

BIJOY KRISHNA GIRLS' COLLEGE, HOWRAH

Estd : 1st August 1947. Affiliated to University of Calcutta
NCTE approved NAAC B accredited College with CPE status

POs PSOs and COs

2. Programme Outcomes:

After completion of this course a student can do the followings:

- Either one can get admission in masters or Integrated Ms-PhD by competing various National or International level exams to pursue higher studies.
- Or can join industries/offices in various departments of microbial practices.
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3. Course Outcome:

Semester – 1

CC-1: INTRODUCTION TO MICROBIOLOGY AND MICROBIAL DIVERSITY

Unit 1 History of Development of Microbiology

- Knowledge about discovery of microbes and history of microbiology.

Unit 2 Diversity of Microbial World

- Knowledge on taxonomy of microbes and classification of algae, fungi and protozoa.

Unit 3 An overview of Scope of Microbiology

- Knowledge about use and economic importance of microbes is daily life.

CC-1: INTRODUCTION TO MICROBIOLOGY AND MICROBIAL DIVERSITY

(PRACTICALS)

- Know how to use instruments in laboratory with proper safety.
- Knowledge on identification and estimation of prokaryotes and preparation of media for microbial growth
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CC-2: BACTERIOLOGY

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Unit 1 Cell organization

- Knowledge of cellular structure and cell organelles found in microbes.

Unit 2 Bacteriological techniques

- To Know how to enumerate and produce pure cultures of microbes and preservation for future use.

Unit 3 Microscopy

- How to use microscope to view microscopic objects.

Unit 4 Growth and nutrition

- To know how to grow microbes invitro in laboratory with help of proper media with specific nutrients.

Unit 5 Reproduction in Bacteria

- To aware about the reproductive processes of microbes.

Unit 6 Bacterial Systematics

- To know about systematics and diversity of bacteria.

Unit 7 Important archaeal and eubacterial groups

- To gain knowledge on comparative studies of archaea and eubacteria.

CC2: BACTERIOLOGY (PRACTICAL)

- To gain knowledge how to use microscope.
- Knowledge of production of pure colonies.
- Identification of microbes by various staining methods

SEMESTER 2

CC3: BIOCHEMISTRY

Unit 1 Bioenergetics

- To know details of biochemical reaction in the cell.

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Unit 2 Carbohydrates

- To have a knowledge about structure function and organization of biomolecule: carbohydrate.

Unit 3 Lipids

- To have a knowledge about structure function and organization of biomolecule: Lipid.

Unit 4 Proteins

- To have a knowledge about structure and organization of biomolecule: Proteins.

Unit 5 Enzymes

- To know working principle enzyme in a reaction and to form product(s).

Unit6 Vitamins

- Knowledge of role of vitamins in cell.

CC-3: BIOCHEMISTRY (PRACTICALS)

- Qualitative and quantitative studies of biochemical reaction with various biomolecules and gain knowledge of reaction kinetics.

CC-4: CELL BIOLOGY

Unit 1 Structure and organization of Cell

- To gain understanding of cell and cellular organelles.

Unit 2 Nucleus

- To understand organization of nucleus in cell.

Unit 3 Protein Sorting and Transport

- To understand transport of proteins from one organelle to others or cell membrane via specific procedure.

Unit 4 Cell Signaling

- To understand the cellular functions via various signals.

Unit 5 Cell Cycle, Cell Death and Cell Renewal

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- To understand working of cell cycle in growth regeneration or death of cell or cellular activity,

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CC-4: CELL BIOLOGY (Practical)

- To gain knowledge of a cell or internal structure of it from Pictorial or microscopic representations.

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SEMESTER 3

CC5: VIROLOGY

Unit 1 Nature and Properties of Viruses

- To know characteristics of viruses and knowledge of its existence.

Unit 2 Bacteriophage

- Knowledge of types and characteristics of Bacteriophages.

Unit 3 Viral Transmission, Salient features of viral nucleic acids and Replication

- To know how viral infects cell and take control of it.

Unit 4 Viruses and Cancer

- To know how virus can cause cancer.

Unit 5 Prevention & control of viral diseases

- To know how we can combat viral diseases with various agents.

Unit 6 Applications of Virology

- Knowledge how to use viruses in human economy.

C-5: VIROLOGY (PRACTICAL)

- To gain knowledge by microscopic view of viruses in pictorial mode.
- Learn to assay infectivity of bacteriophages in host.

CC6: MICROBIAL PHYSIOLOGY AND METABOLISM

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Unit 1 Microbial Growth and Effect of Environment on Microbial Growth

- To know how various factors, help in growth of microbes.

Unit 2 Nutrient uptake and Transport

- To gain knowledge about uptake of nutrient by various mode of transport.

Unit 3 Chemoheterotrophic Metabolism - Aerobic Respiration

- To gain knowledge of metabolism of aerobic bacteria.

Unit 4 Chemoheterotrophic Metabolism- Anaerobic respiration and fermentation

- To get acquainted with metabolism and fermentation of anaerobic bacteria.

Unit 5 Chemolithotrophic and Phototrophic Metabolism

- To get acquainted with the metabolic diversity and control of metabolism.

Unit 6 Nitrogen Metabolism - an overview

- To understand metabolism of Nitrogen utilizing bacteria.

CC6: MICROBIAL PHYSIOLOGY AND METABOLISM

(PRACTICAL)

- To get familiar with the microbial growth and their associated factors, helps in growth.
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CC-7: MOLECULAR BIOLOGY

Unit 1 Structures of DNA and RNA / Genetic Material

- To know details about DNA structure and history of its discovery.

Unit 2 Replication of DNA (Prokaryotes and Eukaryotes)

- To Know about DNA replication in species.

Unit 3 Transcription in Prokaryotes and Eukaryotes

- To learn RNA formation from DNA along with gene regulation and expression.

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Unit 4 Post-Transcriptional Processing

- To know how cell protect their RNA and make further expressions.

Unit 5 Translation (Prokaryotes and Eukaryotes)

- To know about protein formation in cell.

Unit 6 Regulation of gene Expression in Prokaryotes and Eukaryotes

- To provide knowledge on the genes and chromosome.

C-7: MOLECULAR BIOLOGY (PRACTICAL)

- Isolation and qualitative and quantitative expression of genetic materials.

SEMESTER –4

CC8: MICROBIAL GENETICS

Unit-1 Genomic Organization and Mutation:-

- To know the types of Mutations, molecular basis of mutation and the process by which one can get an idea that whether an agent is carcinogenic or not.

Unit-2 Plasmids:-

- The aim of the subject is to acquaint students with the characteristics of plasmids, extrachromosomal elements of DNA, Copy number control, incompatibility etc can be understood.

Unit-3 Mechanism of genetic exchange:-

- Students will be taught genetic materials, their structure and types, mechanism of genetic exchange.

Unit-4 Phage genetics:-

- Learn about genetics and microbial biodiversity using bacteriophages (viruses that infect bacterial hosts) as a model.

Unit-5:- Transposable elements

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- In this course you will study both prokaryotic and eukaryotic transposable element, their mode of action and genetic variability.

CC-8: MICROBIAL GENETICS (PRACTICAL)

- Study the effect of different physical and chemical mutagen.
- Plasmid isolation, different conformation of plasmid.
- Determination of transformation, transduction and conjugation.

CC9: ENVIRONMENTAL MICROBIOLOGY

Unit-1 Microorganisms and their habitat:-

- To learn how the abundance and composition of microbial communities correlate with climatic perturbations, interact to effect ecosystem processes, and influence human health..

Unit-2 Microbial interaction:-

- To understand different microbial interaction in different environment.

Unit-3 Biogeochemical cycling:-

- Learn about biogeochemical cycles by which energy from the sun is assimilated by living organisms in environment.

Unit-4 Waste management:-

- By studying this part you will get an idea that how solid and liquid waste can be managed by various techniques.

Unit-5 Microbial Bioremediation:-

- The application of different microbes and the way by which naturally remediation can be done can be learnt by this portion.

Unit-6 Water potability:-

- Learn about the different techniques we can detect whether the water is potable or not.

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CC-9: ENVIRONMENTAL MICROBIOLOGY (PRACTICAL)

- Soil analysis by pH, moisture, capillary action etc.
- Microbes' isolation from root adhering soil.
- Assessment of microbial quality of water sample.
- Different enzymatic detection of microbial origin.

CC-10: RECOMBINANT DNA TECHNOLOGY

Unit-1 Introduction to Genetic Engineering:-

- What is genetic engineering and how this can be done to improve human welfare can be studied by this unit. How recombinant DNA is prepared will give you the importance of biotechnology.

Unit-2 Molecular cloning: tools and strategies:-

- Learn different methods of Cloning strategy, introduction of recombinant DNA into host organism.

Unit-3 Methods in molecular cloning:-

- Different methods of molecular cloning, their manipulation can be studied by this unit.

Unit-4 DNA amplification and DNA sequencing:-

- Application of different PCR techniques and DNA sequencing methods can be learnt in different aspects in this unit.

Unit-5 Construction and screening of genomic and cDNA libraries:-

- Preparation and application of genomic and cDNA library can be studied

Unit-6 Application of RDT:-

- Knowledge about the different application of Recombinant DNA technology in agricultural, medicinal and in daily life.
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CC-10: RECOMBINANT DNA TECHNOLOGY (PRACTICAL)

- Competence development and transformation test.
- Restriction digestion of DNA and electrophoresis to study band pattern.
- DNA cloning.
- PCR amplification of DNA.

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- Demonstration of southern blot.

SEMESTER -5

CC-11: FOOD AND DAIRY MICROBIOLOGY

Unit-1: Food as a substrate for Microorganism

- Knowledge about microorganisms that can use food as the substrate for their growth and colonization.

Unit-2 Microbial spoilage of food:-

- To know details about the spoilage processes in food by microorganisms.

Unit-3 Principles and method of food preservation:-

- Food preservation by various methods so that we can increase the shelf life.

Unit-4 Fermented food:-

- Knowing about many fermented foods also having live microorganisms that may improve gastrointestinal health and provide other health benefits.

Unit-5 Food borne diseases:-

- Knowledge about different types of food borne diseases.

Unit-6 Food sanitation and control:-

- To know about providing adequate **food safety**, rules such as HACCP.

Unit-7 Cultural and rapid detection methods of food borne pathogen...:-

- Rapid detection of food borne pathogen by ELISA. PCR methods.

C-11: FOOD AND DAIRY MICROBIOLOGY (PRACTICAL)

- Microbial quality of milk.
- Isolation of food spoilage bacteria from spoiled food.
- Preparation of dahi.

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CC-12: INDUSTRIAL MICROBIOLOGY

Unit-1 Introduction of industrial Microbiology:-

- Understanding industrial microbiology, the utilization of microorganisms in the production of a wide range of products.

Unit-2 Isolation of industrially important microbial strains and fermentation media:-

- Different processes for isolation of industrially important microbes and fermentation media.

Unit-3 Types of fermentation process:-

- Knowledge about the types of fermentation process.

Unit-4 Downstream processing:-

- Knowing Downstream processing, recovery and the purification of biosynthetic products from **fermentation** broth.

Unit-5 Microbial production of industrial products:-

- Different industrially important microbial products production process.

Unit-6 Enzyme immobilization:-

- Gaining knowledge about the processes of enzyme immobilizations techniques.

CC-12: INDUSTRIAL MICROBIOLOGY (PRACTICAL)

- Microbial fermentation of enzymes, amino acids, organic acids.
- Industrial visit.

SEMESTER –6

CC-13: IMMUNOLOGY

Unit-1 Introduction:-

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- Knowledge about Immunology, the state of protection from infectious disease.

Unit-2 Immune cell and organs:-

- Knowing different organs and cell that are associated with immune system.

Unit-3 Antigens:-

- Role of antigen, types, and difference between different antigens can be understood.

Unit-4 Antibodies:-

- Types of antibody and their role in protecting the immune system can be understood.

Unit-5 MHC:-

- The choice between self and nonself antigen and the role of MHC can be understood.

Unit-6 Complement system:-

- Knowing the complement system, that enhances (complements) the ability of antibodies and phagocytic cells to clear microbes and damaged cells from an organism

Unit-7 Generation of immune response:-

- Types of generation of immune response can be studied.

Unit-8 Immunological disorder and tumor immunity:-

- Gaining knowledge about types of autoimmunity, immunological disorder.

Unit-9 Immunological techniques:-

- Different methods are predicated on the exquisite specificity of antibodies for their target proteins.

CC-13: IMMUNOLOGY (PRACTICAL)

- Total leukocyte, immunodiffusion, DOT ELISA determination.
- Immunoelectrophoresis technique.
- Serum separation from blood.

CC-14: MEDICAL MICROBIOLOGY

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Unit-1 Normal micro flora in healthy human body:-

- Benefits of normal microflora in human body can be studied.

Unit-2 Sample collection, transport and diagnosis:-

- How sample is collect and transported to a far laboratory without any contamination and changes can be studied.

Unit-3 Bacterial diseases:-

- Knowledge about different types of bacterial diseases.

Unit-4 Viral diseases:-

- Knowledge about different types of viral diseases.

Unit-5 Protozoan diseases:-

- Knowledge about different types of protozoan diseases.

Unit-6 Fungal diseases:-

- Knowledge about different types of fungal diseases.

Unit-7 Antimicrobial agents..:-

- Knowledge about the antimicrobial agents such as antibiotics, bacteriocins etc.

CC-14: MEDICAL MICROBIOLOGY (PRACTICAL)

- Identification of bacteria by different biochemical techniques.
- Bacterial flora identification from skin.
- Antibacterial sensitivity test determination.
- MIC determination.
- Study different stages of malarial parasites.

SEC A: BIOFERTILIZERS AND BIOPESTICIDES

SEM-3

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Unit 1: Biofertilizers:- This chapter gives students idea about biofertilizers, its types, application and role of biofertilizers in agriculture. Also students get acquainted with the advantages and disadvantages of biofertilizers application over chemical fertilizers.

Unit2: Non-symbiotic nitrogen fixers :- This chapter deals with the symbiotic and non-symbiotic N₂ fixing microbes, methods of their isolation and characterization as well as field application.

Unit 3:- Phosphate solubilisers: It illustrates the type of microbes present in soil, their microbial activity, their application in agricultural field, & method of isolation.

Unit 4:- Mycorrhizal biofertilizers: To get knowledge about beneficial microbes in soil, how to increase soil fertility, ability to increase plant growth and health.

Unit 5:- Bioinsecticides: This branch gives idea of field application of bioinsecticides, their importance in plant health and growth, definition of bioinsecticides, and advantages over synthetic pesticides.

SEC B: MICROBIOLOGICAL ANALYSIS OF AIR AND WATER

SEM-4

Unit 1 : Aero microbiology: This deals with microbes present in air, their impact on environment, food and pharma industries.

Unit 2: Air sample collection and analysis: This topic is about how the air borne organism's isolation and characterization is done, what is air sampling; what is the necessity of air sampling and analysis.

Unit 3 : Control measures: It helps to get idea about the methods applicable for air purification, which reduces microbial load in air.

Unit 4: Water Microbiology: It illustrates about water borne diseases, and microbes present in water.

Unit 5: Microbiological analysis of water : Students get acquainted with the techniques of water purification, water quality analysis, and safety of potable water.

Unit 6: Control Measures: It is helpful to understand the physical methods which are applied to kill or inhibit water borne organisms, and to produce potable water for human consumption.

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DSE A: Microbial Biotechnology

SEM 5

Unit 1: Microbial biotechnology and its applications: The knowledge can give the base for understanding the microbial biotechnology, its application in human therapeutics, environment and food technology. What is genetically engineered microbes and its importance in industry, and in agricultural field.

Unit 2: Therapeutic and industrial biotechnology: It illustrates the basics of recombinant microbial production process in pharmaceutical industries, microbial production of bioplastics and biopesticides.

Unit 3: Applications of microbes in biotransformation: This topic deals with the knowledge of biotransformation, its applications and significance, mechanism of microbial based transformation of steroids.

Unit 4: Microbial products and their recovery: This is very important to understand the modern biology; process of microbial product purification, immobilization, and the principles of different techniques like filtration, chromatography techniques etc. and their application in microbial product recovery.

Unit 5: Microbes for bio-energy and environment: This course is designed to build the concept about the applications of microbes in biogas, bio-diesel and bioethanol production, what is the significance of bioremediation, process of methane and hydrogen production using microbial culture.

Unit 6: RNAi: It illustrates about RNAi, its application, therapeutics, drug resistance mechanism, and gene silencing.

Unit 7: Intellectual Property Rights: This course is very important to make the students understand about the legal concept, about trademarks, patents, copyrights and their importance in biological field as well as in industry.

Practicals:

1. Study yeast cell immobilization in calcium alginate gels- Know the techniques of immobilization of cell using calcium alginate beads and also its importance and handling.
2. Study enzyme immobilization by sodium alginate method- Get knowledge of how to isolate enzymes from cell and how to immobilize it.
3. Pigment production from fungi (Trichoderma / Aspergillus / Penicillium) – Know how to isolate fungi from natural sources and their selection using media.

BIJOY KRISHNA GIRLS' COLLEGE, HOWRAH

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4. Isolation of xylanase or lipase producing bacteria:- Understand the technique of isolation of specific organisms using selective media and their preservation.

5. Study of algal Single Cell Proteins- Get idea about single cell protein.

DSE B: MICROBES IN SUSTAINABLE AGRICULTURE AND DEVELOPMENT

SEM 5

Unit 1: Soil Microbiology: This topic deals with the knowledge of soil profile, properties, microbes in soil and microbial activity in soil, as well as the formation of soil.

Unit 2: Mineralization of Organic & Inorganic Matter in Soil: It gives the idea of how the plant materials decomposed and mineralized, role of microbes in that and impact on soil.

Unit 3: Microbial Activity in Soil and Green House Gases: It illustrates how the microbial activity impacts on soil, how the greenhouse gas production occur and impacts on environment.

Unit 4: Microbial Control of Soil Borne Plant Pathogens: It deals with definition of biocontrol agents, its use against microbial pathogens and mechanism of biocontrol agents.

Unit 5: Biofertilization, Phytostimulation, Bioinsecticides: The knowledge can give the base for understanding role of microbes in plant growth promoting, field application of biofertilizers and bioinsecticides, impact on agriculture .

Unit 6: Secondary agriculture Biotechnology: Students get acquainted with the processing parameters of biofuels, biogas ,its application, and advantages.

Unit 7: GM crops: It gives knowledge of production of transgenic plants and crops, its social, economical and environmental aspects, advantages over normally produced crops

Practicals:

1. Study soil profile – Get thorough knowledge of soil type, habitants, steps of soil formation, and microbial activity in soil.

2. Study microflora of different types of soils:- Get idea about soil microflora and their activity.

3. Rhizobium as soil inoculants characteristics and field application : Get hands- on- training of Rhizobium isolation from legumes.

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4. Azotobacters soil inoculants characteristics and field application :- Get acquainted with the technique of Azotobacters isolation, their inoculation into different soil and their impact on soil.

5. Design and functioning of a biogas plant : Know about the industry and designing the biogas plant.

6. Isolation of cellulose degrading organisms- Students get acquainted with the technique of isolation of cellulose degrading organisms from natural sources and their preservation.

DSE A: PLANT PATHOLOGY

SEM-6

UNIT 1: Introduction and history of plant pathology: To get knowledge about the types of plant pathogens, types of diseases that inhibit the growth of plant, symptoms of diseases, and economic and social impact of plant diseases.

UNIT 2: Stages in development of a disease: Gives idea about the stages in development of diseases and role of pathogens.

UNIT 3: Plant disease epidemiology: Students will be acquainted with the concept that how pathogens play role in causing disease.

UNIT 4: Host pathogen interaction: Students get concept of microbial virulence factors, spreading of diseases, gene responsible for causing disease, and constitutive defense mechanisms in plants from this chapter.

UNIT 5: Control of plant diseases: It illustrates how to deal with plant pathogens, principles and practices involved in management of plant diseases, use of insecticides, how to produce disease resistant plants through genetic engineering

UNIT 6: Specific plant diseases: Gives knowledge about specific diseases caused by fungi, viruses, bacteria and their control.

Practicals:

1. Demonstration of Koch's postulates in fungal, bacterial and viral plant pathogens:- Get the knowledge about disease causing microbes .

2. Study of important diseases of crop plants by cutting sections of infected plant material - Albugo, Puccinia, Ustilago, Fusarium, Colletotrichum. :- Understand the type of plant infection and causative agent by sectioning of plant parts.

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DSE B: INSTRUMENTATION AND BIOTECHNOLOGY

SEM- 6

Unit 1: Microscopy: It gives knowledge about principles and operation of microscopes, types of microscopes and their application.

Unit 2 : Chromatography: It illustrates the techniques of macromolecules separation, types & significance, its application, principles in biological field.

Unit 3: Electrophoresis: This chapter deals with the important techniques in biological field. Students get knowledge about the instrument used in this and also the significance of the technique and its advantage, disadvantages.

Unit 4: Spectrophotometry: Gives conception of handling instrument, knowledge of principles and use of the techniques for biomolecule analysis.

Unit 5: Centrifugation: Students get knowledge about the principles, types, importance and applicability of the technique in biological field.

Practicals:

1. Study of fluorescent micrographs to visualize bacterial cells:- Understand the importance of this technique to visualize the bacterial cell and its parts.
2. Ray diagrams of phase contrast microscopy and Electron microscopy:- Get idea of the techniques and its application.
3. Separation of mixtures by paper / thin layer chromatography:- Get thorough knowledge of chromatography techniques, instrument handling, and how the macromolecules get separated by this technique.
4. Demonstration of column packing in any form of column chromatography:- Know the technique, how the column to be packed, and how mixtures of molecules get separated.
5. Separation of protein mixtures by any form of chromatography:- Know the techniques and its application.
6. Separation of protein mixtures by Polyacrylamide Gel Electrophoresis (PAGE):-Get idea of electrophoresis techniques and separation of macromolecules.
7. Determination of λ_{\max} for an unknown sample and calculation of extinction coefficient: It demonstrates the Lambert-Beer law, calculation of λ_{\max} .

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8. Separation of components of a given mixture using a laboratory scale centrifuge:- Know the instrument handling, i.e, centrifuge, separation of mixtures on that.

9. Understanding density gradient centrifugation with the help of pictures:- Get idea of density gradient centrifugation.