn, nano biotechnology and biosensor

### **Unit 3: Microbial Genomics**

**CO6:** Students will learn about the word “ Genomics” and its uses at gene level

**CO7:** One may get idea bout structural, functional and comparative genomics

**CO8:** Also know the word “ Bioinformatics” and “Proteomics” in biological science

### **Unit 4: Forensics and DNA Profiling**

**CO9:** One may learn about molecular genetics study and its uses in forensic science and to generate DNA profiling by using different marker DNA

## BSCC605C : Medical Microbiology

### **Unit 1: Pathogenicity of Microorganisms**

**CO1:** Students will get to know the word “ Pathogenicity” related to Host- Pathogen relationship, process of infection and its types

**CO2:** One can get knowledge about Pathogenicity and pathogenesis of bacterial and viral diseases

**CO3:** Also know the host defense mechanism against pathogen entry into the cell

## **Unit 2: Antimicrobial Chemotherapy**

**After completing the unit students will be able to understand:**

**CO4:** General characteristics of antimicrobial drug

**CO5:** To determine the antimicrobial activity of drug by different test e.g MIC test, Disc diffusion test etc

**CO6:** To know the antimicrobial drugs which are inhibitor of cell wall synthesis

**CO7:** To get idea about drug resistance and antifungal drug

## **Unit 3: Clinical Microbiology and Epidemiology**

**After completing the unit students will be able to understand:**

**CO8:** To know about normal microflora of human body and its importance

**CO9:** To get idea about collection , handling , transportation and performing the clinical sample like pus, urine, blood etc

**CO10:** Also get knowledge about identification of microorganism from that collected clinical sample

**CO11:** To know about clinical microbiology and rapid test and immunological test to diagnose the infection type

**CO12:** To get learn about the terminology “ Epidemiology” and its uses in medical aspect , control & prevention of diseases cycle

## **Unit 4: Human Diseases Caused by bacteria, fungi, protest, viruses and prions**

➤ **After completing the unit students will be able to understand:**

**CO13:** To get know the diseases of various organ systems and their causative agents of the following diseases with Symptoms, mode of transmission, prophylaxis and control

**CO14:** Also get idea about different disease causes by Bacteria , virus , fungi, and prions

## BSCC605D : Instrumentation and Biotechniques

### **Unit 1: Chromatography**

- **After completing the unit students will be able to understand:**

**CO1:** Principles and applications of: paper chromatography (including Descending and 2-D), Thin layer chromatography. Column packing and fraction collection.

**CO2:** Gel filtration chromatography, ion exchange chromatography and affinity chromatography, GLC, HPLC.

### **Unit 2: Electrophoresis**

- **After completing the unit students will be able to understand:**

**CO3:** Principle and applications of : native polyacrylamide gel electrophoresis, SDS-polyacrylamide gel electrophoresis, 2D gel electrophoresis, Isoelectric focusing , Zymogram preparation and Agarose gel electrophoresis.

### **Unit 3: Spectrophotometry**

- **After completing the unit students will be able to understand:**

**CO4:** Principle and use of study of absorption spectra of biomolecules. Analysis of biomolecules using UV and visible range. Colorimetry and turbidometry

### **Unit 4: Centrifugation**

- **After completing the unit students will be able to understand:**

**CO5:** Preparative and analytical centrifugation, fixed angle and swinging bucket rotors. RCF and sedimentation coefficient, differential centrifugation, density gradient centrifugation and ultracentrifugation

## BSCSE-605 : Microbial Quality Control in Food and Pharmaceutical Industries

### **Unit 1: Microbiological Laboratory and Safe Practices**

- **After completing the unit students will be able to understand**

**CO1:** To know about Good Laboratory Practices

**CO2:** To get idea about Biosafety cabinets – Working of biosafety cabinets, using protective clothing, specification for BSL- 1, BSL-2, BSL-3

**CO3:** Discarding biohazardous waste – Methodology of Disinfection, Autoclaving & Incineration, principles of blood bank

## **Unit 2: Determining Microbes in Food / Pharmaceutical Samples**

➤ **After completing the unit students will be able to understand:**

**CO4:** Culture and microscopic methods - Standard plate count, Most probable numbers, Direct microscopic counts

**CO5:** Biochemical and immunological methods: Limulus lysate test for endotoxin, gel diffusion, sterility testing for pharmaceutical products

**CO6:** Molecular methods - Nucleic acid probes, PCR based detection, biosensors

## **Unit 3: Pathogenic Microorganisms of Importance in Food & Water**

➤ **After completing the unit students will be able to understand:**

**CO7:** To get knowledge of Enrichment culture technique, Detection of specific microorganisms on XLD agar, Salmonella Shigella Agar, Manitol salt agar, EMB agar, McConkey Agar, Sabouraud Agar

**CO8:** To know the Ascertaining microbial quality of milk by MBRT, Rapid detection methods of microbiological quality of milk at milk collection centres

## **Unit 4: HACCP for Food Safety and Microbial Standards**

➤ **After completing the unit students will be able to understand:**

**CO9:** Hazard analysis of critical control point (HACCP) - Principles, flow diagrams, limitations

**CO10:** Microbial Standards for Different Foods and Water – BIS standards for common foods and drinking water

## **BSCC605 MICRO- PRA : Semester 6: Practical**

➤ **After completing the unit students will be able to understand:**

**CO1:** Fermentative production of amylase and its activity check by iodometric method

**CO2:** Demonstration of recovery of crude protein / amylase from fermentation broth either by salting out (ammonium sulfate) or by using isopropyl alcohol

**CO3:** Use of enzyme as analytical tool: Glucose estimation by GOD-POD method



- CO4:** Study of antibiogram (using multidisk)
- CO5:** Physical and chemical analysis of urine
- CO6:** Estimation of blood urea by diacetyl monoxime method (DAM)
- CO7:** Study of permanent slides of Insect vectors: Female anopheles mosquito, head louse, tick, flea, mite.
- CO8:** Study of permanent slides of microorganisms: Actinomycetes, yeast, bacteroids, acid-fast bacilli, spirochetes, *Streptococcus pneumoniae*, *Clostridium tetani* and *Plasmodium vivax*
- CO9:** Identify bacteria (*E. coli*, *Salmonella*, *Pseudomonas*, *Staphylococcus*, *Bacillus*) using laboratory strains on the basis of cultural, morphological and biochemical characteristics: IMViC, TSI, nitrate reduction, urease production and catalase tests
- CO10:** Demonstration of characterization of Gram-negative bacteria based on biochemical reactions using rapid identification kit
- CO11:** Separation of mixtures of amino acids by paper / thin layer chromatography.
- CO12:** Determination of  $\lambda_{max}$  for an unknown sample and calculation of extinction coefficient.
- CO13:** Separation of components of a given mixture using a laboratory scale centrifuge.
- CO14:** Determination of MIC of streptomycin
- CO15:** LAL Test for endotoxins by only demonstration
- CO16:** Study of bacterial flora of skin by swab method
- CO17:** Bioassay of penicillin by diffusion method
- CO18:** Sterility testing of pharmaceutical test

