Dnyanopasak Shikshan Mandal's
College of Arts, Commerce and Science, Parbhani

Pro-forma for program and course outcomes (2.6.1)

Paper Title: INTRODUCTORY MICROBIOLOGY (P-I)
Name of Teacher: Dr. P. S. Wakte **Department:** MICROBIOLOGY
Program: BSc FY (Semester-I) **Subject**: Microbiology **Course Code**: CCMB I (Section A)

Unit Number	Unit Name	Topics	Unit-wise Outcome
I	**Scope of Microbiology**	Definition and concept, Types of microorganisms, Distribution of microorganisms in nature, Beneficial & Harmful role of microorganisms in Agriculture, Human & Animal health, Industries and Genetic engineering with suitable examples	Have developed a good knowledge of the development of the discipline of Microbiology, Are able to explain the useful and harmful activities of the microorganisms.
II	**Historical Developments in Microbiology**	Early observation of microorganisms, Controversy over spontaneous generation - Contribution of different scientists, Recognition of microbial role in diseases - Koch's postulates and contribution of Louis Pasteur and Edward Jenner, Recognition of microbial role in fermentation, Discovery of pure culture concept, Aseptic surgery	Gain good knowledge of the development of the discipline of Microbiology and the contributions made by prominent scientists in this field.
III	**General Characters of Microorganisms**	The eukaryotic cell: Algae, Fungi and Lichens, Prokaryotic cell: Archaebacteria, Bacteria and Actinomycetes, Difference between Eukaryotic and Prokaryotic cell, General characters of viruses, General characters of Protozoa	Have developed a very good understanding of the characteristics of different types of microorganisms
IV	**Taxonomy of Microbes**	Microbial Classification and Nomenclature a. Taxonomic groups, b. Goals of classification General methods of classifying bacteria: Intuitive method, Numerical taxonomy and Genetic relatedness, Nomenclature of bacteria, Introduction to Bergey's Manual of Bacteriology (9th edition)	Differentiate a large number of common bacteria by their salient characteristics; Classify bacteria into groups, methods to organize/classify these into and basic tools to study these in the laboratory.

Specify Course Outcome: Acquired knowledge and understanding of the microbiology concepts as applicable to diverse areas such as medical, industrial, environment, genetics, agriculture, food and others.

Specify Program Outcome: The aim of the undergraduate degree in Microbiology is to make students knowledgeable about the various basic concepts in wide-ranging contexts, which involve the use of knowledge and skills of Microbiology and acquire knowledge and understanding of the microbiology concepts as applicable to diverse areas such as medical, industrial, environment, genetics, agriculture, food and others. Their understanding, knowledge and skills in Microbiology needs to be developed through a thorough teaching learning processes in the class, practical skills through the laboratory work, their presentation and articulation skills, exposure to industry and interaction with industry experts, write short research-based projects where they are guided and mentored by the academic and other experts of the subject.

Signature of Teacher

DnyanopasakShikshanMandal's
College of Arts, Commerce and Science, Parbhani

B.Sc. First Year

Paper Title: Fundamentals of Microbiology [P- II]
Name of Teacher: Dr. Manwar A. V. **Department:** MICROBIOLOGY
Program: BSc FY (Sem-I) **Subject**: Microbiology **Course Code**: CCMB- I (Section B)

Unit Number	Unit Name	Topics	Unit-wise Outcome
I	**Bioinstrumentation**	Microscopy: Definition of Magnification, Resolving power, Depth of focus, Focal length, Angular aperture and Numerical aperture. Objectives (Low, High, oil immersion) and oculars function. Condensers: Abbes, Cardioids, Parabolic and their functions. Principle, construction using ray diagram and applications of compound microscope: Electron microscope (SEM and TEM).	Gain Expertise in handling and use of microscope for study of microorganisms which are among the basic skills expected form a practicing microbiologist
II	**Ultra Structure of Bacterial Cell**	Basic concepts of shape, arrangement, and size of prokaryotes cells, Importance of cell shape, cell size in rods and cocci. Structure, Chemical composition and function of following: Capsule and slimes, Cell wall and cytoplasmic membranes c. Flagella and Motility, fimbriae and pili Nuclear material, Plasmids, Mesosomes and Ribosome Reserve materials and other cellular inclusions.	Describe and understand ultra structure of bacterial cell along with its biological and structural importance within the cells, such as cell organelles, cell wall composition and various appendages like capsule, flagella or pilli.
III	**Sterilization Techniques**	Definition of Sterilization, Disinfection, Antiseptic, Germicide, Sanitizer, Fungicide, Viricide, Bacteriostatic and Bactericidal agent. Chemical Disinfectants: Properties of ideal disinfectant, Chemical Agents: Phenol and Phenolic compounds, Alcohols, Gaseous sterilizing Agents: Formaldehyde, Ethylene oxide and β - Propiolactone. Evaluation of disinfectant (Phenol coefficient). Sterilization by Physical Agent a) Moist Heat: Boiling, Tyndallization, Pasteurization and	Understand the principle & importance of various sterilization techniques. Execute this knowledge for sterilization of culture media, glass wares and plastic ware to be used for microbiological work

		Steam under pressure (Autoclave). Dry heat: Flaming, Incineration and Hot air oven. b) Radiation: Ionizing and Non-Ionising radiations. c) Filtration and Types of filters (Concept with e.g. Seitz filter)	
IV	**Microbial Nutrition**	Concept of microbial nutrition, The common nutrient requirements (Basic Nutritional requirements of Microorganisms /macronutrient and micronutrient) Requirement for C, H, O and Electron with their significance Requirements for N, P and S with their significance Growth factors Nutritional categories of microorganisms on the basis of carbon and energy source.	Describe the nutritional requirements of bacteria by their salient characteristics and classify them into different nutritional categories Like Autotrophs, hetrotrophs, chemotrophs, phototrophs, lithotrophs, organotrophs

Specify Course Outcome:

Major learning outcome of this course is to develop a very good understanding of several fundamental microbiology techniques and gain expertise over handling of basic instruments which are commonly used in study of microorganisms.

Specify Program Outcome:

Impart Knowledge of the diverse places where microbiology is involved. Understanding of diverse Microbiological processes. Basic skills such as culturing microbes, maintaining microbes, safety issues related to handling of microbes, Good Microbiological practices etc. Moderately advanced skills in working with microbes such as Pathogens.

Signature of Teacher

Dnyanopasak Shikshan Mandal's

College of Arts, Commerce and Science, Parbhani

Pro-forma for program and course outcomes (2.6.1)

Paper Title: BASIC MICROBIOLOGY & BIOMOLECULES (P-III)

Name of Teacher: Dr. P. S. Wakte **Department:** MICROBIOLOGY
Program: BSc FY (Semester-III) **Subject**: Microbiology **Course Code**: CCMB I (Section A)

Unit Number	Unit Name	Topics	Unit-wise Outcome
I	**Microbial Staining Techniques**	Definition: Stain, Dye, Acidic stain, Basic stain, Auxochrome, Chromophore, Mordent, Chromogen, Leuco compound, Natural stain, Fluorochrome, Decoloursing agent and Counter stain.,Theories of Staining, Principles, mechanism, procedure and observation of:a. Simple staining: Monochrome & Negative staining. Differential staining: Gram's & Acid fast staining, Structural staining: Cell wall & PHB staining	Are able to perform basic experiments to grow and study microorganisms in the Laboratory.
II	**The Viruses: Distribution and Structure**	Viruses, Bacterial viruses (Bacteriophage), Multiplication of Virulent phage: The lytic cycle, The development of temperate phages: Lysogeny, Classification of viruses (LHT system),Distribution and structure of HIV, Enlist plant animal and human viral diseases with their causative agents	Understood viruses and the chemical nature of viruses, different types of viruses infecting animals, plants and bacteria(bacteriophage),Understanding about the biology of bacteriophage, Gained knowledge of a variety of plant viruses and animal viruses,
III	**Biomolecule**	Carbohydrates- Definition and classification, Triose, Pentose, Hexose (Examples), Disaccharides:- Glycoside linkage (Lactose, Maltose and Sucrose), Oligosaccharides, Trisaccharides (Raffinose),Polysaccharides:- Homo and Heteropolysaccharides, Biological Significance of carbohydrates, Lipids- Definition and Classification, Types of lipids i. Simple lipids:- Triglycerides, ii. Conjugated lipids:- Phosphatidic acid, Phospholipids and cholesterol Biological importance of lipids	Have developed how the carbohydrates & Lipids make the structural and functional components such as energy generation and as storage food molecules for the bacterial cells
IV	**Informational and Functional Biomolecule**	Nucleic acids, a. Ribose and Deoxyribose sugars, Nitrogen bases, Nucleosides and Nucleotides b. DNA:- Properties, Structure and Functions c. RNA:- Properties, Structure and Functions Proteins, a. Definition and classification, b. Peptide bonds, c. Enzymes, d. Biological Significance of proteins	Well conversant about multifarious function of protein Knowledge about and nucleic acids as genetic material.

Specify Course Outcome:

Describe phenotypic characteristics of bacterial cells, cell organelles, cell wall composition. Differentiate a large number of common bacteria by their salient characteristics; the ability to describe role of viruses in the causation of the diseases. Developed a very good understanding of various biomolecule which are required for development and functioning of a bacterial cell

Specify Program Outcome:

The aim of the undergraduate degree in Microbiology is to make students knowledgeable about the various basic concepts in wide-ranging contexts, which involve the use of knowledge and skills of Microbiology and acquire knowledge and understanding of the microbiology concepts as applicable to diverse areas such as medical, industrial, environment, genetics, agriculture, food and others. Their understanding, knowledge and skills in Microbiology needs to be developed through a thorough teaching learning processes in the class, practical skills through the laboratory work, their presentation and articulation skills, exposure to industry and interaction with industry experts, write short research-based projects where they are guided and mentored by the academic and other experts of the subject.

Signature of Teacher

B.Sc. First Year

Name of Teacher: Dr. Manwar A V. **Department:** Microbiology

Program: B.Sc. F. Y. Sem. II **Subject**: Microbiology **Course Code**: CCMB II (Section B)
Paper Title: Microbial Physiology P- IV

Unit Number	Unit Name	Topics	Unit-wise Outcome
I	**Bacterial Cultivation and Maintenances**	Cultivation of Bacteria : Media used, Properties of good culture media. Synthetic, Non-synthetic, Natural, Selective, Differential, Enriched, Enrichment, Assay, Minimal, Maintenance and Transport Medium. Buffers in culture medium. Anaerobic and anaerobic cultivation, Pure culture Techniques. Definition and Significance of pure culture Methods of isolation of pure culture: Streak plate, Pour plate, Spread plate and Single cell isolation.	Know various culture media and their applications. Understand General bacteriology and microbial techniques for isolation of pure cultures of bacteria, Employ aseptic techniques and be able to perform routine culture handling tasks safely and effectively
II	**Permeation**	Passive diffusion Facilitated diffusion Active transport mechanism Group translocation Uptake of amino acids and sugars (as examples)	Understand the microbial transport systems and the modes and mechanisms of energy conservation in microbial metabolism .
III	**Reproduction and Growth**	Concept of growth Microbial Reproduction: Binary fission, budding. Bacterial growth: Definition, growth curve − Phases of growth, Growth Kinetics, Generation time, Methods of measurement of growth, different types of culture system: Batch culture system, Continuous culture system (Chemostat and Turbidostat), Factors affecting growth-Temperature, pH, Osmotic pressure and Nutrients	Know the various Physical and Chemical growth requirements of bacteria and get equipped with various methods of bacterial growth measurement.
IV	**Bacterial Sporulation**	Bacterial Sporulation- Structure of endospore, Endospore formation (Stages) in *Bacillus*, Spore germination, Significance of Ca-dipicolinate (DPA) and soluble Proteins (SASP)	Understand the importance of spores and the processes of endospore formation and its germination.

Specify Course Outcome:

Acquire capability of describing growth characteristics of microorganisms capable of growing under on different media and different environmental conditions. Develops understanding of assimilation process of nutrients for growth and development. Get aquanted with different growth phases of bacteria under controlled condition. Mechanism of sporulation and germination in bacteria is understood.

Specify Program Outcome:

Understand the structural similarities and differences among various physiological groups of bacteria. Know various Culture media and their applications. Know General bacteriology and microbial techniques for isolation of pure cultures of bacteria. Master aseptic techniques and be able to perform routine culture handling tasks safely and effectively. Understand the microbial transport systems and the modes and mechanisms of energy conservation in microbial metabolism. Know the various Physical and Chemical growth requirements of bacteria and get equipped with various methods of bacterial growth measurement. Determine importance of endospore in bacteria and acquire knowledge regarding the process of sporulation and germination.

Signature of Teacher

Dnyanopasak Shikshan Mandal's
College of Arts, Commerce and Science, Parbhani

Pro-forma for program and course outcomes (2.6.1)

Paper Title: Annual Practical's based on Section A & Section B of CCMBI & CCMB II
Name of Teacher: Dr. P.S. Wakte **Department:** MICROBIOLOGY
Program: BSc FY **Subject**: Microbiology **Course Code**: Practical Paper Number: V

Unit Number	Unit Name	Topics	Unit-wise Outcome
PRACTICAL V	**Practical**	Microscopy- Different parts of compound microscope. Use and care of compound microscope, Construction, Operation and utility of laboratory Equipments. (any Six)- Autoclave, Hot air oven, Incubator, pH meter, High speed centrifuge, Colorimeter/Spectrophotometer, Anaerobic jar , Bacterial filters, Laminar air flow, Staining, Simple staining: Monochrome, Negative, Differential : Gram's staining, Structural staining: Cell wall staining (Chance's method)PHB staining (Burdon's method.), Hanging drop technique, Micrometry, Preparation of culture media, Nutrient broth and Agar, MacConkeys Broth and Agar, Sugar Media, Isolation of bacteria from mixed culture, Streak plate method, Spread plate method, Pour plate method, Effect of physical and chemical agents on growth of bacteria pH, Temperature, U.V. rays, Antibiotics, Qualitative tests for Carbohydrates: Benedict's test, Protein: Biuret test, Nucleic acid: Diphenylamine test (DPA) for DNA and Orcinol test for RNA, Demonstration of Yeast, Fungi, Actinomycetes, Algae and Protozoa. Study of Bacterial Growth curve.	Handling and use of microscopes for the study of microorganisms which are among the basic skills expected from a practicing microbiologist. They also get introduced a variety of modifications in the microscopes for specialized viewing Major learning outcome of this course is that students develop a very good understanding of several microbiological techniques and instruments which are commonly used in a microbiology laboratory, Principles which underlies sterilization of culture media, glassware and plastic ware to be used for microbiological work. Several separation techniques which may be required to be handled later as microbiologists.

Specify Course Outcome:
This lab course aims to provide the students with analytical and on hands practical skills. Practicals conducted enhances and develops students to analyse, appreciate, understand the basic concepts of chemical reactions that occur in living systems, which enable them to understand the various perspectives of applied sciences that benefit the mankind.

Specify Program Outcome:
The aim of the undergraduate degree in Microbiology is to make students knowledgeable about the various basic concepts in wide-ranging contexts, which involve the use of knowledge and skills of Microbiology. Their understanding, knowledge and skills in Microbiology needs to be developed through a thorough teaching learning processes in the class, practical skills through the laboratory work, their presentation and articulation skills, exposure to industry and interaction with industry experts, write short research-based projects where they are guided and mentored by the academic and other experts of the subject.

Signature of Teacher

DnyanopasakShikshanMandal's
College of Arts, Commerce and Science, Parbhani

Pro-forma for program and course outcomes (2.6.1)

Paper Title: APPLIED MICROBIOLOGY (P-VI)

Name of Teacher: Dr. Shiva C. Aithal **Department:** MICROBIOLOGY

Program: BSc SY (Sem-III) **Subject**: Microbiology **Course Code**: CCMB III (Section A)

Unit Number	Unit Name	Topics	Unit-wise Outcome
I	**Air Microbiology**	Definition and composition of air, sources of microorganisms in air, significance of microorganisms in air (beneficial and harmful), droplet, droplet nuclei and aerosol, enumeration of microorganisms in air, control of microorganisms in air.	Gain Expertise in Microbial aspects of Air related to Human, Animal and Plant Health and their Environment
II	**Water Microbiology**	Types of water, Sources of microorganisms in water, Index of water pollution, Different indicator microorganisms, coliform bacteria, Microbial examination of water, water borne Diseases.	Gain capability in handling Microbial aspects of Drinking and Recreational Water related to Human, Animal and Plant Health and their Environment
III	**Sewage Microbiology**	Definition of sewage, composition and strength of sewage (BOD and COD), Microbiology of sewage, Domestic sewage treatment, Municipal sewage treatment (Primary, secondary, Tertiary sewage treatment) and Composting.	Become skilled in Microbial aspects Sewage and Effluent treatment and its proper disposal with respect to Human Health and Environment
IV	**Milk Microbiology**	Definition and composition of milk, sources of contamination of milk, desirable and undesirable changes in milk, milk born diseases, Microbial examination of milk, pasteurization of milk, Application of microorganisms in dairy industry (examples and microflora).	Handling milk and milk products quality with respect Microbial perspectives pertaining to food quality and human Health.

Specify Course Outcome:

Applied microbiology trains students for gaining expertise in the microbial world and the way it interacts with humans. It looks at how we can harness and utilize the powers of the microbes in areas ranging from air, water and sewage microbiology to Milk Microbiology and extends to industrial applications. A wide range of microbial by-product production, quality assessment and health hazard monitoring is possible by students who get well versed in this course.

Specify Program Outcome:

The aim of the undergraduate degree in Microbiology is to make students knowledgeable about the various basic concepts in wide-ranging contexts, which involve the use of knowledge and skills of Microbiology and acquire knowledge and understanding of the microbiology concepts as applicable to diverse areas such as medical, industrial, environment, genetics, agriculture, food and others. Their understanding, knowledge and skills in Microbiology needs to be developed through a thorough teaching learning processes in the class, practical skills through the laboratory work, their presentation and articulation skills, exposure to industry and interaction with industry experts, write short research-based projects where they are guided and mentored by the academic and other experts of the subject.

Signature of Teacher

Dnyanopasak Shikshan Mandal's
College of Arts, Commerce and Science, Parbhani

Pro-forma for program and course outcomes (2.6.1)

Paper Title: Immunology (P -VII)
Name of Teacher: Dr. Manwar A. V. **Department:** MICROBIOLOGY
Program: B. Sc. SY (Sem-III) **Subject**: Microbiology **Course Code**: CCMB- III (Section B)

Unit Number	Unit Name	Topics	Unit-wise Outcome
I	**Infection & Immunity**	**Infection**- definition, types of infections, sources, modes of transmission, Microbial pathogenicity, aggressive factors of pathogens. **Immunity-** definition and classification with suitable examples.	Conceptual basis for understanding pathogenic microorganisms and the mechanisms by which they cause infection leading to infectious disease in the human body. Understand the overall classification of Immunity.
II	**Antigens, Antibodies and Immune Response**	**Antigen**: Definition, general properties, antigen specificity, bacterial antigens with reference to *S. typhi.* **Antibody:** Definition, properties, structure of immunoglobulin, immunoglobulin classes. **Immune response: Definition, types** and mechanism- Humoral and cellular, list of effector molecules. Theories of antibody production.	Demonstrate an understanding of key concepts in immunology Understand the overall organization of the immune system its functioning and differentiate different type of Immune response to different pathogens.
III	**Antigen antibody reactions**	Mechanism and applications of the following reaction with suitable examples- Agglutination, precipitation, complement fixation, virus neutralization, toxin neutralization reaction, **Principle and applications of recent techniques:** Enzyme linked immunosorbent assay, Radioimmunossay, Immunofluorescence test.	Understand the salient features of antigen antibody reaction & its uses in diagnostics and various other studies.
IV	**Hypersensitivity**	Defination, classification on the basis of time (Delayed and immediate) and mechanism (Type I, II, III and IV) with one example of each.	

Specify Course Outcome:
On completion of the course, students learn about:
Concept related to cells and organs related to immune system , Immunity, Immune response and immune mechanism , protective and destructive immunity.

Specify Program Outcome:

Upon completion of B.Sc. Microbiology programme, the students will be able to :

• Perform the basic techniques related to screening, isolation and cultivation of microorganisms from various sources. Study the microorganism with regard to morphology, cultural and biochemical characters. It will help to classify the microbes to certain extent. Follow the aseptic techniques and conduct the process of sterilization as well as perform the techniques to control the microorganism. Understand microorganisms and their relationship with the environment. Produce and analyze the microbial products at laboratory level. Conduct the basic research with these microorganisms and perform the diagnostic procedures required in food, milk and pharmaceutical industries

Signature of Teacher

Paper Title: **Medical Microbiology [P- IX]**

Name of Teacher: Dr. Manwar A. V **Department:** MICROBIOLOGY

Program: BSc. SY (Sem -IV) **Subject**: Microbiology **Course Code**: CCMB IV (Section B)

Unit Number	Unit Name	Topics	Unit-wise Outcome
I	**Bacterial infection**	Etiology, pathogenesis, Clinical features, laboratory diagnosis, epidemiology, treatment and prophylaxis of the following: a) Cholera b) Typhoid	Understand all the facts regarding cholera and typhoid and apply the knowledge for prevention from these diseases.
II	**Bacterial infection**	Etiology, pathogenesis, Clinical features, laboratory diagnosis, epidemiology, treatment and prophylaxis of the following: a) Diphtheria b) Pulmonary Tuberculosis c) Syphilis	Determine the importance of Respiratory tract infections, acquire knowledge regarding etiological agent its symptoms treatment and prophylaxis.
III	**Viral infections**	Etiology, pathogenesis, Clinical features, laboratory diagnosis, epidemiology, treatment and prophylaxis of the following: a) AIDS b) Hepatitis A and B only.	Understand the severity of infectious diseases caused by viruses, its diagnosis and prevention.
IV	**Infection by other Microorganisms**	a) Morphology, life cycle, pathogenicity, etiology, laboratory diagnosis, treatment and prophylaxis of Malaria. b) Etiology, pathogenesis, Clinical features, laboratory diagnosis and treatment of Candidiosis.	Understand Protozoal and Fungal disease, their causative agent, mode of infection, epidemiology, treatment, lab diagnosis, prophylaxsis.

Specify Course Outcome:

On completion of the course, students learn about:

Various viral disease, their causative agent, mode of infection, epidemiology, treatment, lab diagnosis, prophylaxsis . Various bacterial disease, their causative agent, mode of infection, epidemiology, treatment, lab diagnosis, prophylaxsis . Various fungal disease, their causative agent, mode of infection, epidemiology, treatment, lab diagnosis, prophylaxsis . Various protozoal disease, their causative agent, mode of infection, epidemiology, treatment, lab diagnosis, prophylaxsis

Signature of Teacher

Dnyanopasak Shikshan Mandal's
College of Arts, Commerce and Science, Parbhani

Paper Title: FOOD, SOIL MICROBIOLOGY AND MICROBIAL ECOLOGY (P-VIII)

Name of Teacher: Dr. Shiva C. Aithal **Department:** MICROBIOLOGY

Program: B.Sc. SY (Sem-IV) **Subject**: Microbiology **Course Code**: CCMB IV(Section A)

Unit Number	Unit Name	Topics	Unit-wise Outcome
I	**Food Microbiology**	Definition and composition of food, Sources of contamination in food, Factors affecting kind and number of microorganisms in food. Significance of microorganisms in food, Spoilage and its types (Different types of spoilages with suitable examples). Preservation of food, food poisoning (Botulinum, Staphylococcal intoxication and Salmonellosis).	Understand and explain the action of microorganisms that inhibit, create, or contaminate food.
II	**Soil Microbiology and Carbon cycle**	Definition and composition of soil, types of soil, signification of microorganisms in soil, soil as culture medium. Carbon cycle (with respect to cellulose and starch).	Identify and describe activities of Microrganisms in soil which affect soil structure and fertility.
III	**Elemental transformation in soil**	Nitrogen cycle, Sulfur cycle, Phosphorus cycle.	Describe and interpret the activities of Microorganisms in soil which affect decomposition of organic matter in soil to produce natural fertilizers.
IV	**Microbial interaction, association and ecology**	Symbiosis, antibiosis, mutualism, parasitism. Microbe –microbe interaction-Lichen Plant-microbe interaction: Mycorrhiza, Rhizosphere. Animal - microbe interaction: Rumen, bioluminescence Concept of population, community, Microbial succession, climax and adaptation (Phenotypic and genotypic adaptations).	Illustrate and apply role of soil microorganisms in plant growth and plant exudates, root metabolism, and understand development of healthy soil structure.

Specify Course Outcome:

To apply the knowledge of microorganisms causing food spoilage, pathogens that may cause disease post cooked or storage, those used to produce fermented foods such as cheese, yogurt, bread, beer, and wine, meat and meat products, fruits vegetables and those with other useful roles such as producing probiotics. Understand of principles of soil science, microbiology, and the chemistry and physics of natural elemental cycles, which maintain the balance of our ecosystem. Describe significance of soil fertility, appreciate role of soil microorganisms which play essential roles in the nutrient cycles that are fundamental to life on the planet. Illustrate and explain how microbes are responsible for cycling nutrients through the environment, creating important symbiotic relationships, providing energy in the absence of sunlight, and digesting the food we eat.

Specify Program Outcome:

The aim of the undergraduate degree in Microbiology is to make students knowledgeable about the various basic concepts in wide-ranging contexts, which involve the use of knowledge and skills of Microbiology and acquire knowledge and understanding of the microbiology concepts as applicable to diverse areas such as medical, industrial, environment, genetics, agriculture, food and others. Their understanding, knowledge and skills in Microbiology needs to be developed through a thorough teaching learning processes in the class, practical skills through the laboratory work, their presentation and articulation skills, exposure to industry and interaction with industry experts, write short research-based projects where they are guided and mentored by the academic and other experts of the subject.

Signature of Teacher

DNYANOPASAK SHIKSHAN MANDAL'S

COLLEGE OF ARTS, COMMERCE AND SCIENCE, PARBHANI

B. Sc. Second Year Microbiology

Paper Title: LAB. COURSE BASED On P-VI & P-VIII (PX) & LAB. COURSE BASED ON P- VII & P-IX (P-XI

Name of Teacher: Dr. Manwar A. V. **Department:** MICROBIOLOGY

Program: BSc SY [Sem-III & Sem - IV] **Course Code**: CCMBP- II (Section A) & CCMBP III (Section B)

Programme	**Programme outcomes**	**Programme Specific Outcomes (Outcomes of the Paper)**	**Course Outcomes (Outcomes of each unit in a Paper)**
B. Sc. S. Y Sem. III & IV Paper - X LAB Course II CCMBP - II (Section A)	Impart Knowledge of the diverse places where microbiology is involved. Understanding of diverse Microbiological processes. Basic skills such as culturing microbes, maintaining microbes, safety issues related to handling of microbes, Good Microbiological practices etc. Moderately advanced skills in working with microbes such as Pathogens.	Acquire skills of handling microorganisms in the laboratory and study their characteristics. Has developed laboratory skills in isolating and detecting microbes from soil and water. Laboratory skills of testing microbial load in Food and milk. Has developed skills for growing microorganisms in the laboratory for the production of different enzymes	
B. Sc. S. Y Sem. III & IV Paper - X LAB Course III CCMBP - III (Section B)	Impart Knowledge of the diverse places where microbiology is involved. Understanding of diverse Microbiological processes. Basic skills such as culturing microbes, maintaining microbes, safety issues related to handling of microbes, Good Microbiological practices etc. Moderately advanced skills in working with microbes such as Pathogens.	Acquire skills of handling microorganisms in the laboratory and study their characteristics. Has developed laboratory skills in detecting enzymes antigen and antibodies using dignostic kits Laboratory skills of staining blood and enumerate RBCs and WBCs in whole blood Has developed skills for growing Pathogenic microorganisms in the laboratory and identifying them on basis of various biochemical tests and	

		perform antibiotic sensitivity tests.	

Paper Title: LAB. COURSE BASED On P-VI & P-VIII (PX)

Name of Teacher: Dr. Manwar A V **Department:** MICROBIOLOGY
Program: BSc SY (Sem-III) **Subject**: Microbiology **Course Code**: CCMBP II (Section A)

By the conclusion of this course, the students:

Acquire skills of handling microorganisms in the laboratory and study their characteristics.
Has developed laboratory skills in isolating and detecting microbes from soil and water.
Laboratory skills of testing microbial load in Food and milk.
Has developed skills for growing microorganisms in the laboratory for the production of different enzymes

Paper Title: **LAB. COURSE BASED ON P- VII & P-IX (P-XI)**

Name of Teacher: Dr. Manwar. A.V. **Department:** MICROBIOLOGY
Program: BSc SY (Sem-IV) **Subject**: Microbiology **Course Code :** CCMBP- III (Section B)

By the conclusion of this course, the students:

Acquire skills of handling microorganisms in the laboratory and study their characteristics.
Has developed laboratory skills in detecting enzymes antigen and antibodies using dignostic kits
Laboratory skills of staining blood and enumerate RBCs and WBCs in whole blood
Has developed skills for growing Pathogenic microorganisms in the laboratory and identifying them on basis of various biochemical tests and perform antibiotic sensitivity tests.

SEC

Paper Title: Diagnostic Microbiology
Name of Teacher: Dr. P.S. Wakte **Department:** MICROBIOLOGY
Program: BSc SY **Subject**: Microbiology **Course Code**: **SECMB II A**

Unit Number	Unit Name	Topics	Unit-wise Outcome
I	**Importance of diagnosis of diseases**	Common Bacterial, Viral, Fungal and Protozoan diseases.	Have developed a very good understanding of practical aspects of diagnostic testing, medical sample testing skills using kits available in the market
II	**Collection and Examination of clinical samples**	Collection of clinical samples and precautions required (oral cavity, throat, skin, Blood, Urine, and Feces). Examination of sample by staining - Gram stain, Ziehl-Neelson staining for tuberculosis, Giemsa stained thin blood film for malaria.	
III	**Diagnosis of pathogen using culture media**	MacConkeys agar, Blood agar, Chocolate agar, Lowenstein-Jensen agar.	
IV	**Serological methods for diagnosis**	Agglutination , Precipitation, ELISA, Immuno fluorescence , Kits for rapid detection of Pathogens	
PRACTICAL	**Practice**	1. Clinical sample collection from throat & Skin, Blood staining for Malarial parasite (MP), 2. Preparation of Blood agar. Preparation of Chocolate agar 3, Detection of Typhoid by WIDAL, Detection of Syphilis by RPR	This lab course aims to provide the students with analytical and on hands practical skills

Specify Course Outcome: Have developed a very good understanding of practical aspects of collection of different clinical samples, their transport, culture and examination by staining, and molecular and immunological diagnostic methods for diagnosis of microbial diseases.

Specify Program Outcome:

The aim of the undergraduate degree in Microbiology is to make students knowledgeable about the various basic concepts in wide-ranging contexts, which involve the use of knowledge and skills of Microbiology. Their understanding, knowledge and skills in Microbiology needs to be developed through a thorough teaching learning processes in the class, practical skills through the laboratory work, their presentation and articulation skills, exposure to industry and interaction with industry experts, write short research-based projects where they are guided and mentored by the academic and other experts of the subject.

Signature of Teacher

Paper Title: Public Health Microbiology
Name of Teacher: Dr. P.S. Wakte **Department:** MICROBIOLOGY
Program: BSc SY **Subject**: Microbiology **Course Code**: **SECMB I A**

Unit Number	Unit Name	Topics	Unit-wise Outcome
I	**Scope of Public Health Microbiology**	Definition, areas covered in Public Health Microbiology, Overview of disease process	Have developed a very good understanding of practical aspects of testing, water and food testing skills using kits available in the market.
II	**Water Microbiology**	Water borne pathogens & water borne diseases Bacteria: *E.coli*, *Salmonella*, *Shigella* , *Vibrio cholerae* Viruses : Enteroviruses, Hepatitis virus Protozoa : *Entamoeba histolytica*, Giardia	
III	**Skill in water quality monitoring**	Sources of water, Potable water ,Importance of potable water, Indicator organisms of water pollution, standard tests for determination of potability of water, Quantitative: TC, FC, Membrane Filter count. Qualitative: Presumptive, Confirmed, Completed.	
IV	**Skill in food and milk quality monitoring**	Enrichment culture technique, Detection of specific microorganisms on selective media : XLD agar, Wilson and Blair agar, Manitol Salt agar, MacConkeys agar Pathogenic microorganisms: Salmonella, Coliforms, *Staphylococcus aureus,*	
PRACTICAL	**Practice**	1.Isolation of Coliforms, Identification of fecal Coliforms by IMViC tests 2. MPN: TC & FC 3. Enrichment culture technique for *Salmonella*, *S.aureus*. Determination of Microbiological quality of Milk by MBRT, Resazurin Test.	This lab course aims to provide the students with analytical and on hands practical skills

Specify Course Outcome: Have developed a very good understanding of practical aspects diagnosis of common human waterborne infections, preventive measures for human waterborne infections by the use of antibiotics and vaccines, Gain skills food and milk quality testing.
Specify Program Outcome:

The aim of the undergraduate degree in Microbiology is to make students knowledgeable about the various basic concepts in wide-ranging contexts, which involve the use of knowledge and skills of Microbiology. Their understanding, knowledge and skills in Microbiology needs to be developed through a thorough teaching learning processes in the class, practical skills through the laboratory work, their presentation and articulation skills, exposure to industry and interaction with industry experts, write short research-based projects where they are guided and mentored by the academic and other experts of the subject.

Signature of Teacher

Dnyanopasak Shikshan Mandal's
College of Arts, Commerce and Science, Parbhani

Pro-forma for program and course outcomes (2.6.1)

Paper Title: MICROBIAL GENETICS (P-XII)
Name of Teacher: Dr. Shiva C. Aithal **Department:** MICROBIOLOGY
Program: BSc TY (Sem-V) **Subject**: Microbiology **Course Code**: DSEMBI (Section A) SEM-

Unit Number	Unit Name	Topics	Unit-wise Outcome
I	**The Genetic Material**	a) Evidences for DNA as genetic material i. Griffith Experiment, Avery *et al* Experiments, ii. Hershey and Chase Experiment b) Discovery of RNA as viral genetic material i. Gierer and Schramm Experiment (TMV) c) Properties of DNA as Genetic Material d) Chemical stability of DNA and its information content e) Structure of prokaryotic Chromosomes i. E. coli- The model genetic organism	Recall and Remember the historical aspects which prove DNA is the genetic material and understand the structure and chemical stability of DNA.
II	**Prokaryotic DNA replication**	a) General Concepts of DNA Replication b) Semi Conservative DNA Replication c) Replicon Model (Cairns Model), Precursors and Enzymes of DNA Replication d) Mechanism of DNA Replication: Initiation, Elongation (Beta Clamp and Progressive Polymerases) and Termination e) Replication in E. coli (In Short)	Demonstrate the knowledge and understanding of the molecular machinery of living cells, via understanding these in bacteria.
III	**Molecular Recombination in Bacteria**	a) General Perspective of Genetic Recombination (with Holliday Model as example) b) Homologous Recombination in E.coli (Initiation, Synapsis, Branch Migration and resolution) c) Types of Recombination i. Site Specific Recombination (Integrative and Excessive Recombination) ii. Illegitimate Recombination (Non-Homologus Recombination) iii. Transposition: a. Transposable elements in Prokaryotes b.Insertion Sequence	Illustrate and understand how genetic information in the DNA is selectively expressed by genetic variation to allow organisms to evolve in response to a changing environment via DNA rearrangements.
IV	**Genetic Exchange in bacteria**	a) Transformation i. Introduction and History ii. Mechanism of transformation iii. Competence, Binding, Penetration, Synapsis and Integration. b) Conjugation i. Discovery of conjugation in bacteria ii. Properties of F plasmid/Sex factor iii. Hfr strains and their formation iv. Mechanism of Conjugation v. F ´factor and Sexduction c) Transduction i. Introduction and discovery ii. Generalized and Specialized transduction iii. Abortive transduction	Exhibit knowledge and understanding of the principles that govern the structures of macromolecules and their participation in vital molecular functions via recombination processes.

Specify Course Outcome:

Understanding microbial genes, genomes, and gene expression is essential for understanding the biology and evolution of microorganisms and their interactions with the environment. Students will gain: 1) Understanding of fundamental concepts in microbial genetics. 2) Insight into genetic methods used to investigate interesting biological problems. 3) Insight into current, exciting topics in microbial genetics and related fields. 4) Experience in reading and evaluating scientific articles. 5) Understanding of how microbial genetics has advanced science and society.

Specify Program Outcome:

The aim of the undergraduate degree in Microbiology is to make students knowledgeable about the various basic concepts in wide-ranging contexts, which involve the use of knowledge and skills of Microbiology. Their understanding, knowledge and skills in Microbiology needs to be developed through a thorough teaching learning processes in the class, practical skills through the laboratory work, their presentation and articulation skills, exposure to industry and interaction with industry experts, write short research-based projects where they are guided and mentored by the academic and other experts of the subject.

Signature of Teacher

Dnyanopasak Shikshan Mandal's
College of Arts, Commerce and Science, Parbhani

Pro-forma for program and course outcomes (2.6.1)

Paper Title: MICROBIAL METABOLISM (P- XIII A)
Name of Teacher: Dr. P. S. Wakte **Department:** MICROBIOLOGY
Program: BSc TY (Semester-V) **Subject**: Microbiology **Course Code**: DSEMB I (Section B1)

Unit Number	Unit Name	Topics	Unit-wise Outcome
I	**Enzymes**	Definition, Physicochemical properties of enzymes, Coenzymes and Cofactors, Nomenclature and Classification of enzymes, Mechanisms of enzyme action, Specificity of enzymes, Enzyme kinetics: Michaelis-Menten equation, Factors affecting enzyme Activity, Inhibition of enzyme activity: Competitive, Non-competitive and Uncompetitive inhibition, Regulation of enzyme activity: Allosteric enzymes, Multienzyme system and Isoenzymes.	Well conversant about multifarious function of enzymes; are able to calculate enzyme activity and other quantitative and qualitative parameters of enzyme kinetics; also knowledge enzyme inhibitions, Student are able to make buffers, study enzyme kinetics and calculate Vmax, Km.
II	**Microbial Metabolism**	Introduction to metabolism, catabolism and anabolism with examples, Role of nucleotides in metabolism: Nucleotides as building blocks of nucleic acids; ATP as currency of cell; Pyridine and Flavin nucleotides, Basic pathways of carbohydrate catabolism: EMP, HMP, ED, and PKP, TCA cycle, β-Oxidation of saturated and unsaturated fatty acids	Describing the growth characteristics of the microorganisms which require Different nutrient for growth and the associated biochemical pathways of energy generation for survival of heterotrophs.
III	**Mechanisms of Energy Transformations in Microorganisms**	Respiration, Photosynthesis and Fermentation (Basic concepts),Generation of ATP: Oxidative Phosphorylation, Photophosphorylation and Substrate level Phosphorylation, Biochemical mechanisms of respiration in Heterotrophs and Chemoautotroph, Respiratory electron transport chain in bacteria, Characteristics of Bacterial RETC and It's Components	Describing the metabolic characteristics associated with mechanisms of energy generation for their survival of autotrophs, heterotrophs, chemolithoautotrophs etc.

IV	**Microbial Fermentations**	Ethanol fermentation by yeasts and bacteria, Lactic acid fermentation: Homo and Heterolactatic fermentation, Mixed acid fermentation, Acetone-Butanol fermentation, Butanediol fermentation, Succinic acid fermentation.	Differentiating concepts of aerobic, anaerobic and fermentative respiration and how these are manifested in the form of different fermentative pathways in microorganisms.

Specify Course Outcome: Study enzyme kinetics & Inhibitions, applications and calculate Vmax, Km, Kcat values. Describing the growth characteristics of the microorganisms, which require different nutrient for growth and the associated mechanisms of energy generation for their survival like autotrophs, heterotrophs, chemolithoautotrophs etc.

Specify Program Outcome: The aim of the undergraduate degree in Microbiology is to make students knowledgeable about the various basic concepts in wide-ranging contexts, which involve the use of knowledge and skills of Microbiology and acquire knowledge and understanding of the microbiology concepts as applicable to diverse areas such as medical, industrial, environment, genetics, agriculture, food and others. Their understanding, knowledge and skills in Microbiology needs to be developed through a thorough teaching learning processes in the class, practical skills through the laboratory work, their presentation and articulation skills, exposure to industry and interaction with industry experts, write short research-based projects where they are guided and mentored by the academic and other experts of the subject.

Signature of Teacher

Paper Title: MOLECULAR BIOLOGY (P-XIV)
Name of Teacher: Dr. Shiva C. Aithal **Department:** MICROBIOLOGY
Program: BSc TY (Sem-VI) **Subject**: Microbiology **Course Code**: DSEMBII (Section A)

Unit Number	Unit Name	Topics	Unit-wise Outcome
I	**Gene Expression**	a) Genetic code b) Characteristics of Genetic code: Triplet code, comma free, non-overlapping, degenerate, start and stop signals andwobble hypothesis c) Structure of RNA Polymerase (RNAP) d) Process of transcription e) Structure of Ribosome f) Process of Translation g) Bacterial Transcriptional and Translational Cycle	To determine how genes and the proteins they encode function in the intact organism. Because mutations can interrupt cellular processes, mutants often hold the key to understanding gene function.
II	**Mutagenesis and DNA Repair**	a) Concept of Mutation b) Types of Mutations: c) Mechanism of Spontaneous Mutation: d) Mechanism of Induced Mutation: e) Repair of DNA iii. Base Excision Repair (BER) iv. Mismatch Excision Repair (MER)	To understand the range of strategies used by bacteria to adapt and survive to their changing conditions of environment.
III	**Regulation of Gene expression in Prokaryotes**	a) Gene regulation at Transcription level: Repressors, Activators, Sigma factor and Attenuation b) Gene regulation at Translation level c) The lac Operon of E. coli d) The trp Operon of E. coli	Show that bacteria use genomic modifications to affect gene expression by providing various examples of different strategies and the mechanisms involved in adaptive responses.
IV	**Molecular Techniques and Applications**	a) Introduction, Definition and purpose of Cloning b) Tools for molecular cloning i. ENZYMES: Restriction endonucleases, DNA ligases, alkaline phosphatase, DNA Modifying enzymes ii. VECTORS: Plasmids-pBR322, Bacteriophage- Phage λ, Cosmids c) Methods of Gene Transfer i. Transformation ii. Electroporation iii. Liposome Fusion iv. Transduction d) Screening Strategies (In short) i. Insertional Inactivation ii. Immunochemical Methods iii. Colony hybridization e) Application: i. Expression of Human insulin gene in E.coli	Illustrate molecular machinery of living cells. List out tools used for gene exploration. Understand the utilisation modified DNA to create pharmaceutical, diagnostic, agricultural, environmental, and other products to benefit society. To study how alter genetic information so that human diseases can be modelled and studied.

Specify Course Outcome:
Course is aimed at appreciating complexity of genes, genomes, and gene expression which is essential for understanding the biology and evolution of microorganisms and their interactions with the environment. Students will gain: 1) Understanding of fundamental concepts in molecular biology. 2) Insight into genetic methods used to investigate interesting recombinant DNA technology. 3) Insight into current, exciting topics in Molecular Genetics and related branches. 4) Experience in reading and evaluating scientific articles. 5) Understanding of how Molecular Genetics has advanced as a science and benefited the society.

Specify Program Outcome:
The aim of the undergraduate degree in Microbiology is to make students knowledgeable about the various basic concepts in wide-ranging contexts, which involve the use of knowledge and skills of Microbiology. Their understanding, knowledge and skills in Microbiology needs to be developed through a thorough teaching learning processes in the class, practical skills through the laboratory work, their presentation and articulation skills, exposure to industry and interaction with industry experts, write short research-based projects where they are guided and mentored by the academic and other experts of the subject.

Signature of Teacher

Paper Title: Annual practical Based on XII and XIII A
Name of Teacher: Dr. Shiva C. Aithal **Department:** MICROBIOLOGY
Program: BSc TY **Subject**: Microbiology **Course Code**: Practical Paper Number: XVI

Unit Number	Unit Name	Topics	Unit-wise Outcome
PRACTICAL XVI	**Practical**	1. Purification of chromosomal/plasmid DNA and study of DNA profile. i. Confirmation of nucleic acid by spectral study. ii. Quantitative estimation by diphenylamine test. iii. DNA denaturation and determination of Tm and G + C contents. iv. Agarose gel electrophoresis of DNA. 2. Effect of UV radiations i. To study the survival pattern of E.coli/yeast ii. Repair mechanisms in E.coli / yeast (Dark and Photo reactivation). 3. Isolation of antibiotics resistant Bacterial Mutants by Physical/ Chemical agents. 4. Ampicillin selection method for isolation of auxotrophic mutants. 5. Extraction and purification of RNA from S. cerevisiae. 6. Studies on gene expression in E. coli with reference to Lac operon. 7. Study of Conjugation in E. coli. 8. Restriction digestion and Agarose gel electrophoresis of DNA. 9. Generalized Transduction in E. coli using p1 phage 10. Determination of MIC and LD50 of Streptomycin	Analyse, appreciate, understand the basic concepts of genetic phenomenons that occur in living systems, which enables to understand perspectives of DNA technology that benefits the mankind.

Paper Title: Annual practical Based on XIV and XVI
Name of Teacher: Dr. Shiva C. Aithal **Department:** MICROBIOLOGY
Program: BSc TY **Subject**: Microbiology **Course Code**: Practical Paper Number: XVII

PRACTICAL XVII	**Practical**	1.Estimation of reducing sugar by Sumner's method. 2. Estimation of Amino acids by Rosen's method 3. Study of enzymes (Lecithinase, Gelatinase, Urease, Caseinase, Catalase) 4. Fermentative production of Production of amylase 5. Effect of various physicochemical parameters on amylase activity (pH, Temp) 6. Primary screening of antibiotic producers, amylase producers, organic acid producers 7. Production of Penicillin (Surface / submerged) 8. Fermentative production of Wine & and its estimation by Titrable acidity 9. Production of Citric acid (Surface / submerged) & its estimation by Titrable acidity 10. Production of Biofertilizer (Azotobacter) 11. Bioassay of Penicillin 12. Bioassay of therapeutic enzyme glucose oxidase 13. Determination of antimicrobial activity of chemical compound (Phenol) 14. Sterility testing by using Bacillus stearothermophilius / Bacillus subtilis	This lab course aims to provide the students with analytical and on hands practical skills in Industrial Microbiology and Enzymology techniques.

Specify Course Outcome:
This lab course aims to provide the students with analytical and on hands practical skills. Practicals conducted enhances and develops students to analyse, appreciate, understand the basic concepts of chemical reactions that occur in living systems, which enable them to understand the various perspectives of applied sciences that benefit the mankind.

Specify Program Outcome:
The aim of the undergraduate degree in Microbiology is to make students knowledgeable about the various basic concepts in wide-ranging contexts, which involve the use of knowledge and skills of Microbiology. Their understanding, knowledge and skills in Microbiology needs to be developed through a thorough teaching learning processes in the class, practical skills through the laboratory work, their presentation and articulation skills, exposure to industry and interaction with industry experts, write short research-based projects where they are guided and mentored by the academic and other experts of the subject.

Signature of Teacher

SEC

Paper Title: Enzyme Technology (SECMBIII A)
Name of Teacher: Dr. Shiva C. Aithal **Department:** MICROBIOLOGY
Program: BSc TY (Sem-V) **Subject**: Microbiology **Course Code**: **Skill - III**

Unit Numb	Unit Name	Topics	Unit-wise Outcome
I	**Introduction**	i. Sources of enzymes and their classes ii. Application of enzymes in a. Industrial paper and textile b. Biomedical and in drug design c. Dairy, food and brewing industry d. Artificial enzymes and Recombinant enzymes e. Enzymes as biosensors	Have developed a particularly good understanding of sources of enzymes and their applications in various fields.
II	**Methods of enzyme isolation**	i. Cell lysis methods – a. Osmotic shock b. Enzyme lysis c. Homogenization d. Ultra-centrifugation ii. Concentration of enzymes by a. Precipitation (Ammonium sulphate), b. Dialysis of protein, c. Heat treatment, d. Nucleic acid removal	To understand the range of strategies used to isolate enzymes from different sources.
III	**Enzyme purification, characterization based on**	i. Size and mass (centrifugation, GPC Gel Permeation chromatography, Dialysis and ultracentrifugation), ii. Polarity (ion exchange electrophoresis, iii. Changes in solubility (change in pH, Change in ionic strength, salting in or salting out), iv. Change in dielectric strength by isoelectric focusing and adding organic solvent, hydrophobic interaction chromatography, v. Specific binding sites (Affinity chromatography, Affinity elution, Dye-ligand chromatography, immune adsorption chromatography, co-valent chromatography)	Show how enzymes are purified and characterized based on various physical and chemical criteria
IV	**Immobilization of enzymes methods**	i. Adsorption ii. Covalent bonding iii. Entrapment and membrane confinement iv. Application in - analytical, therapeutic, industrial	Illustrate techniques of immobilizing enzymes and make students familiar with their applications.
PRACTICAL	**Practice:**	1. Fungal Amylase i. Production ii. Isolation methods iii. Purification methods iv. Assay and activity procedure v. Immobilization techniques of fungal amylase	This lab course aims to provide the students. - To understand the importance of enzymes in day today life. - To practically isolate and purify particular enzyme

Specify Course Outcome:
Course is aimed at appreciating complexity of enzymology for understanding the biology and evolution of microorganisms. Students will gain: 1) Understanding of fundamental concepts enzymology. 2) Insight into methods used to isolate enzymes. 3) Insight into purification and characterization of. 4) Understanding of how enzymes are immobilized.

Specify Program Outcome:
The aim of the undergraduate degree in Microbiology is to make students knowledgeable about the various basic concepts in wide-ranging contexts, which involve the use of knowledge and skills of Microbiology. Their understanding, knowledge and skills in Microbiology needs to be developed through a thorough teaching learning processes in the class, practical skills through the laboratory work, their presentation and articulation skills, exposure to industry and interaction with industry experts, write short research-based projects where they are guided and mentored by the academic and other experts of the subject.

Signature of Teacher

Paper Title: Bioprocess Technology (A)
Name of Teacher: Dr. Shiva C. Aithal **Department:** MICROBIOLOGY
Program: BSc TY **Subject**: Microbiology **Course Code**: **SECMB IV A**

Unit Number	Unit Name	Topics	Unit-wise Outcome
I	**Agro based Bioprocesses involved in manufacture of**	a. Biocompost b. Biofertilizers c. Bioinsecticides d. Biogas e. Biofuel	This course aims at developing processes that translate biological science into biologically based manufacturing. This course prepares for the biological manufacturing systems of the future, which include eco-friendly treatment of effluent wastes from industries.
II	**Food and Diary bioprocesses**	Bioprocesses involved in production of a. Breed b. Idli, Dhokla, Dosa c. Pickles d. Yoghurt (curd) & buttermilk e. Cheese	
III	**Industrial effluent Treatment**	a. Physical, chemical b. Biological treatment i. Aerobic treatment processes – Trickling filters, biologically aerated filters, rotating biological contactors, rotating drums, fluidized – bed systems, activated sludge processes.	
IV	**Anaerobic treatment process**	Anaerobic digestion, anaerobic digestor, anaerobic filters, up – flow anaerobic sludge blankets (UASD) Practice: 1. Ethanol production from Agri waste 2. Idli & Dosa preparation 3. Determination of COD of industrial effluent 4. Determination of BOD of industrial effluent	
PRACTICAL	**Practice:**	1. Ethanol production from Agri waste 2. Idli & Dosa preparation 3. Determination of COD of industrial effluent 4. Determination of BOD of industrial effluent	This lab course aims to provide the students with analytical and on hands practical skills

Specify Course Outcome:

Bioprocess technology aims at creating process that uses complete living cells or their components (e.g., bacteria, enzymes) to obtain desired products and designing required microbial process which will give more value added products. This course aims at developing processes that translate biological science into biologically based manufacturing. This course prepares for the biological manufacturing systems of the future, which include eco-friendly treatment of effluent wastes from industries.

Specify Program Outcome:

The aim of the undergraduate degree in Microbiology is to make students knowledgeable about the various basic concepts in wide-ranging contexts, which involve the use of knowledge and skills of Microbiology. Their understanding, knowledge and skills in Microbiology needs to be developed through a thorough teaching learning processes in the class, practical skills through the laboratory work, their presentation and articulation skills, exposure to industry and interaction with industry experts, write short research-based projects where they are guided and mentored by the academic and other experts of the subject.

Signature of Teacher