



॥ विद्याविनयेनशोभते ॥

## **Changu Kana Thakur Arts, Commerce and Science College, New Panvel (Autonomous)**

Re-Accredited 'A+' Grade by NAAC

'College with Potential for Excellence' Status Awarded by University Grants Commission

'Best College Award' by University of Mumbai

### **Department of Biotechnology**

#### **Programme Specific Outcomes**

#### **B.Sc. Biotechnology degree programme**

- PS01 Students will learn the basic concepts of Chemistry and analytical chemistry applied in Biological Sciences.
- PS02 An education in Cell biology, Biochemistry, Animal and plant physiology, human genetics and Immunology will impart knowledge to the students about cellular structure, biomolecules, metabolic pathways, its regulation along with defense mechanism and physiological processes in plants and animals.
- PS03 Students will also learn the concepts of biodiversity, ecology environment and its conservation.
- PS04 Students will gain basic information of microbial cultures, sterilization methods and enzyme production. They will be taught bio-safety guidelines and good laboratory practices.
- PS05 Introduction of recent topics like Drug delivery, Marine biotechnology, Bioinformatics will impart knowledge of mechanism of drug delivery, drug designing and applications of marine organisms as food, nutraceutical and cosmetics etc.
- PS06 Students will understand the principles and the applications of molecular biology and genetic engineering methods with an emphasis on the application of recombinant DNA technology to animals, plants and microbial organisms.
- PS07 The course will give the knowledge of Bioethics, IPR, entrepreneurship, scientific writing Communication, and management skills to the students.
- PS08 Students will get hands on training of techniques used in Cell Biology, Biochemistry, Microbiology, Immunology, Molecular Biology and Genetic Engineering.

## **Department of Biotechnology**

### **Course Outcomes**

#### **Class: F.Y.B. Sc. Biotechnology**

#### **Semester I**

##### **Course (Paper) Name and No.: Paper I Basic Chemistry**

- C01- The students will be acquainted with the basic concepts of Chemistry like Classification and Nomenclature of Chemical compounds.
- C02- Students will know about the different types of chemical bonds with their significance.
- C02- Student will be able to understand the concept of stereochemistry and will be able to solve the problems on it.
- C04- Students will be able to understand the isomerism which will provide them insight of chemical structures and their geometry.

##### **Course (Paper) Name and No.: Paper II Analytical Chemistry**

- C01 Students will use the knowledge regarding chemical calculations and calibrations of glassware and its importance in research.
- C02 Students will use knowledge of titrimetric and volumetric analysis.
- C03 Students will learn to handle basic analytical techniques and tools like chromatography and colorimetry.
- C04 They will learn to solve numerical problems used in preparation of reagents.

### **Course (Paper) Name and No.: Paper III Biodiversity and Ecology**

- C01 Understanding of environmental conservation processes and its importance, pollution control, biodiversity and protection of endangered species by students.
- C02 The students will acquire the knowledge of microbial and viral cell structure; growth and metabolism understand the microbial diversity, taxonomy and dynamics of microbial interactions with other populations.
- C03 The student will be able to learn basic concepts of virology.
- C04 The student is able to define scientific models and questions about the effect of complex biotic and abiotic interactions on all biological systems, from cells and organisms to populations, communities and ecosystems.

### **Course (Paper) Name and No.: Paper IV Basic Microbiology**

- C01 Students are able to know principle, working, ray diagram application of microscope and advanced microscope. Students will be able to develop skill for visualization of microorganisms with different staining techniques.
- C02 Students will learn how different types of chemical and physical methods of sterilization can be applied on laboratorial scale as well as industrial scale.
- C03 Students will understand the growth and reproduction of bacteria. Students will be able to understand the enumeration techniques for microorganisms.
- C04 Students will understand and perform the basic growth and cultivation techniques of microorganisms.

### **Course (Paper) Name and No.: Paper V Introduction to Biotechnology & Cell Biology**

- C01 Students will gain knowledge about field of Biotechnology.
- C02 Students will be able relate the morphological changes that occur in transformed cells.
- C03 Students will gain the knowledge: how cells conduct, coordinate, and regulate cell division.
- C04 Students will be familiar with cytological differences between components of prokaryotic and eukaryotic cells

**Course (Paper) Name and No.: Paper VI Genetics**

- C01 Students will gain knowledge of the fundamental molecular principles of genetics.
- C02 They will learn the basic Mendelian laws and terms use in genetics.
- C02 They will understand the relationship between phenotype and genotype in human genetic traits.
- C03 Students will gain basics of genetic mapping.

**Class: F.Y.B. Sc. Biotechnology**

**Semester II**

**Course (Paper) Name and No.: Paper-I (Biochemistry)**

- C01 Student will acquire the knowledge of chemistry of water and Buffer solutions.
- C02 Students will have knowledge of structure and functions of biomolecules like carbohydrates, lipids and proteins.
- C03 Students will have knowledge of structure and functions of amino acids and proteins.
- C04 Student will acquire the basic knowledge of protein sequencing,

**Course (Paper) Name and No.: Paper II (Bioorganic Chemistry -II)**

- C01 To impart the skill of kinetics and reactions.
- C02 Understand basic terms used in thermodynamics.
- C03 Learn first and second law of thermodynamics and its expression in terms of relationship between Heat (q), work (w) and internal energy (U).
- C04 To impart the knowledge of Principles of oxidation and reduction reactions.

### **Course (Paper) Name and No.: Paper III (Plant and Animal Physiology)**

- C01 Students will be able to explain how terrestrial vascular plants acquire and use the energy and material resources needed to complete their life cycle, highlighting relationships between structure and function, and coordination of development, resource acquisition and environmental responses within and across cells, tissues and organs.
- C02 Students will be acquainted with plant water relationship and basic requirements of nutrients to plants and animals.
- C03 Using one or more model systems, students will be able to integrate the regulation of organ system functions in a whole animal using a conceptual model of feedback to explain homeostasis.
- C04 Students will be acquainted with concept of foods and nutrition.

### **Course (Paper) Name and No.: Paper-IV (Molecular Biology)**

- C01 Students will be acquainted with structure of nucleic acids.
- C02 Students will be aware how replication takes place inside the cell & Distinguish between DNA template strand and new strand.
- C03 Students will gain knowledge regarding mutation (genetic variation or change in DNA sequence), predict whether or not that change would result in a change of function for the resulting protein (phenotypic change)
- C04 Students will be able to understand mechanism of DNA repair.

### **Course (Paper) Name and No.: Paper-V (Tissue Culture and Good Laboratory Practices)**

- C01 Students will learn basic technical aspects of plant tissue culture technique like media preparation, seed sterilization, callus culture and maintenance of aseptic conditions. The skill could be applied in agriculture and crop improvement.
- C02 Students will learn to demonstrate foundational knowledge of Cell culture techniques and competence in laboratory technique.

C03 Students will understand the highly specific requirements and intent of GLP regulation.

C04 Students will understand the importance of documentations such as results reporting, SOPs, Study Plans and Protocol.

**Course (Paper) Name and No.: Paper-VI (Enzymology, Immunology and Biostatistics)**

C01 Students will understand the basic concepts of Enzymology.

C02 Students will understand the immune system, types of immunity and mechanism.

C03 Students will enhance the knowledge of central tendencies.

C04 Students will understand the compiling of data using biostatistical tools.

## **Class: S.Y.B. Sc. Biotechnology**

### **Semester III**

#### **Course (Paper) Name and No.: Paper- I (Biophysics)**

- C01 The students will be able to relate principles of physics to applications & techniques in the field of biology such as spectroscopy, microscopy.
- C02 Students will be gaining the idea regarding the biological applications of sound, heat and viscosity.
- C03 Students will be able to learn the analytical techniques for analysis of biomolecules.
- C04 Students will be able to learn principle and applications of Electrophoresis.

#### **Course (Paper) Name and No.: Paper- II (Applied Chemistry -I)**

- C01 Students will be able to Distinguish between type of addition, elimination and substitution reaction and understand the mechanism of organic reaction.
- C02 Students will learn the role of Essential and Non-essential Elements in the biological system.
- C03 Students will be gaining the knowledge about Synthesis of Organic Compounds and use of Other methods of organic synthesis instead of conventional methods.
- C04 Students will be able to understand the Principles and applications of green chemistry and green synthesis in Industry.

### **Course (Paper) Name and No.: Paper-III (Immunology)**

- C01 Students will be able to understand the role of different types of immune cells.
- C02 Students will be able to understand the role of effector molecules and effector mechanisms in Immunology.
- C03 Students will understand the cellular and molecular aspects of lymphocyte activation, homeostasis, differentiation, and memory.
- C04 Students will be able to understand the principles underlying various immune-techniques.

### **Course (Paper) Name and No.: Paper-IV (Cell Biology and Cytogenetics)**

- C01 The student will be able to develop an understanding of the Cytoskeleton.
- C02 Students will get knowledge of Cell compartmentalization and how solutes are transported across membranes. Also students will be able to distinguish between passive and active transport; can explain how substances are directly transported across a membrane and able to describe the primary mechanisms by which cells import and export macromolecules.
- C04 The student will be able to discuss the structure of Chromosomes and types of Chromosomal Aberrations.
- C05 Students will have an understanding of the principles underlying Sex Determination, Linkage and Mapping.
- C06 By understanding of basic concepts in inheritance students will be able to solve simple genetic problems and recognize common misconceptions regarding human heredity



### **Course (Paper) Name and No.: Paper-V (Molecular Biology)**

- C01 Students will gain the knowledge about how DNA is used to make protein by using the process of transcription and translation. Having successfully completed this unit they will be able to explain the mechanism by which transcription is initiated in prokaryotic and eukaryotic cells, the mechanisms by which post-transcriptional control is achieved.
- C02 Students will be able to discuss the mechanisms associated with Gene Expression at the level of Transcription and Translation. They will be able to make an outline of the mechanisms and factors that control the process of translation Along with an ability to critically evaluate and discuss original research articles in the area of gene regulation.
- C03 Students will be able to describe the primary post-translational modifications that occur before a protein becomes fully functional.
- C03 Students will be able to gain the knowledge about tools and techniques in r-DNA technology- DNA manipulative enzymes, Cloning vectors, methods for selection of recombinants and analysis of cloned genes by sequencing methods.

### **Course (Paper) Name and No.: Paper-VI (Bioprocess Technology)**

- C01 Students will be acquainted with the bioprocess for conversion of raw material to product. Upstream and downstream processing will be discussed it will also explain the processes and techniques used for extraction and purification of a product from culture medium.
- C02 Students will be gaining the information regarding Bioavailability & Bioequivalence studies.
- C03 Students will be studying different types of microorganisms for commercial production of products like Penicillin and Ethanol.
- C04 Students will able to understand principles underlying design of Fermenter and Fermentation Process.

**Course (Paper) Name and No.: Paper-VII (Research Methodology)**

- C01 Students will be able to gain the knowledge about basics of research and the overall research process of designing a research study from its inception to its report.
- C02 Students will be able to understand how to conduct research work and formulate research synopsis and report.
- C03 Students will be studying different types of data analytics skills and meaningful interpretation to the data sets so as to solve the Research problem.
- C04 Students will be able to understand the basic principles of scientific writing.
- C05 Students will acquire knowledge about the Ethics in Scientific writing and research Publication.

**Class: S.Y.B. Sc. Biotechnology**

**Semester IV**

**Course (Paper) Name and No.: Paper-I (Biochemistry)**

- C01 Students will learn the metabolic pathway, the energy yielding and energy requiring reactions in life.
- C02 It will help the students to understand the diversity of metabolic regulation and how this is specifically achieved in different cells
- C03 It will help the students to understand interlinked metabolic reactions with specific control site and key junctions.
- C04 Students will able to understand function of specific anabolic and catabolic pathways and how these pathways are controlled and interrelated.

### **Course (Paper) Name and No.: Paper-II (Applied Chemistry –II)**

- C01 Students will be able to understand the different methods of separation used in analytical chemistry.
- C02 Students learn the Classification of natural products and Chromatographic separation of natural products.
- C03 Students will gain information about the different types of polymers used in applied chemistry.
- C04 Students will be able to learn about the concept of nanomaterial and applications of nanomaterials.

### **Course (Paper) Name and No.: Paper-III (Medical Microbiology)**

- C01 The learner will be able to identify common infectious agents and the diseases that they cause.
- C02 Learners will be able to understand the factors playing a role in causing a disease gain.
- C03 Learners will be able to describe the epidemiology of infectious agents including infectious diseases are transmitted.
- C04 Learners will be able to discuss the various aspects of systemic infections including causative agents, symptoms and prophylaxis.
- C05 Learners will be able to gain the technical capability of handling, isolating and identifying various Bacteria.

### **Course (Paper) Name and No.: Paper-IV (Environmental Biotechnology)**

- C01 Students will understand different types, causes & control measures of different pollutions.
- C02 Students can get some skills to recognize the ecological problems and critical evaluation of the human impacts on pollution, climate changes and as well as environmental protection.
- C03 This unit aims to introduce the students to various regional and global concerns regarding the environment, including the natural challenges, various types of environmental pollutants and their effects, the changing environment, and the developments of diverse technologies to detect, study and address these concerns.
- C04 Students should be able to utilize the knowledge gained on the role and importance of microorganisms in the environment for remediation

### **Course (Paper) Name and No.: Paper-V (Bioinformatics and Biostatistics)**

- C01 Students will be able to gain an understanding of the basic concept of bioinformatics.
- C02 Students will be able to understand the tools used in bioinformatics.
- C03 Students will be able to explain the major steps in pairwise & MSA, explain the principle for & execute pairwise alignment by dynamic programming.
- C04 Students will able to define the principal concepts about biostatistics, collect data relating to variable/variables which will be examined and calculate descriptive statistics from these data, identify distribution form relating to the variable/variables and apply hypothesis testing via some of the statistical distributions.

### **Course (Paper) Name and No.: Paper-VI (Molecular Diagnostics)**

- C01 Students will gain an understanding of the basic Principles used in Molecular Diagnosis.
- C02 Students will be able to gain critical thinking and analytical skills to understand new Diagnostic Methods.
- C03 Students will be able to apply the knowledge and skills gained in the course should be useful in developing new Diagnostic Kits.
- C04 Students can explain the layout of different molecular analysis methods and to understand in depth how the methods work, how these methods are applied in current research and diagnostics, evaluate advantages and disadvantages of the methods and independently select appropriate molecular methods for a given application.

### **Course (Paper) Name and No.: Paper-VII (Entrepreneurship Development)**

- C01 Students will be able to develop and strengthen the Entrepreneurial quality, i.e. motivation or need for achievement.
- C02 Students will be able to understand Entrepreneurial discipline and also get encouragement for Self-employment tendencies.
- C03 Students will be able to create presentations and business plans and also design strategies for successful implementation of ideas.
- C04 Students will be able to develop their awareness about IPR, Patents, Copyright, Trademarks, Trade secret and Geographical indications.

## **Class: T.Y.B. Sc. Biotechnology**

### **Semester-V**

#### **Course (Paper) Name and No.: Paper-I (Cell Biology)**

- C01 Students will get knowledge of different types of extracellular signals and receptors, and explain their functional significance
- C02 Students will get knowledge of developmental biology which includes stages, mechanism and patterns of embryonic development.
- C03 Students will get knowledge of plant developmental biology and stem cell biology
- C04 The students will be able to learn how genetics contributes to predisposition and progression of cancer. It will help the students to understand how immunotherapy is, and can be, used to treat human illness.

#### **Course (Paper) Name and No.: Paper-II (Medical Microbiology & Instrumentation)**

- C01 It will help the students to understand viral replication strategies; and compare and contrast replication mechanisms used by viruses relevant for human disease.
- C02 Students will learn mechanism of action of chemotherapeutic drugs and resistance.
- C03 Students will learn basic principle and applications of spectroscopy..
- C04 They would be able to compare different separation techniques & use them in research work.
- C05 Students will develop the analytical approach to use advanced instruments required during experimentation

### **Course (Paper) Name and No.: Paper-III (Genomics & Molecular Biology)**

- C01 Students will learn different techniques of gene transfer in plants to develop transgenic plants.
- C02 Students will learn different techniques of gene transfer in animals to develop transgenic Animals.
- C03 Students will be able to Understand the range of molecular laboratory techniques used routinely in human forensic analysis and population genetic analysis including sex typing, DNA profiling, Single Nucleotide Polymorphism (SNP) detection and DNA sequencing.
- C04 The students will have knowledge of tools like gene sequencing and editing.

### **Course (Paper) Name and No.: Paper-IV (Marine Biotechnology)**

- C01 Students will learn methodological approaches that are currently being used for microbial bioprospecting, with emphasis in the marine environment.
- C02 Students will get knowledge of various functional food ingredients and nutraceuticals obtained from marine sources.
- C03 Students will get knowledge of different applications of marine food biotechnology.
- C04 Students will get knowledge of aqua farming and their and techniques like aquaponics and fish feed technology.

### **Course (Paper) Name and No.: Paper-V (Biosafety-Applied Component)**

- C01 Students will be acquainted with the biosafety regulation in Biotechnology.
- C02 Students will be familiar with research in a GLP-complaint manner.
- C03 Learners will understand how to detect potential contamination risks for product.
- C04 Students will be able to develop the concepts of biosafety in Biotechnology.

## **Class: T.Y.B. Sc. Biotechnology**

### **Semester VI**

#### **Course (Paper) Name and No.: Paper- I Biochemistry**

- C01 Students will learn the levels of protein structure and protein-ligand interactions
- C02 Analyze the metabolism of carbohydrates and fates of various intermediate and end product
- C03 Students will get knowledge of different protein purification techniques
- C04 Students will learn about different hormones and their biochemical functions with associated disorders.
- C05 Students will get knowledge of protein denaturation and folding.

#### **Course (Paper) Name and No.: Paper-II (Industrial Microbiology)**

- C01 Students will learn the production outline of various dairy products.
- C02 Students will learn the different modes of fermentation and Down-stream Processing.
- C03 Students will learn to develop strategy for fermentation process development
- C06 Students will understand the Standard operating procedures, GMP and QA and QC.

#### **Course (Paper) Name and No.: Paper-III (Pharmacology and Neurochemistry)**

- C01 Students will learn the mechanism of drug action and its dose-response relationship
- C02 Students will learn the mechanisms of drug delivery and action in the body.
- C03 Students will get in depth knowledge on toxic substances and poisons ie. Toxicology
- C04 Students will understand the properties of cells that make up the nervous system including the propagation of electrical signals used for cellular communication.



### **Course (Paper) Name and No.: Paper-IV (Environmental Biotechnology)**

- C01 Students will learn the concept of solar energy, wind power, geothermal energy and hydropower, biomass energy, Biogas technology and Biofuels.
- C02 Students will understand the techniques and strategies of Industrial effluent treatment.
- C03 Students will understand the techniques of waste water management.
- C04 Students will be Exposed to the processes which are currently associated and taking place in industry along with their consequences arise on generation of hazardous waste.

### **Course (Paper) Name and No.: Paper-V (Agri Biotechnology)**

- C01 Students will be Exposed to technology and the techniques that can be used to improve the efficiency of agricultural operations like greenhouse technology.
- C02 Students will develop knowledge in plant physiology and genetics in breeding programmes for plant resistance to abiotic stresses
- C03 Students will develop knowledge in plant pathogen interactions and genetics in breeding programmes for plant resistance to pest and diseases. They will gain the knowledge of different markers used in plant breeding techniques
- C04 Students will gain concept of bio-fertilizers, Symbiotic-Non symbiotic nitrogen fixation in leguminous plant, assimilation of phosphorus and biopesticides.

## M.Sc. Biotechnology Degree programme

### **Programme Specific Outcome**

- PS01 Courses will provide integrated knowledge of biochemistry, cell biology and immunology with details of protein folding, protein targeting, and regulation of metabolic pathways, bio-membranes, cell signaling, vaccinology, immunological techniques and Animal Models.
- PS02 Students will develop understanding of history, theoretical basis, of latest technologies in area of biotechnology.
- PS03 On completion of course, students should be able to gain basic skills in plant and animal biotechnology.
- PS04 Students will get conceptual exposure of computational, biostatistical and bioinformatics tools.
- PS05 Course will provide integrated knowledge of operations of various fermenters and important microbial/enzymatic industrial processes in food and fuel industry. It will also provide knowledge on intellectual property rights and their implications in biological research and product development
- PS06 Courses will provide integrated knowledge and broad perspectives of various pandemics diseases and emerging pathogens. Students will be familiar with the basic concepts and significance of Biologics/Biosimilar, principles and the applications of enzyme technology with enzyme purification techniques.
- PS07 Students will develop understanding about Health hazards of pollution and waste, solid waste management, biodiversity concepts and data management and environmental monitoring.
- PS08 Students will be able to understand the basic science behind the properties of nanomaterials synthesis and applications of nanomaterials.
- PS09 Students will get knowledge of the emerging fields of OMICS and Systems Biology, biological systems as a whole and how parts of systems interact with each other and their applications for screening, testing and treatment of human diseases.

- PSO10 Students will have a firm foundation in Drug Discovery and Clinical Studies along with detail information of Clinical Trial Design and Indian Regulations, Pharmacovigilance and Clinical Data Science.
- PSO11 Students will develop skills for the processing and analysis of scientific data along with knowledge of techniques used Food Technology - Nutraceuticals

## **Class: M.Sc. I Biotechnology**

### **Semester I**

#### **Course (Paper) Name and No.: Biochemistry Paper-I**

- C01 Gain fundamental knowledge in biochemistry.
- C02 Understand the molecular basis of various pathological conditions from the perspective of biochemical reactions.
- C03 Develop a deep understanding of concepts like glycosylation, folding and degradation of proteins, regulation of metabolic pathways, cell structure, cell division and molecular basis of various cellular processes
- C04 Students will learn chemistry of nucleic acids with regulation of metabolic pathways.

#### **Course (Paper) Name and No.: Immunology Paper-II**

- C01 Gain education in Immunology, molecular Diagnostics and developmental biology
- C02 Get an idea of defense mechanism and diagnosis of infectious diseases with essential concepts of differentiation and growth in animals.
- C03 Evaluate usefulness of immunology in different pharmaceutical company.
- C04 Identify proper research lab working in area of their interests

#### **Course (Paper) Name and No.: Cell Biology Paper-III**

- C01 Students will learn signal transduction mechanisms, in particular the concepts of response specificity, signal amplitude and duration, signal integration and intracellular location
- C02 Students will get knowledge of different types of extracellular signals and receptors, and explain their functional significance
- C03 The students will able to learn how genetics contributes to predisposition and progression of cancer.
- C04 It will help the students to understand how immunotherapy is, and can be, used to treat human illness.

**Course (Paper) Name and No.: Genomics and Emerging Technologies - Paper-IV**

- C01 Students will be able to acquire knowledge and understanding of fundamentals of genomics, proteomics, transcriptomics and metabolomics with their applications in various applied areas of biology.
- C02 Students will be able to learn history, theoretical basis, and basic understanding of latest technologies in area of biotechnology.
- C03 They will also be able to learn about various applications of emerging techniques used in genomics, proteomics.
- C04 Students will get knowledge of molecular cytogenetics including advanced fluorescence techniques and CRISPER CAS

**Semester II**

**Course (Paper) Name and No.: Bioinformatics and Biostatistics – Paper-I**

- C01 Students will be acquainted to organization of various databases.
- C02 Students will be able to analyze, interpret and study biological data (sequence, structure, etc.) stored in various databases available on internet.
- C03 Biostatistics & Computational Biology will enrich the students how to utilize various tools of biostatics in interpretation of biological data, different sampling methods including probability, correlation and regression.
- C04 To Gain broad understanding in statistics and approach to problem solving, on a diverse variety of disciplines. To Gain working knowledge of these computational tools and methods

**Course (Paper) Name and No.: Plant and Animal Biotechnology –Paper II**

- C01 Gain basic skills in plant and animal biotechnology.
- C02 Learn basic technical aspects of plant tissue culture technique like media preparation, seed sterilization, callus culture and maintenance of aseptic conditions. The skill could be applied in agriculture and crop improvement.
- C03 Learn to demonstrate foundational knowledge of Cell culture techniques and

competence in laboratory technique

- C04 Students will learn molecular mapping, marker assisted selection and plant genetic manipulations including strategies for introducing biotic and abiotic stress resistance

**Course (Paper) Name and No.: Bioprocess Engineering and Technology- Paper III**

- C01 Appreciate relevance of microorganisms from industrial context.
- C02 Give an account of design and operations of various fermenters.
- C03 Give an account of important microbial/enzymatic industrial processes in food and fuel industry
- C04 Students will learn about fermented foods and beverages with knowledge of Food additives and supplements

**Course (Paper) Name and No.: Intellectual Property Rights & Bioethics-Paper IV**

- C01 Understand the rationale for and against IPR and especially patents;
- C02 Understand why India has adopted an IPR Policy and be familiar with broad outline of patent regulations;
- C03 Gain knowledge of biosafety and risk assessment of products derived from recombinant DNA research and environmental release of genetically modified organisms, national and international regulations
- C04 Students will become familiar with ethical issues in biological research.

## **Class: M.Sc. II Biotechnology**

### **Semester III**

#### **Course (Paper) Name and No.: Applied Virology and Microbiology- Paper- I**

- C01 Students will learn theoretical knowledge of various diseases condition, causative agents, history, diagnosis & clinical manifestation.
- C02 Students will develop understanding about epidemiological principles in prevention, control and management of pandemic disease and emerging pathogens.
- C03 Students will become aware of organizations in disease control & research and also current research and developments in various diseases with understanding of antimicrobial resistance for management of drug resistance in population
- C04 Students will get to know about the characteristics of biofilms formed due to different infectious agents and get insights into latest development of diagnostics & therapeutics for such diseases.

#### **Course (Paper) Name and No.: Environmental Biotechnology- Paper-II**

- C01 Students will learn the use of microorganisms and their products in the prevention of environmental pollution through biotreatment of solid, liquid, and gaseous wastes
- C02 Students will get introduced to latest concepts in environmental biotechnology, various types of pollutions, monitoring, latest mitigation strategies and management of the same using microbiological, molecular and analytical methods
- C03 Students will develop understanding about Health hazards of pollution and waste, solid waste management.
- C04 Students will be able to understand biodiversity concepts and data management, biosensors and its application in environmental monitoring.

### **Course (Paper) Name and No.: Biologics and Regulatory Affairs- Paper- III**

- C01 Student will gain essential knowledge about Clinical and Biopharmaceutical Development along with the basic concepts and significance of Biologics/Biosimilar in addition to having knowledge about its therapeutic applications
- C02 Students will be aware of the techniques required for characterization of the Biosimilars relative to the Reference Biologic
- C03 The course will impart the understanding of various application of techniques in analysis of impurities/Purity, Characterization of biosimilar products.
- C04 Students will know about the regulatory aspects of approval of a Biosimilars.

### **Course (Paper) Name and No.: Molecular Enzymology and Enzyme Technology- Paper- IV**

- C01 Students will gain basic knowledge of mechanism of action, enzyme kinetics – factors affecting enzyme activity, regulation of enzyme activity & enzyme pattern in diseases.
- C02 Students will develop understanding regarding techniques and the underlying principle in enzyme purification and enzyme engineering.
- C03 Students will be able to integrate the practical aspects of Industrial application of enzymes.
- C04 Students will understand the role of Enzymes in diagnosis of diseases, therapeutic uses and as biosensors.



## Semester IV

### Course (Paper) Name and No.: Nano biotechnology- Paper- I

- C01 Students will gain the knowledge about Synthesis of nanometer scale materials.
- C02 Students will be able to understand the basic science behind the properties of nano-materials and the principles behind advanced experimental techniques for studying nano-materials.
- C03 Student will acquire knowledge on biomedical applications as well as toxicology studies of nanotechnology.
- C04 Students will get an insight into complete systems where nanotechnology can be used to improve our everyday life.

### Course (Paper) Name and No.: OMICS AND SYSTEMS BIOLOGY- Paper- II

- C01 Students will understand how the data is generated by OMICS technologies to contribute to different databases along with screening, testing and treatment of human diseases
- C02 Students will Understand, compare and contrast the techniques involved in Genomics, Proteomics, Transcriptomics, Lipidomics and Metabolomics.
- C03 Students will gain the knowledge of advanced genomic and proteomic technologies and their data from high-quality human bio-specimens to identify potentially actionable therapeutic molecular targets.
- C04 Students will have the knowledge of applications of systems biology in development of personalized medicine, drug development

### Course (Paper) Name and No.: Drug Discovery and Clinical Study- Paper- III

- C01 Students will have a firm foundation in Drug Discovery and Clinical Studies.
- C02 Students will able to learn about drug discovery-design pathway using some in-silico tools.
- C03 Students will be able to understand the clinical trial design set up
- C04 Students will gain information on rules-regulation and responsibilities in clinical studies.

**Course (Paper) Name and No.: Scientific Writing and Food Biotechnology- Paper- IV**

- C01 The course impart knowledge about the Guidelines for Medical writing & Plagiarism.
- C02 Students will understand about Presentation skills & Research ethics
- C03 Students will able to think critically, organize and analyze scientific data.
- C04 Students will be able to present their research results in the format of oral or poster presentations at conferences, to write scientific publications (theses, articles) and to prepare applications for scientific grants (research proposals).