Jaya College of Arts and Science, Thiruninravur-602024.

Department of Microbiology

Year : 2020-2021

Programme Offered:

- **M.Sc. Applied Microbiology**
- **B.Sc. Microbiology**

B. Sc., Microbiology- Program File

Program Objectives (POs):

- To create a centre of Academic Excellence in the field of education in Microbiology.
- Provide a sound academic background for overall development of personality for a successful career in Microbiology.
- Provide an environment that fosters continuous improvement and innovation in the subject.
- Inculcate in student's right skills oriented towards self-development.
- To inculcate in students the need for the value of dignity of labor and the attitude and proper community orientation and civic responsibilities in their outlook.
- Develop an orientation towards the society as responsible citizens for excellent academic program, involvement of students in day today management for specific duties.

Program Specific Outcomes (PSOs):

- Students will be able to describe diversity of microorganisms, bacterial cell structure and function, microbial growth and metabolism, and the ways to control their growth by physical and chemical means.
- Students will explain the role of microorganisms in food production and preservation, their ability to cause food-borne infections and demonstrate practical skills in fundamental microbiological techniques.
- Students will demonstrate engagement in the Microbiology discipline through involvement in their post-graduation period, research or internship activities, and outreach their goals specific to microbiology.

COURSE STRUCTURE:

Semester I

Course Content	Name of the Course	Ins. Hrs	Credits	Int. Marks	Ext. Marks	Total
Part-I	Language Paper – I	6	3	25	75	100
Part-II	Communicative English I	3	3	50	50	100
Part-III	General Microbiology and Microbial Physiology	6	4	25	75	100
	Major Practical-I (General Microbiology and Microbial Physiology)	3	4	40	60	100
	Biochemistry (Theory)	5	3	25	75	100
	Biochemistry (Practical)	3	2	40	60	100
Part-IV	*Basic Tamil/Adv. Tamil/NME-I*	-	2	25	75	100
	English for Life Sciences I	4	4	50	50	100

Semester II

Course Content	Name of the Course	Ins. Hrs	Credits	Int. Marks	Ext. Marks	Total
Part-I	Language Paper – II	6	3	25	75	100
Part-II	Communicative English II	3	3	50	50	100
Part-III	Basic and Applied Immunology	6	4	25	75	100
	Major Practical II (Basic and Applied Immunology)	3	4	40	60	100
	Bioinstrumentation (Theory)	5	3	25	75	100
	Bioinstrumentation (Practical)	3	2	40	60	100
Part-IV	Basic Tamil/Adv. Tamil/ NME-II	-	2	25	75	100
	English for Life Sciences II	4	4	50	50	100

Semester III

Course Content	Name of the Course	Ins. Hrs	Credits	Int. Marks	Ext. Marks	Total
Part-I	Language Paper – III	6	3	25	75	100
Part-II	Language Through Literature- I	6	3	50	50	100
Part-III	Molecular Biology	6	4	25	75	100
	Major Practical III (Molecular Biology)	3	4	40	60	100
	Clinical Lab Technology (Theory)	6	3	25	75	100
	Clinical Lab Technology (Practical)	3	2	40	60	100
Part-IV	Environmental Studies	-	Examination will be held in Semester IV			
	Soft Skills	4	4	50	50	100

Semester IV

Course Content	Name of the Course	Ins. Hrs	Credits	Int. Marks	Ext. Marks	Total
Part-I	Language Paper – IV	6	3	25	75	100
Part-II	Language Through Literature- II	6	3	50	50	100
Part-III	Soil and Agricultural Microbiology	6	4	25	75	100
	Major Practical IV (Soil and Agricultural Microbiology)	3	4	40	60	100
	Clinical Biochemistry (Theory)	6	3	25	75	100
	Clinical Biochemistry (Practical)	3	2	40	60	100
Part-IV	Environmental Studies	-	2	25	75	100
	Soft skills	-	3	50	50	100

Semester V

Course Content	Name of the Course	Ins. Hrs	Credits	Int. Marks	Ext. Marks	Total
Part-III	Medical Bacteriology	6	4	25	75	100
	Medical Mycology and Parasitology	6	4	25	75	100
	Medical Virology	6	4	25	75	100
	Major Practical V (Medical Bacteriology, Mycology, Parasitology and Virology)	6	4	40	60	100
	Biotechnology and Genetic Engineering	5	5	25	75	100
Part-IV	Value Education	**1**	2	25	75	100

Semester VI

Course Content	Name of the Course	Ins. Hrs	Credits	Int. Marks	Ext. Marks	Total
Part-III	Environmental Microbiology	6	4	25	75	100
	Food and Dairy Microbiology	6	4	25	75	100
	Major Practical VI (Environmental, Food and Dairy Microbiology)	6	4	40	60	100
	Industrial and Pharmaceutical Microbiology	6	5	25	75	100
	Microbial Marketable Products	5	5	25	75	100
Part-V	Extension Activities	1	1			

SEMESTER – I

YEAR: I B.Sc. **SEMESTER: I**

COURSE: General Microbiology & Microbial Physiology **COURSE CODE: SN21A**

COURSE OBJECTIVES:

- To understand the key features of the structure, growth, physiology and behavior of bacteria.
- To provide basic knowledge to deal with the study of genetic, metabolic strategies and ecology of microorganisms.
- To understand the main microbiological techniques to be applied in the laboratory.
- Students acquire knowledge to the use of bacteria in the lab and the main sterilization techniques.
- To provide students with the basis to face the study of the major fundamentals of microbiology including bacteriology, virology and immunology.

COURSE OUTCOMES:

After successful completion of this course students are expected to be able to:

CO-1. Demonstrate theory and practical skills in microscopy a n d their handling techniques and staining procedures.

CO-2. Understand the basic microbial structure and function and study the comparative characteristics of prokaryotes and eukaryotes.

CO-3. Know various Culture media and their applications and also understand various physical and chemical means of sterilization.

CO-4. Know General bacteriology and microbial techniques for isolation of pure cultures of bacteria, fungi and algae

CO-5. Know the various Physical and Chemical growth requirements of bacteria and get equipped with various methods of bacterial growth measurement.

SYLLABUS:

UNIT I:

History of Microbiology- Contributions of Scientists - Anton Von Leeuwenhoek, Louis Pasteur, Robert Koch, Edward Jenner, Alexander Flemming, Joseph Lister. Spontaneous generation Vs Biogenesis hypothesis - Germ theory of diseases- Koch postulates. Classification of Microorganisms - Three Kingdom, Whittaker's Five Kingdom and Eight kingdom. General characteristics of a cellular microorganisms - (Viruses, Viroids, Prions) and cellular microorganisms (Bacteria, algae, fungi and protozoa), Differences between prokaryotic and eukaryotic microorganisms.

UNIT II:

Microscopy: Light Microscopy - Simple, Compound, Dark field, Phase Contrast, Fluorescence and Electron Microscopy – SEM, TEM. Staining methods–Principles of staining, simple staining, negative staining, differential staining, Gram and Acid Fast Staining, flagella staining, capsule and endospore staining.

UNIT III:

Culture media and pure culture techniques- Streak plate, Pour plate and Spread plate methods. Anaerobic culture – Anaerobic Jar.Methods of Sterilization- Physical Methods - Mode of Action and Applications of Heat- Dry and Moist, Pasteurization and Tyndallisation, Chemical Methods - Mode of action and applications - Alcohol, Halogen, Heavy Metals, Phenol and Phenol derivatives, Formaldehydes. Methods of bacterial identification- morphological and biochemical properties.

UNIT IV:

Nutrition and Growth of Bacteria - Photoautotrophs, Photoorganotrophs, Chemolithotrophs (Ammonia, Nitrite, Sulfur, Hydrogen, Iron oxidizing Bacteria), Chemoorganotrophs. Nutrition transport mechanisms – Passive diffusion and Active transport. Culture media -Types. Bacterial Growth, Generation time and Growth Curve.

UNIT V:

An overview of Metabolism - Embden Meyerhof Pathway, Entner-Doudoroff Pathway, Pentose Phosphate Pathway, Tricarboxylic Acid Cycle. Electron Transport Chain and Oxidative Phosphorylation.ATP synthesis. Fermentation-Homolactic Fermentation, Heterolactic Fermentation, Mixed Acid Fermentation, Butanediol Fermentation. Photosynthesis - An Overview of chloroplast structure. Photosynthetic Pigments, Light Reaction-Cyclic and non-cyclic Photophosphorylation. Dark Reaction - CalvinCycle.

YEAR: I B.Sc. **SEMESTER: I**

COURSE: Practical – I **COURSE CODE: SN221**

General Microbiology & Microbial Physiology

COURSE OBJECTIVES:

- To develop skills and competencies in standard microbiological laboratory techniques.
- Train students in the proper use and maintenance of the research grade laboratory microscope with emphasis on oil immersion methods.
- Train students in aseptic technique, prophylaxis, and the proper methods relating to the safe manipulation and maintenance of microorganism.
- Train students in fundamental laboratory methodology to include the use of differential media, metabolic/enzymatic testing and associated reagents.

- Provide students with a hands-on familiarity with basic research procedure and associated critical and investigative thinking skills utilizing identification of unknown microorganismal specimens & Provide students with an understanding of important facts, concepts, and the investigative procedures of a microbiology producing accurate, skilled clinical laboratory workers with strong ethical and professional values.

COURSE OUTCOMES:

After successful completion of the course, students will be able to:

CO-1. Properly prepare and view microbiological specimens for examination using bright field microscopy.

CO-2. Use pure culture and selective techniques to enrich for and isolate microorganisms, using proper aseptic technique.

CO-3. Estimate the number of microorganisms in a sample using viable plate counts

CO-4. Evaluate a microbiological problem in the context of an unknown microorganism, using appropriate media-based methods for identification. Accurately document and report observations and interpretations made during laboratory exercises.

CO-5. Use appropriate microbiological lab equipment and methods, in order to conduct and analyze experimental measurements relevant to microbiology. Practice safe microbiology, using appropriate protective and emergency procedures

SYLLABUS:

UNIT I:

Cleaning of glass wares Sterilization principle and methods- moist heat- dry heat and filtration methods. Media preparation: liquid media, solid media, agar slants, agar plates, basal, enriched, selective media preparation- quality control of media, growth supporting properties, sterility check of media.

UNIT-II:

Pure culture techniques: streak plate, pour plate, decimal dilution. Culture characteristics of microorganisms: growth on different media, growth characteristics and description. Demonstration of pigment production.

UNIT-III:

Microscopy: light microscopy and bright field microscopy. Motility demonstration: hanging drop, wet mount preparation, dark field microscopy, semi solid agar, Craigie's tube method. Staining techniques: smear preparation, simple staining, Gram's staining and Acid fast staining.

UNIT-IV:

Morphology of microorganisms: morphological variations in algae, morphology of fungi, slide culture technique. Antibiotic sensitivity testing: Disc diffusion test with standard strains. Micrometry: Demonstration of size of yeast and fungal filaments.

UNIT-V:

Physiology characteristics: IMViC test, H2S, Oxidase, catalase, urease test. Carbohydrate fermentation test, maintenance of pure culture, paraffin method, stab culture, maintenance of mold culture.

YEAR: I B.Sc. **SEMESTER: I**

COURSE: NME (Good Laboratory Practices) **COURSE CODE: SC5AC**

COURSE OBJECTIVES:

- Students will understand the essential practices that need to be followed inside a laboratory / industry
- Students will have awareness on safety measures and Industry standards.
- The content minimizes the gap between Academics and Industry.

COURSE OUTCOMES:

After successful completion of the course, students will be able to:

CO-1. Understand the essential practices that need to be followed inside a Industry laboratory.

CO-2. Have awareness on the safety measures followed in the Industry.

CO-3. Understand the standards followed in Industry

CO-4. Relating and differentiating the laboratory protocols and procedure followed in Academics and Industries.

SYLLABUS:

UNIT I: Biotechnology lab organization

Types of labs associated with Biotechnology (General lab, microbial culture lab, plant tissue culture lab, Fermentation lab, computational stimulation lab), Types of Chemical (Analytical grade, molecular grade) and its various arrangement (Arrangement of basic chemicals, solvent, acid and base, fine chemicals like dyes, protein and enzyme storage units), Physical chemical characteristics: hygroscopic, corrosive, volatile properties; Fire and explosion hazard data, Health hazards (how to use UV-illuminator), Fumigation technique.

UNIT II: Lab ethics

Regulatory affairs: Methods and types of documentation (pre-lab writes, result recording and post lab report: interpretation of result), Dilution factor calculation, Molarity, percentage, dilution of concentrated solution, metric units (kg to gms and vice -versa).

UNIT III: Instrument calibration and importance

Principles, use and maintenance of laboratory instruments like Autoclave, hot air oven, Incubators, Water bath, Refrigerator, Centrifuge, Calorimeter, pH meter, Haemocytometer, Microtomes, Electronic balances, Biosafety cabinets. SOP preparation for instrumentation

UNIT IV: GLP & Biotechnology Industry standards

Good Laboratory guidelines, Elements of GLP, Standard Operating Procedures and its importance, Quality Assurance & Quality control, Internal audit basics, ISO, BIS and HACCP standards

UNIT V: Types of wastes and safe disposal methods

Definition of waste, types of waste: Biological and chemical waste, methods of Safe Disposal of biological and chemical waste: treatment methods of Ethidium Bromide solutions, Electrophoresis Gels, Contaminated Gloves, debris, Wastes containing sodium azide, Silver staining solutions, Perchloric acid, Nanoparticle wastes, Spill management, Awareness and training for personnel.

SEMESTER – II

YEAR: I B.Sc. **SEMESTER: II**

COURSE: Basic and Applied Immunology **COURSE CODE: SN22A**

COURSE OBJECTIVES:

- The students will be able to identify the cellular and molecular basis of immune responsiveness.
- The students will be able to describe the roles of the immune system in both maintaining health and contributing to disease.
- The students will be able to describe immunological response and how it is triggered and regulated.

COURSE OUTCOMES:

CO-1. Students will understand the key concepts in immunology.

CO-2. Understand the overall organization of the immune system**.**

CO-3. Conceptualize how the collection of individual clones of lymphocytes (termed the "immune repertoire") arises from rearrangement within two genetic loci: The Ig gene in B cells and the antigen receptor in T cells.

CO-4. Learn how "clonal selection" allows for the expansion of a limited number of antigen-recognizing lymphocytes in response to a specific antigenic stimulus

CO-5. To make them understand the salient features of antigen antibody reaction &its uses in diagnostics and various other studies.

CO-6. Learn about immunization and their preparation and its importance

SYLLABUS:

UNIT I:

Introduction - History, Scope of Immunology and Recent developments. Cells of Immune System. Hematopoiesis. Mononuclear - Phagocytic System.LymphoidOrgans.Primary –Thymus, Bone Marrow, and Bursa of Fabricius, Secondary - Lymph Node and Spleen.Tertiary - CALT, GALT and MALT.Innate and Acquired immunity.Humoral& Cell mediated immunity. Mechanism of immune response.

UNIT II:

Antigen - Types, Properties and Function.Haptens, Adjuvants. Antibody: Structure, and Types of antibody, Theories of Antibody formation. Monoclonal antibody. Complement pathways- Classical and Alternative pathways.

UNIT III:

Antigen – Antibody reaction- Immunohematology-ABO, In vitro methods: precipitation reactions, agglutination, Immunofluroscence, ELISA and RIA. *In vivo* methods: skin tests –Mantoux test.

UNIT IV:

Hypersensitivity – Introduction to Hypersensitivity Reactions. Type I – Mechanism, Primary Mediators, Secondary Mediators, Symptoms and test for Type I Hypersensitivity. Type II -Mechanism and Symptoms. Type III- Mechanism and Diseases - Serum sickness, Arthus reaction. Type IV- Mechanisms& types - Tuberculin. Autoimmune disorders - Rheumatoid Arthritis and SLE.

UNIT V:

Major Histocompatability complex (MHC) - Introduction, MHC types and pathways, Applications of MHC, Graft rejection.TransplantationImmunology.Vaccines – Types- Live, Attenuated, Sub-unit and Recombinant Vaccines, Immunization schedule. Cancer immunology- Malignant tumors (leukemias andlymphomas).

YEAR: I B.Sc. **SEMESTER: II**

COURSE: PRACTICAL-II: Basic and Applied Immunology COURSE CODE: SN222

COURSE OBJECTIVES:

- Developing a working knowledge of the principles and procedures of serology by utilizing Immunological laboratory techniques.
- Producing accurate, skilled clinical laboratory workers with strong ethical and professional values.
- Promoting respect and understanding of allied health professionals through renewed understanding of the clinical laboratory technician's role as a member of the allied health care team.

COURSE OUTCOMES:

CO-1. Apply principles of safety, quality assurance and quality control in Immunology/Serology.

CO-2. Evaluate specimen acceptability

CO-3. Describe the principles involved in the immune response.

CO-4. Explain the principles of and perform serological tests.

CO-5. Evaluate and correlate test results with associated diseases or conditions.

SYLLABUS:

UNIT-I

Blood groups and typing.Precipitation reaction in Gel-Outchelony double diffusion, Single Radial Immunodiffusion.VDRL, RPR.

UNIT-II

Complement fixation test.Titration of amboceptor and complement (demonstration only).Immunofluorescene, (Demonstration only), ELISA

UNIT-III

Isolation of Buffy coat, using heparin lymphocytes (T cells, B cells), Enumeration of different cell types, Peripheral blood cell counts, absolute cell counts.

UNIT-IV

Antibody productions in rabbits against sheep RBC and its titration (Demonstration) Anaphylactic reactions in guinea pigs.Arthus reaction in rabbits, (Demonstration).

UNIT-V

Skin tests, both immediate and delayed hypersensitivity reactions to egg proteins, bacterial, fungal antigens. (Demonstration)

YEAR: I B.Sc. **SEMESTER: II**

COURSE: NME (Food Preservation) **COURSE CODE: SL52C**

COURSE OBJECTIVES:

- To understand the basic principles of food preservation.
- To learn the food preservation techniques.
- To prepare preserved foods

COURSE OUTCOMES:

CO-1. Student should be able to discuss the causes of food spoilage.

CO-2. Student should be able to explain the food preservation techniques.

CO-3. Students should be able to prepare preserved food.

SYLLABUS:

UNIT I

Importance of preservation – basic principles of preservation, food deterioration-agents causing spoilage, types of spoilage, prevention and need for preservation.

UNIT II

Food preservation techniques

a) Preservation by heat – blanching, pasteurization, sterilization, concentration. Drying methods- sun, mechanical, freeze and osmotic drying, Changes during drying

b) Preservation by low temperature – Refrigeration & freezing, factors to be considered in low temperature preservation.

c) Preservation by ionizing radiations- units, process, effect on microorganisms, effect of irradiation overdose on foods.

d) Preservation by use of preservatives –sugar, salt, chemicals.

UNIT III

Preparation of preserved food products (any 3)

Fruits – Jams, Jellies, Squashes,Cordials, marmalades, candy

Vegetables – Pickles.

SEMESTER – III

YEAR: II B.Sc. **SEMESTER: III**

COURSE: Molecular Biology **COURSE CODE: SN23A**

COURSE OBJECTIVES:

- To describe the general principles of gene organization and expression in both prokaryotic and eukaryotic organisms.
- Discuss the various macromolecular components of cells and their functions.
- To understand the chemical synthesis of polynucleotide, transcription and translation process.
- To study the various types of mutations can alter the structure of a polypeptide chain.
- To study the processing of protein and distribution.
- To learn the role of enzymes involved in the replication, transcription and translation process.

COURSE OUTCOMES:

CO-1. Students can explain concepts such as gene structure and function, gene regulation, microbial genetics, mutation and DNA repair, DNA sequencing.

CO-2. Students can gain insight into the most significant molecular and cell-based methods used today to expand our understanding of biology.

CO-3. They can understand the chemical and molecular processes that occur in and between cells.

CO-4. Students can understand the synthesis, structure, and function of nucleic acids and proteins in prokaryotes and eukaryotes.

CO-5. To gain the knowledge of functions of polycistronic mRNA and monocistronic mRNA.

CO-6. To understand the concept of Operon like Lactose, Tryptophan, Arabinose and Galactose in gene expression studies.

SYLLABUS:

UNIT I

Primary Structure of Nucleic Acids, ABZs of DNA Secondary Structure, Denaturation and Renaturation of DNA, Supercoils and Cruciforms: Tertiary Structure in DNA. Ribonucleic Acid, types of RNA and Secondary and Tertiary Structure of RNA.

UNIT II

Prokaryotic replication- model of replication - semiconservative mode of replication-replication forks, semi-discontinuous replication, Okazaki fragments.Bacteriophages M13 and ΦX174 replication,rollingcirclemodelof replication.Enzymology of replication- role of DNA polymerases I, II, III, gyrase, topoisomerases, helicase, ligases and SSB proteins.Theta replication in *E.Coli*- initiation events at Ori C, elongation events on the replication fork and termination - fidelity of replication - inhibition of replication.

UNIT III

Transcription- prokaryotic RNA polymerases - role of sigma factor. TATA box, promoter, closed and open promoter complexes- initiation, elongation and termination of transcription, post transcriptional modifications in prokaryotes (tRNA and rRNA). Inhibitors of transcription.

UNIT IV

Protein synthesis: Ribosome, formation of initiation complex, initiation factors and their regulation, elongation and elongation factors, termination, inhibition factors of protein synthesis, genetic code, aminoacylation of tRNA,

UNIT V

Regulation of activity of Genes and Gene products in Prokaryotes: The lactose system and the operon model, The Galactose operon, The Arabinose operon, The Tryptophan operon, Regulation of Translation, Regulation of the synthesis of Ribosomes, Feedback Inhibition.

YEAR: II B.Sc. **SEMESTER: III**

COURSE: Practical-III: Molecular Biology **COURSE CODE: SN241**

COURSE OBJECTIVES:

- To review critically the fundamental and key concepts of Molecular Biology and gene cloning.
- To grasp a common and valuable techniques used in molecular Biology.
- To understand a broad range of experimental techniques used in molecular biology and how they are used to improve the concepts of replication, transcription and translation.
- To gain the knowledge of the theories underlying both basic and some advanced methods in molecular biology
- To know the knowledge of the special experimental methods like Isolation of chromosomal DNA and Plasmid DNA.

COURSE OUTCOMES:

CO-1. To understand the concepts such as gene structure and function, gene regulation, microbial genetics, mutation and DNA repair, PCR and sequencing.

CO-2. Use basic laboratory equipment, apparatus and procedures for molecular study.

CO-3. Safely carry out a range of laboratory techniques used for the isolation, purification and manipulation of biomolecules, for example PCR, DNA recombination techniques and electrophoresis.

CO-4. Laboratory exercise provides the students skills about the DNA manipulation and routine laboratory techniques.

SYLLABUS:

UNIT I

Estimation of DNA by diphenylamine method.Estimation of RNA by rcinol method.

UNIT II

Isolation of Plasmid DNA by Alkalysis method.Isolation of genomic DNA from prokaryotes. Isolation of Chromosomal DNA from Eukaryotic cells.Eg. Leaves.

UNIT III

Isolation of RNA from yeast.

Isolation of antibiotic resistant mutants.

UNIT IV

Preparation of competent cells.

UNIT V

Transformation of *E.coli.*

SEMESTER – IV

YEAR: II B.Sc. **SEMESTER: IV**

COURSE: Soil and Agricultural Microbiology **COURSE CODE: SN24A**

COURSE OBJECTIVES:

- To provide students with useful information regarding the taxonomical, physiological, and environmental aspects of soil microorganisms.
- To learn the roles of soil microbes, such as decomposing dead organic matter, enriching the soil with nutrients, increasing water infiltration, improving soil texture, etc.
- To provide students with knowledge concerning soil microorganisms both harmful and beneficial and how to control and enhance each respectively.
- To acquire knowledge on such topics as: organisms and interactions, mycorrhizal symbiosis, biological dinitrogen fixation (both symbiotic and non-symbiotic).
- To know the role of microorganisms in bio geo chemical cycles.
- To study about the symptoms, Etiology, Epidemiology and Management of several plant diseases.
- To help students keep abreast of the most recent advances in soil microbiology.

COURSE OUTCOMES:

CO-1. On completion of the course, students will develop skill regarding various methods used in agriculturally important microbes and disease management of plant diseases.

CO-2. Students will develop the knowledge in soil texture and soil fertility.

CO-3. Students will learn that the soil is an excellent habitat for multitude of microorganisms balancing the soil ecosystem.

CO-4. Attainment of course objectives will mean realization of the various beneficial effects of soil microorganisms on soil health. Conversely, students learned that some soil microbes are deleterious.

CO-5. The knowledge acquired in Soil Microbiology will enhance the student's competency in the performance of their duties as future employees in the field of Agronomy/Soil Science.

SYLLABUS:

UNIT I

Soil microbiology - quantitative and qualitative micro flora of different soils-role of microbes in soil fertility-tests for soil fertility - soil structure, soil formation - characterization of soil types and importance.

UNIT II

Biogeochemical cycles-role of micro organisms in carbon, phosphorus, sulphur and iron cycles. Methods of studying ecology of soil micro organisms-microbial gas metabolism-carbon dioxide, hydrogen, and methane and hydrogen sulphide.

UNIT III

Microbial interactions between microorganisms, plant and soil.Rhizoplane, rhizosphere, phyllosphere, spermosphere, mycorrhizae.Microbial association with insects-gut micro flora -symbiosis between microbes and insects; organic matter decomposition.

UNIT IV

Nitrogen cycle; ammonification- nitrification- de-nitrification- nitrogen fixation- Biofertilizers (bacterial, cyanobacteria and azolla), mycorrhiza and its types and crop response-bio-pesticides (bacterial, viral and fungal) saprophytes for pathogen suppression.

UNIT V

Principles of plant infection and defense mechanisms. Symptoms, Etiology, Epidemiology and Management of the following plant diseases: Bacterial disease – Citrus canker, blight of paddy, Fungal disease- Red rot of sugarcane, Black stem rust of wheat, Tikka leaf spot, Wilt of cotton, Viral Disease – TMV, Vein clearing disease.

YEAR: II B.Sc. **SEMESTER: IV**

COURSE: Practical-IV: Soil and Agricultural Microbiology **COURSE CODE: SN242**

COURSE OBJECTIVES:

- To gain knowledge of the role played by microorganisms in agriculture.
- To gain basic knowledge and skill in microbiological techniques.
- To gain knowledge on the biology of different groups of microorganisms of importance in agriculture.
- To know about the enzyme producing soil microorganisms.
- To isolate and identify the root nodule bacteria.
- To study of several important plant diseases.

COURSE OUTCOMES:

CO-1. Appreciate the impact of microbial processes in agricultural production.

CO-2. Use basic laboratory equipment, apparatus and procedures for the study of microorganisms.

CO-3. Isolate and recognize major groups of microorganisms.

CO-4. Understand the key basic characteristic features that differentiate the different groups of microorganisms

SYLLABUS:

UNIT I

Methods to study soil microorganisms - Isolation and enumeration of Bacteria, Fungi, Bacterio-phages, Algae, Protozoa etc., Microbiological test for fertility - Bacterial and Fungal

UNIT II

Microbiological demonstration of soil enzymes – Amylase, Protease, Lipase, Gelatinase etc.

UNIT III

Isolation and identification of root nodule bacteria- Rhizobium(symbiotic), demonstration of rhizobium in the root nodule(CS of root nodule) Isolation and identification of Azotobacter (Asymbiotic).

UNIT IV

Isolation and identification of nitrogen fixing Cyanobacteria-Anabaena, Nostoc etc., Demonstration of Azolla Demonstration of antagonistic activity –bacterial and fungal.

UNIT V

Study of the following discases: Tobacco mosaic; Bacterial blight of paddy; Downy mildew of bajra; Powdery mildew of cucurbits; Head smut of sorghum; Leaf rust of coffee; Leaf spot of paddy, Red rot of sugar cane, Root knot of mulberry.

YEAR: II B.Sc. **SEMESTER: IV**

COURSE: Environmental studies **COURSE CODE: ENV4B**

COURSE OBJECTIVES:

The Environmental Studies curriculum is designed to provide you with the ability to investigate environmental issues from a rigorous interdisciplinary perspective by integrating insights and information from the natural sciences, social sciences, and humanities

COURSE OUTCOMES:

CO-1. Demonstrate a scientific understanding of the physical and biological dynamics of global ecologies including first-hand knowledge of local and regional ecosystems.

CO-2. Analyze the social, economic, and political and policy dynamics involved in both the emergence and the resolution of environmental problems

CO-3. Explain and analyze the historical development, ethical implications, and religious dimensions of the human relationship with the nonhuman world

SYLLABUS:

Unit 1: Introduction to Environmental Studies

- Multidisciplinary nature of environmental studies;
- Scope and importance; concept of sustainability and sustainable development.

Unit 2 : Ecosystem (2 lectures)

- What is an ecosystem? Structure and function of ecosystem; Energy flow in an ecosystem Food chains, food webs and ecological succession, Case studies of the following ecosystem:
  a) Forest ecosystem
  b) Grassland ecosystem
  c) Desert ecosystem
  d) Aquatic ecosystem (ponds, stream, lakes, rivers, ocean, estuaries)

Unit 3: Natural Resources : Renewable and Non – renewable Resources (6 lectures)

- Land resources and landuse change: Land degradation, soil erosion and desertification.
- Deforestation : Causes and impacts due to mining, dam building on environment, forests, biodiversity and tribal populations.
- Water : Use and over –exploitation of surface and ground water, floods, droughts, conflicts over water (international and inter-state).
- Energy resources : Renewable and non renewable energy sources, use of alternate energy sources, growing energy needs, case studies.

Unit 4: Biodiversity and Conservation (8 lecturers)

- Levels of biological diversity: genetics, species and ecosystem diversity, Biogeographic zones of India: Biodiversity patterns and global biodiversity hot spots
- India as a mega- biodiversity nation, Endangered and endemic species of India.
- Threats to biodiversity: Habitat loss, poaching of wildlife, man- wildlife conflicts, biological invasions; Conservations of biodiversity: In-situ and Ex-situ Conservation of biodiversity.
- Ecosystem and biodiversity services: Ecological, economic, social, ethical, aesthetic and Informational value.

Unit 5: Environmental Pollution (8 lecturers)

- Environmental pollution: types, causes, effects and controls: Air, Water, soil and noise Pollution.
- Nuclear hazards and human health risks
- Solid waste management: Control measures of urban and industrial waste
- Pollution case studies.

Unit 6: Environmental Policies & Practices (8 lecturers)

- Climate change, global warming, ozone layer depletion, acid rain and impacts on human communities and agriculture
- Environment Laws: Environment Protection Act, Air (Prevention & Control of Pollution) Act; Water (Prevention and Control of Pollution) Act; Wildlife Protection Act; Forest Conservation

Act. International agreements: Montreal and Kyoto protocols and Convention on Biological Diversity (CBD).

- Nature reserves, tribal populations and rights, and human Wildlife conflicts in Indian context.

Unit 7: Human Communities and the Environment (7 lectures)

- Human population growth, impacts on environment, human health and welfare.
- Resettlement and rehabilitation of projects affected persons; case studies.
- Disaster management: floods, earthquake, cyclone and landslides.
- Environmental movements : Chipko, Silent Valley, Bishnois of Rajasthan.
- Environmental ethics : Role of Indian and other religions and cultures in environmental conservation.
- Environmental communication and public awareness, case studies(e.g. CNG Vehicles in Delhi)

Unit 8: Field Work (6 lectures)

- Visit to an area to document environmental assets: river / forest/ flora/ fauna etc.
- Visit to a local polluted site – Urban / Rural/ Industrial/ Agricultural.
- Study of common plants, insects, birds and basic principles of identification.
- Study of simple ecosystem- pond, river, Delhi Ridge etc.

(Equal to 5 Lectures)

SEMESTER – V

YEAR: III B.Sc. **SEMESTER: V**

COURSE: Medical Bacteriology **COURSE CODE:**

COURSEOBJECTIVE:

To learn the different types of medically important bacteria, their properties, collection, transportation, isolation, identification of bacteria from different clinical specimens based on their virulence nature, pathogenesis and diagnosis methods and also provides immense knowledge on treatment and prophylaxis for each pathogenic bacterium.

COURSE OUTCOMES:

CO-1. This course helps to understand the properties of various pathogenic bacteria and to know the procedure for collecting, transporting and isolation of pathogens from clinical specimens

CO-2. It provides the knowledge on the sensitivity of pathogen to a particular antibiotic which can be given for treating patients against pathogen.

CO-3. It helps students to know the pathological conditions and virulence nature of pathogen inside the host

CO-4. The course describes the diagnosis methods to identify the pathogen by various tests and also helps to suggest particular antibiotics against the bacteria.

CO-5. The course also helps to students to know the epidemiology and prophylaxis methods related to the pathogen.

SYLLABUS:

UNIT I

Classification and General Properties of medically important bacteria.Principles and specific procedures for the collection and transport of clinical samples from skin, respiratory tract (upper and lower), urinary tract, genital tract and blood.

UNIT II

Isolation of bacteria from clinical specimens: Primary media for the isolation of microorganisms, common staining procedures (Gram, Negative – Capsule, Acid fast

and spore staining) and biochemical tests. Antimicrobial sensitivity testing by Kirby-Bauer disc diffusion method and determination of MIC by broth dilution method.

UNIT III

Morphology, cultural characteristics, pathogenicity, Laboratory diagnosis, prevention and treatment of diseases caused by the following organisms: *Staphylococcus aureus*, *Streptococcus pyogenes*, *Corynebacteriumdiphtheria,Mycobacterium tuberculosis and Mycobacteriumleprae.*

UNIT IV

Vibrio cholera, Haemophilusinfluenzae,Pseudomonasaeruginosa, Bordetellapertussis. Escherichia coli, Salmonella typhi, Shigella, Proteus, Klebsiella pneumonia, Neisseria meningitides and Neisseria gonorrhea.

YEAR: III B.Sc. **SEMESTER: V**

COURSE: Medical Mycology and Parasitology **COURSE CODE:**

COURSE OBJECTIVES:

- Describe Morphology, Lifecycle, Pathology and laboratory diagnosis of fungi and parasites.
- Classify parasites and fungi.
- Perform appropriate laboratory techniques used in the processing of specimens and identification of parasites and fungi.

COURSE OUTCOMES:

CO-1. Understand the classification and characteristics of fungi and parasites.

CO-2. Provide knowledge about collection and transport of Specimens.

CO-3. Studied the pathogenesis and laboratory diagnosis of disease caused by parasites and fungi.

CO-4. Prevention and awareness of public health.

SYLLABUS:

UNIT I

Morphology, Taxonomy, Reproduction, Classification of fungi.General characteristics of Zycomycetetes, Ascomycetes, Basidiomycetes and Deuteromycetes.

UNIT II

Superficial Mycoses- Pityriasisversicolor, Tineanigra, Piedra. Cutaneous Mycoses- Dermatophytoses(Trichophyton, Epidermophyton and Microsporum). Subcutaneous Mycoses- Eumycoticmycetoma.Systemic Mycoses- Histoplasmosis.Oppurtunistic Mycoses- Candidiasis andCryptococcosis.

UNIT III

Collection and transport of specimens. Isolation of fungi from clinical specimens: Methods for direct microscopic examination of specimens (KOH wet mount, KOH with calcofluor white, India ink, Tissue stains, LPCB stain, cellophane tape mount), culture technique-primary media, slide culture technique, germ tube test, Carbohydrate fermentation and assimilation test. Antifungal agents.

UNIT IV

General introduction to Medical Parasitology.Classification of medically important parasites. Morphology, life cycle, pathogenesis, clinical features, laboratory diagnosis, prevention and treatment of diseases caused by the following organisms: *Entameoba (histolytica and coli), flagellates (Giardia lamblia, Leishmaniadonovani), Sporozoa- Plasmodium (malariae andfalciparum).*

UNIT V

Introduction to Helminths. Platyhelminthes: Taenia (saginata and solium), Schistosomahaematobium, Fasciola hepatica, Paragonimuswestermani. Nematihelminthes: Ascarislumbricoides, Enterobiusvermicularis, Wuchereriabancrofti, Dracunculusmedinensis. Laboratory techniques in parasitology: Examination of faeces for ova and cyst by direct wet mount and iodine wet mount, concentration methods (Floatation and sedimentation techniques), Examination of blood for parasites. Cultivation of protozoanparasites.

YEAR: III B.Sc. **SEMESTER: V**

COURSE: Medical Virology **COURSE CODE:**

COURSE OBJECTIVE:

To provide knowledge, about virus, their structure, DNA and RNA viruses, effect of virus on cell growth, cultivation virus and vaccine preparation.

COURSE OUTCOMES:

CO-1. Students gain knowledge of properties, diagnosis and cultivation of virus.

CO-2. Understand and learn about various virus life cycle and treatment of viral infections

CO-3. Able to learn about immunization schedule.

CO-4. Learn about various types of bacteriophage, their structure, and life cycle of bacteriophage

CO-5. Gains knowledge about antiviral agents and also about vaccine production

SYLLABUS:

UNIT I

General characteristics of viruses: Structure (nucleic acid, capsid, envelope) and replication. Laboratory diagnosis of viral diseases: Microscopy, culture and isolation, serological diagnosis of viral infections. Cultivation of viruses– inoculation in animals, embryonated eggs and tissue culture.

UNIT II

Morphology, mode of transmission, pathogenesis, symptoms, laboratory diagnosis, prophylaxis and control of diseases caused by the following viruses – Arboviruses (Flavi virus), Picorna viruses (Polio virus and Rhinovirus), Hepatitis viruses (HAV, HBV, HCV, HDV), Rabies virus, Orthomyoviruses (Influenza virus) and Paramyxoviruses (Mumps and Measles virus).

UNIT III

Pox viruses (Variola, Vaccinia), Herpes viruses (Herpes simplex, Varicella zoster), Adeno viruses, Rota viruses and HIV viruses. Oncogenic viruses (Human Papilloma virus): Introduction, characteristics of transformed cells, mechanism of viral oncogenesis and clinical manifestations.

UNIT IV

Bacteriophages – Types, Morphology and life cycle (lytic and lysogenic). Significance of phages.Study of recent outbreaks of human diseases (SARS, Swine flu, Ebola, Dengue, Chikungunya) – causes, spread and preventive measures.

UNIT V

Antiviral agents and their mode of action.Interferons. Viral vaccines - types, Immunization schedule.

YEAR: III B.Sc. **SEMESTER: V**

COURSE: Practical V **COURSE CODE:**

Medical Bacteriology, Mycology, Parasitology and Virology

COURSEOBJECTIVE:

This course helps to learn about collection, transportation, processing of different clinical specimens and also enhances the skills of techniques to isolate and identify pathogenic bacteria, fungi, bacteriophages and parasites from clinical specimens.

COURSE OUTCOMES:

CO-1. Learn the procedure for collecting, transporting of clinical specimens and processing by staining techniques and enumeration methods.

CO-2. Enhances the skills of isolation, identification and sensitivity of pathogen to a particular antibiotic which can be given for treating patients against pathogen.

CO-3. Helps students to isolate bacteriophages from sewage sample by plaque assay method

CO-4. The course describes the diagnosis methods to identify the pathogen by various tests and also helps to suggest particular antibiotics against the bacteria.

CO-5. The course also helps to students to know the epidemiology and prophylaxis methods related to the pathogen.

SYLLABUS:

UNIT I

General requirements for collection and transport of clinical Specimens. Isolation of organisms from clinical materials viz: Throat swab, Pus, Urine, Sputum, Stool etc. Enumeration of Bacteria in Urine, Quantitative UrineCulture.

UNIT II

Identification of bacterial pathogens from clinical specimens and their biological reactions.Simple, differential and special staining techniques.Antimicrobial Sensitivity testing by Kirby-Bauer disc-diffusion technique and determination of MIC by broth dilution method.

UNIT III

Identification of pathogenic viruses in Slides/ Smears / Spotters.Isolation of phage from naturalsources.

UNIT IV

KOH and Lactophenol preparations for skin scrapings for dermatophytes.Microscopic identification and cultural characteristics of medically important fungi and lab contaminants. Germ tube, carbohydrate assimilation and fermentation tests for yeasts.

UNIT V

Direct examination of faeces- wet mount and Lugol’s iodine method- demonstration of protozoan cysts and helminthes eggs. Concentration techniques of stool specimen- floatation and sedimentation methods.Examination of blood for malarial parasites- thin and thick smearpreparation.Identification of pathogenic parasites in slides/ specimens as spotters.

YEAR: III B.Sc. **SEMESTER: V**

COURSE: Elective I Biotechnology and Genetic Engineering COURSE CODE:

COURSE OBJECTIVE:

The purpose of this course is to introduce the basic molecular biological concepts and techniques used in the fields of genetic engineering.

COURSE OUTCOMES:

CO-1. Gaining an appreciable knowledge of dealing with ethical issues relating to science

CO-2. Gaining and understanding basic molecular and cellular biology concepts and techniques.

CO-3. Gaining the knowledge about current experimentation in genetic engineering.

SYLLABUS:

UNIT I

Biotechnology–Definition & history, Microbial production of industrial enzymes (Amylase , Lipase , Proteases). Methods for immobilization of enzymes, application of soluble and immobilized enzymes; enzyme-based sensors.

UNIT II

Production of biotechnological products- Insulin, interferon, human growth hormone, recombinant vaccine, gene therapy methods.

UNIT III

Principles and application of genetic engineering. Host cell restriction; Restriction modification; Restriction enzymes: Types- Nucleases, Ribonucleases, DNA ligases, Tag DNA Polymerases, Methylases, Topoisomerases (I and II), Gyrases, and ReverseTranscriptases.

UNIT IV

Vectors: Plasmid vectors: pSC101, pBR322, pUC series (18, 19) and Ti plasmids based vectors; Bacteriophage vectors: Lambda phage vectors, phagemids, cosmids, Viral vectors: Vaccinia, Retroviral, SV40 and Baculoviral system

UNIT V

Methods of Gene transfer – transformation, Electroporation, microinjection and biolistic gun. Genomic DNA and cDNA library Construction; Screening methods- Analysis of Recombinant DNA; Polymerase chain reaction; Principles and techniques of nucleic acid hybridization; Southern, Northern, Western blotting techniques Applications of genetic engineering in agriculture; health and industry. Development of transgenic plant andanimal.

SEMESTER – VI

YEAR: III B.Sc. **SEMESTER:VI**

COURSE: Environmental Microbiology **COURSE CODE:**

COURSE OBJECTIVES:

- To provide a basic understanding of environmental microbiology including
- The functional diversity of microorganisms in the environment in relation to human welfare and ecosystem health
- Microbial interactions with pollutants in the environment and the fate of microbial pathogens in the environment.
- To learn the basic principles of environment microbiology and be able to apply these principles to understanding and solving problems in water quality and bioremediation.
- To become familiar with current research in environmental microbiology.

COURSE OUTCOMES:

Upon successful completion of the course, students are expected to be able to:

CO-1. Appreciate the diversity of microorganism and microbial communities inhabiting a multitude of habitats and occupying a wide range of ecological habitats.

CO-2. Learn the occurrence, abundance and distribution of microorganism in the environment and their role in the environment and also learn different methods for their detection and characterization

CO-3. Competently explain various aspects of environmental microbiology and microbial ecology and to become familiar with current research in environmental microbiology.

CO-4. Understand the basic principles of environment microbiology and be able to apply these principles to understanding and solving environmental problems – waste water treatment and bioremediation

CO-5. Know the Microorganisms responsible for water pollution especially Water- borne pathogenic microorganisms and their transmission

CO-6. Comprehend the various methods to determine the sanitary quality of water and sewage treatment methods employed in waste water treatment

SYLLABUS:

UNIT I

Introduction: Organization of the biosphere and components of ecosystem, Natural habitats of microorganisms, Microbial communities in aquatic and terrestrial habitats, Microorganisms as components of ecosystem-as producers and decomposers

UNIT II

Microbes in air: Composition of Air; Number and kinds of organisms in air; Distribution and sources of air borne organisms, droplet nuclei - aerosol , Assessment of air quality - some important air borne diseases caused by bacteria, fungi, viruses their symptoms and preventive measures.

UNIT III

Aquatic Microbiology: Distribution of Microorganisms in the Aquatic Environment- fresh water (ponds,lake,River), Sources and Types of Water Pollution, Biological Indicators of Water Pollution. Determination of the quality of Water - MPN Index, Membrane Filtration, Biological Oxygen Demand potability of water - microbial assessment of water quality, water borne diseases and preventive measures.

UNIT IV

Waste Treatment: Types of wastes - Characterization of solid and liquid wastes - wastes treatment and useful byproducts, Solid - Saccharification - gasification – composting, Vermicoposting - liquid waste treatment - aerobic - anaerobic methods.

UNIT V

Degradation of pesticides and detergents; Degradation of lignin; synthetic polymers, Petroleum and hydrocarbon degradation, Detoxification of heavy metals (chromium, lead, arsenic, mecury).

YEAR: III B.Sc. **SEMESTER:VI**

COURSE: Food & Dairy Microbiology **COURSE CODE:**

COURSE OBJECTIVES:

- This course helps students to learn the different microflora in different foods and factors influencing their growth.
- This course provides knowledge on the role of food microbiota in spoilage, contamination and Preservation.
- It also helps students to study the food borne diseases and their outbreaks along with their investigation methods.
- This course concentrates on the preparation of different fermented products (cheese, yogurt, oriental fermented foods, etc.,)

COURSE OUTCOMES:

CO-1. Understand the significance and activities of various microorganisms in Food.

CO-2. Ability to learn the different preservation techniques such as low temperature, freezing, etc., chemical preservation to prevent food spoilage and contamination.

CO-3. Know the important spoilage organisms and their mechanisms in foods and thus identify methods to control.

CO-4. It provides the knowledge on the basis of food safety regulations and the use of standard methods and procedures for the microbiological analysis of food•.

CO-5. It helps students to know the beneficial role of microorganisms in fermented foods and in food processing of different types of fermented food products

SYLLABUS:

UNIT I

Food as a substrate for micro organisms -.Micro organisms important in food microbiology; Molds, yeasts and bacteria - General Characteristics - Classification and importance.

UNIT II

Principles of food preservation - Asepsis - Removal of micro organisms, anaerobic conditions - High temperature - Low temperature - Drying - Food additives.

UNIT III

Contamination and spoilage - Cereals, sugar products, vegetables and fruits, meat and meat products, milk and milk products - Fish , Poultry

UNIT IV

Food borne infections and intoxications - bacterial, non -bacterial - Food borne disease outbreaks - Laboratory testing - preventing measures - Food sanitation - plant sanitation -Employees' health standards.

UNIT V

Food fermentations: Bread cheese, vinegar, fermented vegetables (sauerkraut), fermented dairy products (yoghurt,). Spoilage and defects of fermented dairy products - oriental fermented foods.

YEAR: III B.Sc. **SEMESTER:VI**

COURSE: Practical VI **COURSE CODE:**

ENIVRONMENTAL, FOOD& DAIRYMICROBIOLOGY

COURSE OBJECTIVE:

This course helps students to learn the different analysis techniques in isolation, enumeration of bacteria, yeast and mold from different food samples, water, air, milk etc., It provides the skills for handling the samples for disease outbreak. Thereby helps in creating basic skills in handing laboratory procedures.

COURSE OUTCOMES:

CO-1. Helps to learn the enumeration of bacteria in milk sample by Standard Plate Count Method.

CO-2. Ability to learn the rapid test to check the quality of milk samples and determine the reason for the contamination.

CO-3. Know the presence of important and common spoilage organisms in various spoiled foods like nuts etc., by their morphological features, staining techniques and biochemical studies.

CO-4. Enhances the knowledge on finding the BOD and COD level of waste water and report the quality of drinking water by standard procedures

CO-5. It provides the knowledge on the prevalence of air microflora in different locations by settle plate method. Helps to create knowledge on detection of aflatoxins from food samples.

SYLLABUS:

UNIT I

Detection of number of Bacteria in milk by breed count. Detection of number of bacteria in milk by standard plant count.

UNIT II

Determination of quality of milk sample by methylene blue reductase test and Resorzurin method.

UNIT III

Isolation of yeast and molds from spoiled nuts, fruits, and vegetables. Bacteriological examination of specific food a) Curd b) Raw meat c) Fish d) Ice cream.

UNIT IV

Determination of BOD and COD of wastewater. Water analysis

a) MPN method b) Memberane filter method.

UNIT V

Quantification of microorganisms in air by settle plate and air sampler methods. Detection of aflatoxin B1 from moldy grains using thin layer chromatography.

YEAR: III B.Sc. **SEMESTER:VI**

COURSE: Elective II **COURSE CODE:**

Industrial & Pharmaceutical Microbiology

COURSE OBJECTIVES:

- To provide knowledge and understanding of Pharmaceutical Microbiology relevant to health care.
- To provide knowledge about use of microorganisms to manufacture antibiotics, protein.
- Ability to apply the techniques used in different phase of industry.

COURSE OUTCOMES:

CO-1. Discover new useful microorganism and store for later use

CO-2. Describe the main steps and process used to produce biological products in industry.

CO-3. Understand ethical and commercial issues such as patenting and licensing.

SYLLABUS:

UNIT I

General introduction to fermentation process. Industrially important microbes (Streptomyces, Saccharomyces, Penicillium) Fermentation media-desired qualities- media formulation strategies- carbon, nitrogen, vitamin, mineral sources, role of buffers, precursors, inhibitors, inducers and antifoams.

UNIT II

Types of fermentation-fermentors-basic functions, design and components, asepsis and containment requirement.Specifications of fermentors- sterilization of fermentors- aseptic inoculation methods.

UNIT III

Microbial products of commercial use-Penicillin, ethanol, vitamin B12, protease, citric acid and glutamic acid.

UNIT IV

Down stream processing - objective and criteria, foam separation, precipitation methods, filtration, industrial scale centrifugation and cell disruption methods. Liquid-liquid extraction, solvent recovery- chromatography.

UNIT V

Ecology of microorganisms affecting pharmaceutical industries- atmosphere-water- raw materials- packaging- equipment. Factors affecting microbial spoilage of pharmaceutical products - Cotntrol of contamination during manufacture- good pharmaceutical manufacturing process.Quality control and validation of Pharmaceutical products.Sterility test-Microbial limit test (*Staphylococcus, E.coli, Salmonella* and *Pseudomonas*).

YEAR: III B.Sc. **SEMESTER:VI**

COURSE: Elective III: Microbial Marketable Products **COURSE CODE:**

COURSEOBJECTIVE:

- To provide knowledge and understanding of Microbial products
- To make them learn the large scale cultivation microbes used as bio fertilizers, food, SCP etc.,

- To provide knowledge about the patenting, trademarking, licensing and Marketing of the products

COURSE OUTCOMES:

CO-1. Acquire the knowledge about Spirulina cultivation and edible mushroom cultivation

CO-2. Acquire a thorough understanding of the importance of probiotics in human health and their production on a large scale

CO-3. Get an awareness of the availability of natural pigment and its application, Bio fertilizers and their application

CO-4. Imbibe knowledge on the various marketing strategy such as patenting, trade mark, marketing, license procurement etc.

SYLLABUS:

UNIT- I:

Morphology and structure of *Spirullina maxima* and *Spirullinsplatensis.*Biochemical composition,phycobiliprotein, beta carotene and UV Protecting pigments. Methods of cultivation - Freshwater, marine and hyper saline – photobioreactors, plate method, tubular, annular and plate airlift. Tank construction, Race way pond – open and closed - construction, Scale-up cultivation.Contaminants identification and processing.Harvesting, drying and packaging.Uses& Application of Spirulina.

UNIT-II:

Mushroom fungi – *Agaricus*sp.,*Calocybe*sp., *Pleurotus*sp., and *Volvariella*sp., biochemical composition, nutrient value, compounds and flavanoids. Cultivation – Tropical and temperate types, growth media preparation - compost, waste recycling, isolation, spawn production; spawn running, harvesting and packing. Construction cultivation shed - Small scale and large scale production setup. Diseases and control measures. Medicinal properties,

UNIT-III:

Introduction probiotics, mechanism of probiotics, Probiotic microorganism- Bacteria and Yeast Structure and cultural characteristics of *Lactobacillus* sp., *Saccharomyces* sp. Nutritional sources, yeast propagation. Cultivation and fermentation techniques: Raw materials, Fermentor design, construction, production, microbial growth requirements, quality testing, stability during storage, packing. Commercial Probiotic dairy products, Health benefits.Safety of probiotics in legalstatus.

UNIT-IV:

Microbial pigments – allophycocyanin, phycocyanin, phycoerythrin, chlorophyll (Bacterial andcyanobacterial), Pigment proteins applications – medical, industrial and textile, extraction methods.

biological nutrient management – organic manures, Biofertilizers – soil improvement, structure and cultural characteristics of *Rhizobiu*m sp., *Azotobacter*sp., *Azospirillum*sp., *Nostoc*sp. Cultivation – raw material, fermentor design, mass production, harvesting, macro quality analysis, grading, Packaging and post harvestmanagement.

UNIT-V:

General principle of intellectual property rights, concept of property..Forms of IPR- law of copyrights, Trademark, Patents, industrial design, trade secrets, application of different forms.