Jaya College of Arts and Science, Thiruninravur-602024.

Department of Microbiology

Year : 2020-2021

Programme Offered:

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

M.Sc. Applied Microbiology

Programme Objective:

- The objective of the Master's Program in Microbiology is to equip the students to apply knowledge of prokaryotic and eukaryotic cellular processes, classification, interaction of microorganisms among themselves, and chemical agents and higher order organisms.
- The laboratory training in addition to theory is included to prepare them for careers in the industry, agriculture, and applied research where biological system is increasingly employed.
- Basics and current molecular updates in the areas of Industrial Microbiology, Fermentation Technology, Agriculture& Environmental Microbiology are included to train the students and also sensitize them to scope for research.
- To provide basic understanding of the principles of modern applied microbiology. To provide teaching and research activities in applied microbiology.
- The Master's Program in Microbiology will address the increasing need for skilled scientific manpower with an understanding of research ethics involving microorganisms to contribute to application, advancement and impartment of knowledge in the field of microbiology.

Program Specific Outcomes (PSOs):

- The two-year study of Master in Microbiology will impart in-depth understanding of basic aspects of microbiological science pertaining to industrial applications. The student will be able to assess treatment strategies including the appropriate use of antimicrobial agents and common mechanisms of antimicrobial action and resistance.
- The courses of Industrial Microbiology & Fermentation Technology, Genetic Engineering, Microbial Genetics, Bio-analytical Techniques, Molecular Microbial Physiology, Agriculture & Environmental Microbiology, Animal Biotechnology, and Vaccinology will make the students ready to contribute to; Molecular, Biochemical, Industrial, medical and other basic and applied applications of better understanding of the key principles of microbial functioning at an advanced level.
- Production of substantial original research of significance and quality sufficient for publication. Awareness of ethical issues in Microbiology research and careers options.

COURSE STRUCTURE:

Semester I

Semester	Course Components	Name of the Subject	Inst. Hrs.	Credits	Exam Hours	Max. Marks		
						CIA	External	Total
I	Core Paper-I	Microbial Taxonomy	5	4	3	25	75	100
I	Core Paper-II	General Microbiology and Laboratory Animal Science	5	4	3	25	75	100
I	Core Paper-III	Immunology	5	4	3	25	75	100
I	Core Paper-IV	Practical - I * General Microbiology, Physiology and Immunology	6	4	6	40	60	100
I	Elective - I	Metabolic Pathways	4	3	3	25	75	100
I	Elective - II	Microbial Diversity	4	3	3	25	75	100
I	Soft Skill - I		1	2	3	40	60	100

Semester II

Semester	Course Components	Name of the Subject	Inst. Hrs.	Credits	Exam Hours	Max. Marks		
						CIA	External	Total
II	Core Paper-V	Virology	5	4	3	25	75	100
II	Core Paper-VI	Systematic Medical Bacteriology	5	4	3	25	75	100
II	Core Paper-VII	Mycology and Parasitology	5	4	3	25	75	100
II	Core Paper-VIII	Practical - II * Systematic Bacteriology, Mycology, Parasitology and virology	6	4	6	40	60	100
II	Elective-III	Industrial & Pharmaceutical Microbiology	4	3	3	25	75	100
II	Extra disciplinary Elective - I	Biostatistics & Bioinformatics	4	3	3	25	75	100
II	Soft Skill -II		1	2	3	40	60	100

Semester III

Semester	Course Components	Name of the Subject	Inst. Hrs.	Credits	Exam Hours	Max. Marks		
						CIA	External	Total
III	Core Paper-IX	Microbial Genetics	5	4	3	25	75	100
III	Core Paper-X	Genetic Engineering	5	4	3	25	75	100
III	Core Paper-XI	Molecular Biology	5	4	3	25	75	100
III	Core Paper-XII	Practical III*- Microbial Genetics, Molecular Biology & Genetic Engineering	6	4	6	40	60	100
III	Elective -IV	Soil and Agricultural Microbiology	4	3	3	25	75	100
III	Extra disciplinary Elective -II	Environmental Bio-technology	4	3	3	25	75	100
III	Internship*		-	2	-	-	-	100
III	Soft Skill-III		1	2	3	40	60	100

Semester IV

Semester	Course Components	Name of the Subject	Inst. Hrs.	Credits	Exam Hours	Max. Marks		
						CIA	External	Total
IV	Core Paper XIII	Food, Dairy and Environmental Microbiology	5	4	3	25	75	100
IV	Core Paper XIV	Practical IV* -Soil, Agricultural, Food and Environmental Microbiology -	6	4	6	25	75	100
IV	Core Paper XV	# Project	14	4	3	20	80	100
IV	Elective V	Research Methodology	4	3	3	25	75	100
IV	Soft Skill -IV		1	2	3	40	60	100

SEMESTER – I

YEAR: I M.Sc., **SEMESTER: I**

COURSE: MICROBIALTAXONOMY **COURSE CODE: MDT1A**

COURSE OBJECTIVE:

The purpose of studying the paper is to gain detailed taxonomic classification of microbes.

COURSE OUTCOMES:

CO-1. Understanding and gaining knowledge in concepts and techniques for identification.

CO-2. Concepts related to extremophilic microbes and archea.

CO-3. Significance and characteristics of algae and fungi.

CO-4. Characteristics of virus.

SYLLABUS:

UNIT I

Taxonomy, systematics, identification: Taxonomical hierarchyspecies- type strains: culture collections; binomial nomenclature; systems of classification- phenetic, numerical taxonomy- similarity matrix, dendrograms with examples; phylogenetic with examples; general characteristics used in classification- five kingdom, six kingdom and eight kingdom systems.

UNIT II

Classification of bacteria according to Bergey's Manual of systematic bacteriology 9th edition (up to level of section); characteristics of major sections; classification of archaea, photosynthetic bacteria, Entrobacteriaceae, Mollicutes.

UNIT III

Classification of Fungi - characteristics of zygomycetes, ascomycetes, basidiomycetes and dueteromycetes.

UNIT IV

Classification of Protozoa - classical 1980; official system & 1993 Cavalier- Smith. Distinguishing characteristics of ciliates; flagellates; sporozoa; heliozoans; amoeba.

UNIT V

Classification of Algae - major characteristics of chlorophycophyta, crisophycophyta, cryptophycophyta, euglinophycophyta & rhodophycophyta. Classification of viruses - animal viruses, plant viruses and phages.

YEAR: I M.Sc., **SEMESTER: I**

COURSE: General Microbiology & Laboratory Animal Science **COURSE CODE:MDT1B**

COURSE OBJECTIVES:

- Explain the theoretical basis of the tools technologies and methods common to general microbiology and immunology.
- Demonstrate practical skills in the use of tools, technologies and methods common to Microbiology and immunology.
- Describe methodological information.
- Apply concepts, basic research findings through description interpretation and analysis.

COURSE OUTCOMES:

CO-1. Understand the structures and functions of biomolecules.

CO-2. To know the functions of DNA replication, recombination and their repair mechanism.

CO-3. Gain the knowledge about protein synthesis and protein regulations.

CO-4. To Study the concepts of Genetic code, Gene silencing and gene regulations.

SYLLABUS:

UNIT I

Microscopy – Its principles and application in the field of Microbiology including the following: Dark field, Phase contrast, Fluorescence microscopy. TEM and SEM. Principles, operation and maintenance of: refrigerated and ultracentrifuges, Spectrophotometer. Lyophilizers. Staining methods – Simple, differential and special methods. Sterilization and disinfection methods and their quality control.

UNIT II

Bacterial Anatomy, Structure, properties and biosynthesis cellular components of bacteria – Sporulation – Growth and nutrition – Nutritional requirements – Growth curve – Kinetics of growth – Batch culture – Synchronous growth – Measurement of growth and enumeration of cells – Pure culture techniques.

UNIT III

Distribution of Algae - Thallus structure in algae - Reproduction in alga - Life cycle patterns in algae - *Chlamydomonas* – *Volvox* (Green algae) - *Nostoc* – *Spirogyra* (BGA) - *Ectocarpus* – *Sargassum* (Brown algae) - *Poly siphonia* – *Batrachospermum* (Red algae).

UNIT IV

Laboratory Animal Science. Modern methods of care, management, breeding and maintenance of laboratory animals. Detailed account of nutrition, handling, uses of different laboratory animals - rabbits, mice, rats, guinea pigs, monkeys, hamsters, fowl, sheep.

UNIT V

Breeding and handling of specific pathogen free Gnotobiotic animals and their maintenance and uses. Transgenic animal models – Methodology and uses. Disposal of animal house wastes and used animals. Laboratory uses of animals with special reference to microbiology, pathogenicity testing, antibody production, toxin/toxoid testing, hypersensitivity testing, maintenance of microbes in animals.

YEAR: I M.Sc., **SEMESTER: I**

COURSE: Immunology **COURSE CODE:MDT1C**

COURSE OBJECTIVES:

- Knowledge the structure and function of organ systems.
- Study the pathogenesis of diseases, effective treatment and mechanisms of health maintenance to prevent diseases.
- To provide knowledge on how the immune system works building on their previous knowledge from biochemistry, genetics, cell biology and microbiology.
- Overview of the Immune system learning.

COURSE OUTCOMES:

CO-1. Gain knowledge about immune system.

CO-2. Studied the structure and functions of Antibody and Antigen.

CO-3. Skills in immunological techniques.

CO-4. Provided knowledge in various mechanism of immune function.

CO-5. Importance in public health and awareness about immunological diseases.

SYLLABUS:

UNIT I

History and scope of immunology: types of immunity – Innate, acquired, passive and active, Physiology of immune response – Humoral immunity and cell mediated immunity – Lymphoid organs.

UNIT II

Antigen: Types – properties and functions: Immunoglobulin: structure, function and techniques of purification, - Antibody production – regulation and diversity – polyclonal and monoclonal antibodies.

UNIT III

Antigen – antibody reaction including agglutination and precipitation reactions – Enzyme immunoassays –Radio immune assays, Immunofluorescene, Immunoperoxidase. Immunohaematology of blood groups. ABO and RH incompatibility.

UNIT IV

Complement and its role in immune responses. Hypersensitivity – types and manifestations. Autoimmunity. Transplantation immunology and tumor immunology. HLA tissue typing – Major histocompatibility complex – structure and types.

UNIT V

Vaccines: Principles and types. Immunization - its rationale, schedules and importance in public health.

YEAR: I M.Sc., **SEMESTER: I**

COURSE: Practical-I: General Microbiology & Laboratory Animal Science **COURSE CODE: MDT11**

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 microorganism 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

Microscopic Techniques: Light microscopy: Hay infusion broth. Wet mount to show different types of microbes, hanging drop. Dark field microscopy: To show motility of spirochetes and others. Phase contrast microscopy: To show Eukaryotic Cell division, morphology etc. Fluorescence microscopy: Fluorescent staining for Mycobacteria, auromine, staining, Fluorescent antibody techniques.

UNIT II

Washing and cleaning of glass wares: Sterilization principles methods: moist heat, dry heat, filtration. Quality control check for each method:

UNIT III

Staining Techniques: Smear preparation, simple staining, Gram's staining, Acid fast staining, Metachromatic granule staining, Cell wall, spore, capsule, Flagella, Silver impregnation methods.

UNIT IV

Media Preparation: Preparation of liquid, solid and semisolid media. Agar deeps, slants, plates. Preparation of basal, enriched, selective, enrichment media. Quality control and uses. Preparation of Biochemical test media, media to demonstrate enzymatic activities.

UNIT V

Microbial Physiology: Purification and maintenance of microbes. Streak plates, pour plate, and slide culture technique. Aseptic transfer, growth and growth requirements: Cell number, and cell proteins. Direct counts, viable counts, pour plate, streak plate. Bacterial growth curve – Turbidimetry, Anaerobic culture methods.

UNIT VI

Preparation of Bacterial Antigens (Crude preparation) by homogenization or sonication. Raising polyclonal antisera in experimental animals - rabbit or mouse with bacterial antigens, RBC (Demonstration).

UNIT VII

Agglutination & Haemagglutination reactions: Latex Agglutination - RF, ASLO, CRP. Blood grouping, RH -Typing/IHA/RPHA. Precipitation reactions in gels: SRID -Single radial immunodiffusion. Double immunodiffusion. Immuno electrophoresis and staining of precipitation lines. ELISA technique – HbsAg / or other Viral Markers.

UNIT VIII

Preparation of Lymphocytes from peripheral blood by density gradient centrifugation. Purification of Immunoglobulins: Ammonium sulphate precipitation. Separation of IgG by chromatography using DEAE cellulose or Sephadex. Anaphylactic reactions in Guinea pigs; Arthus reaction in rabbits (Demonstration only). Skin tests.

YEAR: I M.Sc., **SEMESTER: I**

COURSE: Elective I - Metabolic Pathway **COURSECODE: MDTAA**

COURSE OBJECTIVE:

Students will learn about the fundamental energetic of biochemical process biosynthesis of various amino acids, carbohydrate and lipid metabolism, understand about pathway regulation

COURSE OUTCOMES:

CO-1: Students gain knowledge about enzymes, mechanism and regulation of enzyme

CO-2: Understand and learn about bioenergetics and phosphorylation,

CO-3: Students again knowledge about various biosynthesis process of biomolecules

CO-4: Students have clear idea about respiration and fermentation and about energy yield

CO-5: Students can describe amino acid structure, properties, inter conversion of an amino acid.

SYLLABUS:

UNIT I

Enzymes – nomenclature, components - Mechanism of enzyme reactions - Factors influencing enzymatic activity - Inhibition of enzyme action - Metabolic channeling – Control of enzyme activity – Regulation of enzyme synthesis.

UNIT II

Principles of Bio energetics - Oxidation –reduction reactions - Generation of energy –Substrate Level and oxidation phosphorylation - Electron transport chain

UNIT III

Carbohydrate catabolism – Glycolysis – Pentose phosphate pathway – ED pathway – The Kreb`s cycle – Energy yield in glucolysis and aerobic respiration – Anaerobic respiration – Lactic acid fermentation – Alcohol fermentation.

UNIT IV

Lipid Metabolism – Oxidation of lipids*;* biosynthesis of fatty acids; triglycerides; phospholipids; sterols. Protein and amino acid catabolism – Oxidation of inorganic molecules – Photophosphorylation.

UNIT V

Bio chemical pathways of energy use – Photosynthetic fixation of CO2 – Biosynthesis of peptidoglycan – Biosynthesis of lipids – Biosynthesis of amino acids -proline, arginine, aspartic acid, histidine- Interconversions - therionine, isoleucine and methionine; isoleucine, valine and leucine; serine and lysine; Aspartate and pyruvate. Bio synthesis of purines and pyrimidines.

YEAR: I M.Sc., **SEMESTER: I**

COURSE: Elective II - Microbial Diversity **COURSE CODE: MDTAB**

COURSE OBJECTIVE:

The course helps students to acquire knowledge on the classification, cell wall membranes, genetic functionality, characteristic feature and adaptation features of different extremophiles for their survivability in their different ecosystems.

COURSE OUTCOMES:

CO-1. Describes the common groups of bacteria and archeae and their distribution and ecological niche.

CO-2. Understand the classification, habitats, biogeochemical process and applications of thermophiles and methanogens.

CO-3. It provides knowledge on the classification, cell wall membrane, solutes and osmo adaptation of halophiles and barophiles.

CO-4. Understand the objectives of space research, life detection methods for metabolism, photosynthesis, ATP production and Sulphur uptake.

CO-5. Learn about Antarctica as a model for mars and to search for life on mars by sending various mission, landers and conducting biology box experiment. As well monitoring of microflora in Martian environment and within astronauts.

SYLLABUS:

UNIT I

Biodiversity: Introduction to microbial biodiversity- distribution, abundance, ecological niche. Types – Bacterial, Archael and Eucaryal

UNIT II

Thermophiles: classification, hyperthermophilic habitats and ecological aspects. Extremely Thermophilic Archaebacteria, Thermophily, commercial aspects of thermophilies, Applications of thermozymes. Methanogens: Classification, Habitats, applications.

UNIT III

Alkalophiles and Acidophiles - Classification, discovery basin, cell walls and membranes- purple membrane, compatible solutes. Osmoadaptation/ halotolerance. Applications of halophiles and their extremozymes. Barophiles: Classification, high pressure habitats, life under pressure, barophily, death under pressure. Halophiles - Classification, discovery basin, cell walls and membranes- purple membrane, compatible solutes.

UNIT IV

Space Microbiology - Aim and objectives of space research. Life detection methods a) Evidence of metabolism (Gulliver) b) Evidence of photosynthesis (autotrophic and heterotrophic) c) ATP production d) phosphate uptake e) sulphur uptake.

UNIT V

Martian environment (atmosphere, climate and other details). Antartica as a model for Mars. Search for life on Mars, Viking mission, Viking landers, and Biology box experiment. Gas exchange, label release and pyrolytic release experiments. Monitoring of astronauts microbial flora: Alterations in the load of medically important microorganisms, changes in mycological and bacterial autoflora.

SEMESTER – II

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

COURSE: Virology **COURSE CODE: MDT2A**

COURSE OBJECTIVES:

- To understand the architecture of viruses.
- Understand the interactions between viruses and the host immune system.
- The terms Oncogenes and tumor suppressor genes, and how tumor viruses interact with these products and their intersecting pathways and cause oncogenesis.
- To know about the vaccine strategies and mechanisms of antiviral drugs and interferons.
- To know how viruses can be used as tools to study biological processes, as cloning vectors and for gene transfer.
- To study of epidemiology, diagnosis and treatment of viral diseases.

COURSE OUTCOMES:

CO-1. The process of entry into the cells, control of gene transcription and where relevant translation and gene product stability, control of and mechanism of genome replication, virion assembly and release from the cell.

CO-2. Define the growth behavior differences between normal cells and cells transformed by oncogenic DNA and RNA Viruses.

CO-3. Define the process of virus latency and describe in molecular terms control of the process and activation of viral genomes during reactivation.

CO-4. Describe the processes involved in the anti-tumor effects of "anti-tumor" viruses.

SYLLABUS:

UNIT I

Brief outline of virology- discovery of virus- general properties of viruses- general methods of diagnosis and serology- viriods, prions, satellite RNAs and virusoids.

UNIT II

Bacterial viruses - ΦX 174, M13, MU, T4, lambda, Pi; structural organization, lifecycle and phage production. Lysogenic cycle-typing and application in bacterial genetics.

UNIT III

Plant viruses-TMV- general characters- morphology-replication-RNA as its initiator of infection. Cauliflower mosaic virus; Transmission of plant viruses; common viral diseases of crop plants- paddy, cotton, tomato, and sugarcane. Viruses of cyanobacteria, algae, fungi and insects.

UNIT IV

DNA Viruses- Pox viruses, Herpes viruses, Adeno viruses, Papova viruses and Hepadna viruses; RNA Viruses- Picorna, Orthomyxo, Paramyxo, Toga and other arthropod borne viruses, Rhabdo, Rota, HIV and other Hepatitis viruses.

UNIT V

Epidemiology, Diagnosis and Treatment of Viral Diseases; Viral Vaccines and Antiviral agents.

YEAR: I M.Sc., **SEMESTER: II**

COURSE: Systematic Medical Bacteriology **COURSECODE: MDT2B**

COURSE OBJECTIVES:

- Proforma development and direct examination of infectious human samples.
- Exposure of laboratory methods used in identifying infectious agents.
- Antibiotic sensitivity testing for pathogens.
- Epidemiology of infectious agents.
- Employing different staining methods for bacterial and fungal pathogens.
- Studies on the viral infections and cultivation.

COURSE OUTCOMES:

CO-1. Rationale and basis of classification of bacteria and to enumerate the order, family, genus and species.

CO-2. The morphology, cultural, biochemical and other biological properties and characteristics of medically important bacteria.

CO-3. The mechanism of virulence and pathogenesis and pathology.

CO-4. The disease caused by them, epidemiology, treatment, prevention and control.

SYLLABUS:

UNIT I

Philosophy and General approach to clinical conditions of various syndromes – general and specific syndromes. Indigenous normal microbial flora of human body. General attributes and virulence factors of bacteria causing infections.

UNIT II

Host Parasite relationships – Nonspecific host immune mechanisms. Ground rules for collection and dispatch of clinical specimens for microbiological diagnosis.

UNIT III

Morphology, classification, cultural characteristics, Pathogenicity, pathology, Laboratory diagnosis and prevention – Control and treatment of diseases caused by the following organisms: Staphylococci,

Streptococci, Pneumococci, Neisseriae (Gonococci & Meningococci), Corynebacterium, Mycobacterium, Clostridium, Bacillus.

UNIT IV

Studies on Salmonella, Shigella, Vibrios, Brucella, Gram negative anaerobes, Spirochetes, Rickettsiae, Chlamydiae, Mycoplasmas and ureoplasmas.

UNIT V

Zoonotic diseases and their control – Hospital acquired infections – Hospital Infection control committee – functions – Hospital waste disposal – Ethical committee – functions.

YEAR: I M.Sc., **SEMESTER: II**

COURSE: Mycology & Parasitology **COURSE CODE:MDT2C**

COURSE OBJECTIVES:

- Describe basic morphology, physiology of fungi and parasites.
- Classify parasites and fungi.
- Principles of safety, quality assurance and quality control.

COURSE OUTCOMES:

CO-1. To provide students both academic instruction and professional training in the field of laboratory medicine.

CO-2. To carry out the education of each student in a manner this encourages further education, participation in community service and maintenance of special interests in the field.

CO-3. Evaluate specimen acceptability.

SYLLABUS:

UNIT I

Historical introduction to mycology - Structure and cell differentiation. Lichens – ascolichens, basidiolichens, deuterolichens. Fungi as insect symbiont. Morphology, Taxonomy, Classification of fungi.

UNIT II

Dermatophytes and agents of superficial mycoses. Yeasts of medical importance. Dimorphic fungi causing systematic mycoses. Dimatiaceous fungi, opportunistic hyaline hyphomycetes, agents of zygomycosis. Fungi causing Eumycotic mycetoma.

UNIT III

Detection and recovery of fungi from clinical specimens. Newer methods in diagnostic mycology. Immunity to fungal infections. Mycotoxins. Antifungal agents - testing methods and quality control.

UNIT IV

Introduction to Medical parasitology – classification, host-parasite relationships. Epidemiology, life cycle, pathogenic mechanisms, lab diagnosis, treatment, etc. for the following: Protozoa causing human infections – Entamoeba, Aerobic and Anaerobic amoebae. Toxoplasma, Cryptosporidium, Leishmania, Trypanasoma, Giardia, Trichomonas, Balantidium.

UNIT V

Classification, life cycle, lpathogenicity, laboratory diagnosis and treatment for the following parasites: Helminths: cestodes – Taenia solium, T.saginata, T. echinococcus. Trematodes – Fasciola hepatica, Fasciolopsis buski, Paragonimus, Schistosomes. Nematodes: Ascaris, Ankylostoma, Trichuris, Trichuris, Trichinella, Enterobius, Strongyloides, Wuchereria. Other parasites causing infections in immunocompromised hosts and AIDS.

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

COURSE: Practical-II Systematic Bacteriology **COURSE CODE: MDT21**
Mycology, Virology & Parasitology

COURSE OBJECTIVES:

- Identify common infectious agents
- Evaluate methods used to identify infectious agents
- Specific mechanisms by which an infectious agent causes disease
- Epidemiology of infectious agents
- Appropriate use of antimicrobial agents and common mechanisms of antimicrobial action and resistance
- Infection control measure and vaccines.

COURSE OUTCOMES:

CO-1. Rationale and basis of classification of bacteria and to enumerate the order, family, genus and species.

CO-2. The morphology, cultural, biochemical and other biological properties and characteristics of medically important bacteria.

CO-3. The mechanism of virulence and pathogenesis and pathology.

CO-4. The disease caused by them, epidemiology, treatment, prevention and control.

SYLLABUS:

UNIT I

Collection and transport of clinical specimens -Prerequisites -Proforma -Methodologies. Direct examinations - wetfilms/stainings for Faeces (V.cholerae, Shigella, Salmonella) Pus, Sputum, throat/ear/nasal/wound swabs, CSF and other body fluids. Simple, differential and special staining methods.

UNIT II

Cultivation methods -Transport media - Isolation methods – Basal, differential enriched, selective media & special media for the pathogenic bacteria. Biochemical identification. Tests for the respective bacteria up to species level.

UNIT III

Antibiotic sensitivity tests -Stokes & Kirby Bauer methods - Disc diffusion -Dilution -Agar dilution & broth dilution -MBC/MIC - Quality Control for antibiotics and standard strains.

UNIT IV

KOH preparation of skin / nail scrapings for fungi and scabies mites. Examination of hair infection under UV light. LPCB mount. Special stains for fungi -Gomori, PAS and Methanamine silver stain for sections. Cultivation of fungi and their identification -Mucor, Rhizopus, Aspergillus, Penicillium, Candida, Trichophyton, Microsporum, Epidermophtyon - Slide culture method - Germ tube method, Sugar assimilation / fermentation tests for yeast.

UNIT V

Examination of parasites in clinical specimens - Ova/cysts in faeces -Direct and concentration: methods – Formal, Ether and Zinc sulphate methods - Saturated salt solution method. Blood smear examination for malarial parasites. Thin smear by Leishman's stain - Thick smear by J.B. stain. Wet film for Microfilariae. Identification of common arthropods of medical importance - spotters of Anopheles, Glossina, Phelbotomus, Aedes, etc. Ticks and mites.

UNIT VI

Isolation and characterization of bacteriophage from natural sources–phage titration - T4. Study of virus infected plants. Isolation of viruses - chick embryo - animal tissue culture - fibroblast culture – preparation (demonstration). Spotters of viral inclusions and CPE-stained smears. Viral serology- HAI-ELISA, Western Blotting.

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

COURSE: Industrial and pharmaceutical Microbiology **COURSE CODE: MDTAC**

COURSE OBJECTIVES:

- Enable Graduates to enter industry with an appropriate level of understanding of the need for both the science.
- Ability to apply the techniques used in industries.
- To produce new drug.

COURSE OUTCOMES:

CO-1. Get equipped with a theoretical and practical understanding of industrial microbiology.

CO-2. Know about design of bioreactor, factors affecting growth and production.

CO-3. Understand the rationale in medium formulation and design for microbial fermentation, sterilization of medium and air.

CO-4. Discuss microbial contamination, product spoilage and antimicrobial preservation of cosmetic products.

SYLLABUS:

UNIT I

Isolation, preservation and improvement of industrially important micro organisms; Raw materials and media design for Fermentation processes; Sterilization; Development of inoculums for industrial fermentations; Types of fermentation: Batch, continuous, dual or multiple, surface, submerged, aerobic and anaerobic.

UNIT II

Fermenter – Design and types. Instrumentation and control -aeration and agitation. Recovery and purification of fermentation products. Enzyme and cell immobilization, production of recombinant proteins having therapeutic and diagnostic applications: Vaccines, Insulin, Interferon, Somatotropin, Single cell protein.

UNIT III

Biology of industrial micro organisms. *Streptomyces*, Yeasts (*Saccharomyes, Hansenela*) *Spirulina* and *Penicillium*. Mushroom cultivation. Biosensors and Biochips. Biofuels from microbial sources.

UNIT IV

Production of primary metabolites: Alcohols (Ethanol and Butanol); Beverages (Beer and Wine); Aminoacids (Glutamic acid and Lysine); Organic acids (Citric acid and acetic acid).

UNIT V

Production of secondary metabolites: Antibiotics (Penicillin and Streptomycin); Vitamins (Riboflavin and Cyanocobalamin); Steroids; Production of enzymes (Protease, amylase and lipase); Biopolymers (Xanthan gum and PHB); Biopreservatives (Nisin).

YEAR: I M.Sc., **SEMESTER: II**

COURSE: BIOSTATISTICS & BIOINFORMATICS **COURSECODE: MDTBA**

COURSE OBJECTIVES:

- This course helps student's emphasis on the application of bioinformatics and biological databases to problem solving in real research problems.
- This course helps students to learn computational tools to find sequences, analysis of protein and nucleic acid sequences by various software packages (BLAST, FASTA, Gen Bank etc.,)
- This course helps students gain knowledge on the different protein structure –MOTIFs, DNA Microarray and System Medicines.

COURSE OUTCOMES:

CO-1. Describes the contents and properties of the most important bioinformatics databases, perform text- and sequence-based searches.

CO-2. Understand the major steps in pairwise and multiple sequence alignment by dynamic programming and predict the secondary and tertiary structures of protein and DNA sequences.

CO-3. Familiarized with various tools in identifying sequences for enhancing the advancements in system medicines.

SYLLABUS:

UNIT I

Nature and scope of statistical methods and their limitations compilation, classification, tabulation and applications in life sciences. Graphical representation – measure of average, dispersion - stem and leaf plots; box and whisker plots, coplots. Introduction to probability theory and distributions (concepts without derivation) binomial, poission and normal (only definition and problems).

UNIT II

Correlation and regression – concepts of sampling and sampling distribution – tests of significance based on t-test, chi-square and F-test for means, proportions, variations and correlation efficient, theory of attributes and tests of independence of contingency tables.

UNIT III

Sampling methods- simple, random, stratified, systemic and cluster sampling procedures. Sampling and non-sampling errors. Principles of scientific experiments- analysis of variance- one way and two way classification.

UNIT IV

Overview of bioinformatics- database types. Genomics and human genome project. Computational tools for sequence analysis and similarity searching.

UNIT V

Pair wise and multiple sequence alignment. Macromolecular structure function relationships. DNA micro array. Next generation sequencing. Systems medicine.

SEMESTER – III

YEAR: II M.Sc. **Semester: III**

COURSE: Microbial Genetics **COURSE Code: MDT3A**

COURSE OBJECTIVES:

- To understand the structure and function of Plasmids and Transposons.
- Understand the importance of mutations.

- Understand how gene expression is controlled.
- To understand the mechanism of transfer of genetic material from one species to another.
- To understand the organization of gene and chromosome.
- To understand the mechanism, control and models in molecular recombination.

COURSE OUTCOMES:

CO-1. To analyze processes involved in gene mutation and transfer in microorganisms.

CO-2. To apply valid microbial genetic knowledge to commercial applications.

CO-3. Students can able to identify and distinguish genetic regulatory mechanisms at different levels

CO-4. To gain the knowledge of gene mapping and strain construction.

CO-5. Students can able to differentiate phenotypic and genotypic relationship.

CO-6. Students can gain the knowledge of organization of chromosome in Prokaryotes and Eukaryotes.

SYLLABUS:

UNIT I

Historical perspectives of microbial genetics. Nucleic acid as genetic information carriers: experimental evidence. DNA – types, structure and properties topology, super helicity, linking number.

UNIT II

Organization of genes and chromosomes: Definition of gene. Operon Positive regulation. Structure of chromatin and chromosomes -unique and repetitive DNA, heterochromatin, euchromatin, transposons.

UNIT III

Plasmids as extrachromosomal genetic elements; types and properties. Structure and replication of different plasmids: Col E1, F1 and Ti plasmids. Plasmid amplification and curing; Gene transfer mechanisms: Transformation, conjugation and transduction.

UNIT IV

Mutation and Mutagenesis – mechanisms, biochemical basis, mutagens. Molecular basis of spontaneous and induced mutations. Reversion and suppression. Environmental Mutagenesis and toxicity testing; Carcinogenecity - chemical carcinogenesis and their testing. Isolation of Mutants.

UNIT V

Molecular recombination - Mechanism, control and models. Transposition; regulatory sequences and transacting factors. Genetic mapping in E. coli and Yeast. Genetics of Lambda, M13, Mu, T_4 and OX174Genetic systems of yeast and *Neurospora*.

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

COURSE: Genetic Engineering **COURSE CODE: MDT3B**

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 relaying 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

Principles and methods in genetic engineering: Host cell restriction -restriction modification. Restriction enzymes - types and applications, restriction mapping; Enzymes used in genetic engineering -Nucleases, Ribonucleases, DNA ligases, Tag DNA Polymerases, Methylases, Topoisomerases, Gyrases and Reverse Transcriptases.

UNIT II

Vectors - Plasmid vectors: pSC101, pBR322, pUC series and Ti plasmids based vectors - Bacteriophage vectors: Lambda phage based vectors, phagemids, cosmids, and M13 based vectors - Viral vectors: Vaccinia, Retroviral, SV40 and Baculoviral system; Bacterial and yeast artificial chromosomes. Expression vectors.

UNIT III

Cloning techniques - Genomic DNA and cDNA library Construction -Screening methods. Cloning in *E. coli, Bacillus, Pseudomonas, Streptomyces* and yeast. Expression systems. Gene fusion and Reporter genes. Gene targeting. Methods of gene transfer -transformation, transfection; electroporation, microinjection and biolistics.

UNIT IV

Analysis of Recombinant DNA. Polymerase chain reaction. Principles and techniques of nucleic acid hybridization and cot curves - Southern, Northern, Western and South-Western blotting techniques. Dot and Slot blotting.

UNIT V

DNA and protein sequencing. Protein engineering. Protoplast fusion. Hybridoma Technology. DNA finger printing - RFLP, RPAD and AFLP techniques. Applications of genetic engineering in agriculture, health and industry including gene therapy.

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

COURSE: Molecular Biology **COURSE CODE:MDT3C**

COURSE OBJECTIVES:

- Provide knowledge about molecular biology and inheritance at the molecular, cellular and phenotypic levels.
- Gain laboratory skills in molecular biology techniques such as micro pipetting, PCR and electrophoresis.
- Study about the terminology of cell and molecular biology.

COURSE OUTCOMES:

CO-1. Understand the structures and functions of biomolecules.

CO-2. To know the functions of DNA replication, recombination and their repair mechanism.

CO-3. Gain the knowledge about protein synthesis and protein regulations.

CO-4. To Study the concepts of Genetic code, Gene silencing and gene regulations.

SYLLABUS:

UNIT I

Composition, structure and function of biomolecules (carbonhydrates, lipids, proteins and nucleic acids). Conformation of proteins (Ramachandran plot, secondary, tertiary and quaternary structure; domains; motif and folds). Conformation of nucleic acids (A-, B-, Z-, DNA), t-RNA, micro-RNA. Stability of protein and nucleic acid structures. Molecular approaches to diagnosis and strain identification.

UNIT II

DNA replication, repair and recombination - unit of replication, enzymes involved, replication origin and replication fork, fidelity of replication, extra-chromosomal replications. DNA damage and repair mechanisms.

UNIT III

RNA synthesis and processing: Transcription factors and machinery -formation of initiation complex, transcription activators and repressors, RNA polymerases, capping, elongation and termination. RNA processing - RNA editing, splicing, polyadenylation, RNA transport.

UNIT IV

Protein synthesis - formation of initiation complex, elongation and termination – machineries and their regulation. Genetic code. Aminoacylation of tRNA, tRNA-identity, aminoacyl tRNA synthetase, translational proof-reading, translation inhibitors. Post-translational modification of proteins.

UNIT V

Control of gene expression at transcription and translation level -Regulation of phages, viruses, prokaryotic and eukaryotic gene expression - Role of chromatin in regulating gene expression and gene silencing.

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

COURSE: Practical-III Microbial Genetics, **COURSECODE: MDT31**

Molecular Biology and Genetic Engineering

COURSE OBJECTIVE:

The purpose of this course is to provide knowledge about various separation, isolation techniques students will learn about electrophoresis and also advanced techniques.

COURSE OUTCOMES:

CO-1: Students can able to isolate DNA, RNA and perform electrophoresis.

CO-2: Students can isolate and estimate RNA.

CO-3: Students can perform SDS-PAGE, and also separate amino acids by thin layer chromatography and paper chromatography.

CO-4: They can able to separate proteins, immobilized enzyme, isolation of protoplast and spleroplast.

CO-5: Have clear idea about competent cells and also perform transformation.

SYLLABUS:

UNIT I

Isolation of genomic DNA from bacteria and demonstration in agarose gel electrophoresis. Isolation of plasmid DNA by alkali lysis method. Estimation of DNA by diphenyl amine method. Determination of Tm value of DNA. Quantitation of nucleic acids by UV Spectrophotometer.

UNIT II

Isolation of RNA from yeast. Estimation of RNA by orcinol method. Induced mutagenesis - Isolation of antibiotic resistant auxotrophic mutants.

UNIT III

Estimation of proteins by Lowery *et al* method. SDS-PAGE. 2D-Gel electrophoresis. Isoelectric focussing. Separation of amino acids by TLC and paper chromatography.

UNIT IV

Separation of proteins using Gel filtration and Ion exchange chromatography. Immobilization of enzymes and whole cells. Western blotting. Protoplast and spheroplast isolation. Induction of beta-galactosidase activity in E. coli using IPTG.

UNIT V

Preparation of competent cells. Transformation and Blue-White selection for transformants. DNA amplification by PCR. Separation of PCR amplified product on PAGE and determination of product size. Restriction mapping / Restriction analysis.

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

COURSE: Soil & Agricultural Microbiology **COURSE CODE: MDTAD**

COURSE OBJECTIVE:

This course helps students to gain knowledge on the types of soil, microbial interactions in soil, nitrogen fixing organisms, bio fertilizer and bio pesticide production using microbes and plant disease management to promotes prevention and enhance the plants growth.

COURSE OUTCOMES:

CO-1. Understand the properties of different types of soil and interaction of microbes with plants, insects and microbes itself.

CO-2. Insight knowledge on nitrogen fixing organisms, their cultivation on usage for bio fertilizer and bio pesticides.

CO-3. Learn the types of pathogen causing plant disease and their defense mechanism by pathology, biochemical and molecular aspects.

CO-4. Efficient in understanding the different symptoms, epidemiology and management of various plant diseases like Tobacco Mosaic Diseases, Leaf spot of paddy etc.,

CO-5. Ability to use biotechnological methods to manage plant diseases, sanitation and plant disease forecasting.

SYLLABUS:

UNIT I

Characteristics and classification of soils; Soil Microorganisms; Interactions between microorganisms - Mutalism, commensalism, ammensalism, synergism, parasitism, predation, competition. Interaction of microbes with plants - rhizosphere, phyllosphere and mycorrhizae.

UNIT II

Symbiotic and Asymbiotic Nitrogen fixation – mechanism and genetics of Nitrogen Fixation. Biogeochemical cycles - carbon, nitrogen, phosphorus, sulfur. Biofertilizers - *Rhizobium*, *Azotobacter*, *Azospirillum*, VAM, Phosphobacteria, *Azolla* Cyanobacteria. Biopesticides. Interrelationships between microorganisms, plants and soil - Enzymes of microbial origin and their role in release of available plant nutrients.

UNIT III

Plant pathogens and classification of plant diseases. Host-pathogen recognition and specificity. Principles of plant infection and defense mechanisms - entry of pathogen in to host, colonization of host; role of enzymes, toxins and growth regulatory substances. Defense mechanisms in plants - Structural and biochemical - Molecular aspects of host defense reactions - Lipoxygenase and other enzymes in the expression of disease resistance.

UNIT IV

Symptoms, Etiology, Epidemiology and management of the following plant diseases: Mosaic disease of tobacco; Bunchy top of banana; Leaf roll of potato; Bacterial blight of paddy; Angular leaf spot of cotton, Late blight of potato; Damping off of tobacco, Downy mildew of bajra; Powdery mildew of

cucurbits; Head smut of sorghum; Leaf rust of coffee; Blight of maize/sorghum; Leaf spot of paddy, Grassy shoot of sugar cane; Root knot of mulberry.

UNIT V

Plant disease management – exclusion, evasion, eradication, crop rotation. Sanitation - physical, chemical and biological control. Plant disease forecasting. Biotechnological approaches to disease management.

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

COURSE: Environmental Biotechnology **COURSE CODE: MDTBB**

COURSE OBJECTIVE:

To provide knowledge for environmental engineering, bioremediation control and monitoring, study on microbial growth kinetics.

COURSE OUTCOME:

CO-1: Students gain knowledge on biofilm occurrence, effect and control measures.

CO-2: Understand and learn about various bioreactor and its usage, effluent recycle

CO-3: Able to learn about waste water treatment, drinking water treatment, denitrification process.

CO-4: Learn about various hazardous chemical and biodegradation process

CO-5: Gains knowledge about control and bioremediation of various industry

SYLLABUS:

UNIT I

Biofilm – occurrence causes and effects - control measures. Biofilm reactor-soluble microbial products and inert biomass – principle and applications.

UNIT II

Bioreactors - principles and designing. Reactor types – batch, continuous-flow, stirred-tank reactor, plug-flow reactors. Effluent recycle - reactors with recycle of settled cells - alternate rate models - Reactors in series.

UNIT III

Denitrification – physiology, types and microbes involved - sludge denitrification. Waste water treatment systems - anaerobic and aerobic- Special factors for the design of anaerobic sludge digesters. Drinking-water treatment: principles - anaerobic treatment by methanogenesis.

UNIT IV

Detoxification of Hazardous chemicals - factors causing molecular recalcitrance. Synthetic organic chemicals - Energy metabolism versus co-metabolism - Electron donor versus electron acceptor - Biodegradation of environmental contaminants.

UNIT V

Bioremediation: Strategies for bioremediation - Pollution monitoring, control and remediation (petroleum industry, paper industry, chemical industry etc.). Biomass from the wastes.

SEMESTER – IV

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

COURSE: Food, Dairy & Environmental Microbiology **COURSE CODE: MDT4A**

COURSE OBJECTIVES:

- This course helps students to learn the microflora in different foods and their role in spoilage, contamination, preservation and disease causing nature
- This course concentrates on the preparation of different fermented products (cheese, yogurt etc.,) dairy microbiology, food sanitation process and different food control agencies and their regulations.
- The course provides knowledge on Micro flora in air – techniques to assess air quality, air sanitation and air borne disease causing pathogen
- It helps students learn about water microbiology – fauna and flora in aquatic habitat and ecology factors on environment.
- As a part of serving nation this course provides knowledge on treatment of liquid and solid wastes by different method (composting, silage, saccharifiction etc.,)
- It also helps students to study how to degrade xenobiotic compounds like petroleum, paper, wood etc., to reduce the load of pollutants in environment
- To provide students knowledge on bioaccumulation of heavy metals, biofouling and bioleaching to control pollution.

COURSE OUTCOMES:

CO-1. Understand the role of intrinsic and extrinsic factors on growth and survival of microorganisms in foods, their spoilage mechanism and preservation and prevention methods.

CO-2. Learn the basis of food safety regulations and the use of standard methods and procedures for the microbiological analysis of food.

CO-3. Know the beneficial role of microorganisms as well as the methods of processing and preparing different fermented foods like cheese, soy sauce etc.,

CO-4. Acquire the knowledge of different air micro flora and how to sanitize and assess the quality of air by various techniques.

CO-5. Learning about water microbiology helps to understand the different methods of water quality check and their related factors of microflora.

CO-6. Enhances the knowledge of students on waste treatment methods and methods to control pollution on the earth.

CO-7. Understand the role of microflora in degradation of xenobiotic compounds like petroleum, paper, wood etc., to reduce the load of pollutants in environment as well as emphasis on biofouling and bioleaching to control pollution.

SYLLABUS:

UNIT I

Food Microbiology: Occurrence of microorganisms in food - Factors influencing microbial growth - extrinsic and intrinsic. Principles and methods of food preservation - high Temperature, low Temperature, drying, irradiation and chemical preservatives. Food borne diseases -Bacteria, Fungi, Viruses, Algae and Protozoa. Spoilage of fruits, vegetables, meat, poultry, fish and sea foods.

UNIT II

Dairy Microbiology: Microflora of milk - sources of contamination. Spoilage and preservation of milk and milk products. Fermented foods - Sauerkraut, Pickles, Buttermilk, Yogurt and Cheese. Probiotics and Prebiotics. Milk borne diseases. Food sanitation -food control agencies and their regulations.

UNIT III

Microbiology of air: Occurrence - number and kinds of microbes in air. Distribution and sources of air borne organisms - aerosol and droplet nuclei. Assessment of air quality -Air Sanitation - Airborne diseases. Microbiology of water: Aquatic habitats - their microflora and fauna - lake, ponds, river, estuary and sea. Biology and ecology of reservoirs and influence of environmental factors on the aquatic biota.

UNIT IV

Environmental Microbiology: Waste treatment - Wastes - types and characterization. Treatment of solid wastes - composting, vermiform composting, silage, pyrolysis and saccharifications. Treatment of liquid wastes - primary, secondary (anaerobic and aerobic) - trickling, activated sludge, oxidation pond, and oxidation ditch-tertiary -disinfection.

UNIT V

Degradation of Xenobiotic compounds: Simple aromatics, chlorinated polyaromatic petroleum products, pesticides and surfactants. Biodeterioration of materials - paper, leather, wood, textiles and paint. Metal corrosion - Bioaccumulation of heavy metals. Biofouling and Bioleaching.

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

COURSE: Practical-IV Soil, Agricultural, Food and Environmental Microbiology **COURSE CODE: MDT41**

COURSE OBJECTIVES:

- It will provide an introduction to the microbial world and its impacts, both positive and negative on humans.

- Discuss about soil micro organisms
- Describe Food and dairy microorganisms and its impacts.

COURSE OUTCOMES:

CO-1. Introduction to a wide range of microbial life, to the techniques used to study microorganisms and to the interactions, both beneficial and adverse, between microbes and humans.

CO-2. Learn how to manipulate date from Microbiological experiments and how the results may be used for the benefits of mankind.

CO-3. Evaluate specimen acceptability.

SYLLABUS:

UNIT I

Isolation and enumeration of soil microorganisms (fungi, bacteria and actinomycetes). Isolation of phosphate solubilizer from soil. Isolation of Nitrogen fixers - *Rhizobium* from root nodule and - *Azotobacter* from rhizosphere. Screening of antagonistic bacteria in soil by agar overlay method. Isolation of Cyanobacteria and Photosynthetic bacteria from soil/water.

UNIT II

Estimation of foliar infection by Stoyer's method. Cultivation of oyster mushroom. Study of the following diseases: Tobacco mosaic; Bacterial blight of paddy; Downy mildew of bajra; Powdery mildow of cucurbits; Head smut of sorghum, Leaf rust of coffee; Leaf spot of mulberry, Red rot of sugarcane, Root knot of mulberry.

UNIT III

Detection of number of bacteria in milk by breed count. Determination of quality of milk sample - methylene blue reduction test and Resorzurin method. Detection of number of bacteria in milk -standard plant count. Isolation of yeast and molds from spoiled nuts, fruits, and vegetables. Bacteriological examination of specific foods –curd, raw meat, fish, Ice cream.

UNIT IV

Extracellular enzyme activities - phosphatase. Quantification of microorganisms in air-solid and liquid impingement techniques.

UNIT V

Physical, chemical and microbial assessment of water and potability test for water. Physical and chemical - colour, pH, alkalinity, acidity, COD, BOD, anions and cations. Microbiological - MPN index -presumptive, completed and confirmatory tests.

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

COURSE: Research Methodology **COURSE CODE: MDTAE**

COURSE OBJECTIVES:

To impart advanced practical knowledge in conducting a research project.

COURSE OUTCOMES:

CO-1. Student can able to plan and design research statistically, retrieve relevant literature, organize and conduct, process the data, photograph relevant observations, evaluate by statistical programmes.

CO-2. Student will be able to present the project in any regional/national conference/seminar.

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

COURSE: Research Methodology **COURSE CODE: MDTAE**

COURSE OBJECTIVES:

- Problem identification.
- Reviewing information.
- Recent techniques in applied biology.

COURSE OUTCOMES:

CO-1. An overview of Education Research.

CO-2. Knowledge of the various research designs.

CO-3. Knowledge of how to do quality scholarly research including, identifying a research problem, review of literature, hypotheses, data collection, analysis the data, reporting and evaluating research.

SYLLABUS:

UNIT I

Research Methodology - Meaning and objectives and types of research. Research approaches - research Process. Defining the research problem - research design. Sampling – types and design. Data collection - methods - processing and analysis of data. Testing of Hypothesis. Fundamentals of Bioethics.

UNIT II

Writing the Research Report (Thesis and publications): Components of research report - Title, Authors, Addresses, Abstract, Keywords, Introduction, Materials and Methods, Results, Discussion, Summary, Acknowledgements and Bibliography.

UNIT III

Molecular biology methods: In vitro mutagenesis and detection techniques. Gene knock out in bacterial and eukaryotic organisms. Methods for analysis of gene expression - RNA and protein level

-micro array based techniques. Isolation, separation and analysis of protein, carbohydrate and lipid molecules.

UNIT IV

Histochemical and immunotechniques: Flowcytometry and immunofluorescence microscopy. Detection of molecules in living cells - FISH and GISH. Biophysical methods: Analysis of biomolecules - UV/visible, fluorescence, circular dichroism, NMR and ESR spectroscopy. Structure determination - X-ray diffraction, mass spectrometry and surface plasma resonance methods.

UNIT V

Radiolabeling techniques: Radioisotopes used in biology –properties, detection and measurement. Molecular imaging of radioactive material and safety guidelines. Miscroscopic techniques: Microscopy of living cells, scanning and transmission microscopes, different fixation and staining techniques for EM, freeze-etch and freeze-fracture methods for EM - Image processing methods in microscopy.