**Programme Outcomes,**

**Programme Specific Outcomes and**

**Course Outcomes For**

**PG Programmes**

Programme Name: M.Sc. in Bioinformatics

Number of Semesters: 4


Department of Bioinformatics
University of North Bengal
West Bengal, INDIA

**Programme Outcomes**

Bioinformatics is a multi-disciplinary subject in the field of life science. Bioinformatics is information technology applied to the management and analysis of biological data with the aid of computational and statistical techniques. It is the science of using information to understand biology. In this field biological information is collected, compared, studied and analyses to find the interrelation between them for solving structural, functional and evolutionary problems using computational technologies. The biological information stored in various databases is available in web through internet. Bioinformatics refers to the creation and development of databases, software, computational and statistical techniques and theory to solve problems generated from the management and analysis of biological data. On the other hand, computational biology refers to the hypothesis-based investigation of a specific biological problem using computers, carried out with experimental or simulated data, with the primary goal of discovery and the advancement of biological knowledge. Bioinformatics solves the following problems and put more emphasis on understanding disease related problems at the molecular level.

• Protein sequencing, Nucleic acid sequencing and their analysis.
• Find proteins, their interaction, activity, modification and function.
• Elucidation of function of a molecule based on its structure.
• Gene expression, analysis, prediction and establishing a genomic library.
• Find homology for studying evolutionary relationships among different species.
• Molecular modelling and molecular dynamics methods to study structure from sequence.
• Drug designing and discovery from data of functional genomics and proteomics.

In recent years in this age of the Internet and sequenced genome we have more information at our fingertips than ever before. Organizing this entire data and combating information overload is becoming more and more important. Utilization of computational power has solved this problem to some extent. The course covers the principles and computational methods used to search and compare DNA, RNA and proteins, cast as biological "sequences". The course explains why they can give us answers to fundamental biological questions important to fields such as Cell Biology, Biochemistry and Medical science.

**Programme Specific Outcomes**

To build in candidates a strong foundation in interdisciplinary sciences such as Computer Sciences and Biological Sciences, to develop accelerated and precise technologies for industrial problems, and prepare them for productive careers in fields of biotechnology, pharmaceutical, bioinformatics, Research, and healthcare industries

Strengthening ongoing university research in the area of bioinformatics, in particular and life science in general. Further it will be helpful in creating an advanced research facility to carry out research in frontier areas of bioinformatics, biotechnology, and molecular modelling.

To address the challenges arising from the huge amount of genomic data and to overcome by analyzing and individualizing the corresponding drug responses towards appropriate drug specified dosages.

**Semester-I**

| **Core Course** | |
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| **Theory (Cr. 2)** | **BINFCCT0101N - Cell Biology, Genetics, and Molecular Biology** |
| **Course Objectives:** | The main objective of the course is students to understand the structure and function of living systems at the molecular level and to understand genetics concepts from mendelian to modern era |
| **Course Outcomes:** | After completion of the course the learners will be able to:<br>● Understand the concepts of cell and molecular biology and to utilize them in bioinformatics applications.<br>● Understand the gene and its modular structure, mutation and its role in genome evolution, genetic and physical map<br>● Understand the connection of Applied areas of cell and molecular biology and Bioinformatics for human diseases and health |
| **Theory (Cr. 2)** | **BINFCCT0102N - Basic Bioinformatics** |
| **Course Objectives:** | The course introduces Bioinformatics in general and online resources and tools related to sequences, structures, pathway, and genome databases in particular to the students |
| **Course Outcomes:** | After completing the course, the student will recognize various online bioinformatics resources, able to retrieve relevant information from biological databases and also learn to differentiate between file formats to store biological data. They will learn to compare sequence data |
| **Theory (Cr. 2)** | **BINFCCT0103N - Basic Computer Application** |
| **Course Objectives:** | The main objective of the course is for students to understand the basics of computer architecture, computer software and hardware. The concepts like principles of operating systems with special reference to Windows, Linux along with data communication and computer network, and computer graphics presentation will be introduced. |
| **Course Outcomes:** | After completion of the course the students will be able to do:<br>● webpage designing,<br>● 3D presentation using computer graphics<br>● Command line scripting in the operating system. |
| **Practical (Cr. 2)** | **BINFCCP0104N - Cell Biology, Genetics, and Molecular Biology** |

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| | Knowledge acquired:<br>1. (1) Important functions of the cell, its microscopic structure<br>2. (2) Understand the basic molecular genetics mechanisms about the structure and function of the cells<br>3. (3) Gain insight into the most significant molecular biology-based methods used today to expand our understanding of biology.<br>Skills gained:<br>4. Able to explain genetic disorders in humans and the genes responsible for it<br>5. Ability to design experiments to understand molecular-level interactions and their relation to the biological system<br>Competency Developed:<br>**6.** Employ critical thinking and scientific knowledge to design experiments, carry out, record, and analyze the results |
| **Practical (Cr. 2)** | **BINFCCP0105N - Basic Bioinformatics** |
| | Knowledge acquired:<br>(1) Knowledge of general biology and understanding of biological data generation technologies<br>(2) Understanding of data structure (databases) used in bioinformatics and interpreting the information, understanding and being aware of current research and problems relating to this area<br><br>Skills gained:<br>(1) Students gained the skills of how to utilize bioinformatics resources<br>(2) Understand a Bioinformatics Databases and Tools<br><br>Competency Developed:<br>(1) An ability to use current techniques, skills, and tools necessary for Bioinformatics practice |
| **Practical (Cr. 2)** | **BINFCCP0106N - Basic Computer Application** |

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| | **Knowledge acquired:**<br>(1) basic of computer architecture, computer software, and hardware,<br>(2) principles of the operating system with special reference to windows, Linux,<br>(3) data communication and computer network, and<br>(4) computer graphics presentation.<br>**Skills gained:**<br>(1) webpage designing,<br>(2) 3D presentation using computer graphics, and,<br>(3) command-line scripting in the operating system.<br>**Competency Developed:**<br>(2) Understanding computer techniques to solve the biological problem,<br>(3) Basic understanding of webtool development for bioinformatics algorithm<br>(4) Understanding of computer operating systems and networking for the execution of bioinformatics software<br>(5) Basic of developing visualizer for bioinformatics. |
| **Department Skill Enhancement (DSE) (Any One to be chosen)** | |
| **Theory (Cr. 1)** | **BINFDET0101A - Biochemistry and Biophysics** |
| **Course Objectives:** | This is meant to introduce biochemistry and biophysics as a course in biosciences applying the theoretical language of chemistry and physics to aid functional understanding of molecular and cellular processes |
| **Course Outcomes:** | After completion of the course the students will be able to:<br>● Explain the structure of Biomolecules and their interactions<br>● Understand physical laws underlying biological systems<br>● Understand the structure, functions and classifications of proteins, nucleic acid, lipids and carbohydrate |
| **Theory (Cr. 1)** | **BINFDET0101B Basic mathematics and statistics for Biology** |
| **Course Objectives:** | The course is designed to provide the students basic understanding of systems of linear equations, their associated matrices and their properties, characteristic polynomials, eigenvalues and eigenvectors, bilinear forms, and linear programming. |
| **Course Outcomes:** | The student will be able to-<br>● analyze system of linear equations,<br>● solving linear recurrences, and,<br>● formulating linear programming problems and finding their feasible and optimal solutions. |
| **Practical (Cr. 1)** | **BINFDET0101A - Biochemistry and Biophysics** |

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| | Knowledge acquired:<br>(1) Structure, functions and classifications of amino acids and Proteins<br>(2) Structure and functions of DNA and RNA<br>(3) Structure and functions Carbohydrates<br>(4) Functions and classifications of Enzymes<br>Skills gained:<br>(1) Ability to explain the structure of Biomolecules and their interactions<br>(2) Ability to explain the formation of macromolecules from monomers<br>Competency Developed:<br>(5) Understanding of structure and functions of Biomolecules.<br>(6) Employ critical thinking and scientific knowledge to design experiments, carry out, record and analyze the results |
| **Practical (Cr. 1)** | **BINFDET0101B - Basic mathematics and statistics for Biology** |
| | Knowledge acquired:<br>(1) systems of linear equations, their associated matrices and their properties,<br>(2) characteristic polynomial, eigenvalues and eigenvectors,<br>(3) bilinear forms,<br>(4) linear programming.<br>Skills gained:<br>(1) analyze the system of linear equations,<br>(2) solving linear recurrences, and,<br>(3) formulating linear programming problems and finding feasible and optimal solutions.<br>Competency Developed:<br>(1) Applying the concept of group action to real-life problems such as Counting<br>(2) The facility in handling problems involving polynomial equations<br>(3) The facility in solving real-life problems by thinking logically and outside of the box. |

**Semester-II**

| **Core Course** | |
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| **Theory (Cr. 2)** | **BINFCCT0201N - Genomics and Proteomics** |
| **Course Objectives:** | The goal is to determine how all the genes in a genome act and how their products interact to produce a functional organism. The different methods of sequencing, microarrays, protein fingerprints and the role of bioinformatics tools applied to analyse and interpret the protein-protein interactions in different cell types will be detailed |
| **Course Outcomes:** | After completion of the course the learners will be able to:<br>● explain the genomic and proteomic strategies and apply bioinformatics tools for the same<br>● Understand how the proteins act and how their products interact<br>● Learn different computational resources available for genomics and Proteomics<br>● understand the nature of transcriptome data, normalize it and perform differential expression analysis<br>● able to compare 2D gel images for difference of protein expression |

| **Theory (Cr. 2)** | **BINFCCT0202N - Advanced statistical techniques for Bioinformatics** |
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Knowledge acquired:

(1) statistical estimation procedure for estimating parameter with reference to biological data,
(2) hypothesis testing procedure considering the problem of simultaneous hypothesis testing,
(3) sampling and resampling techniques.

Skills gained:

(1) biological data analysis with the help of linear estimation techniques,
(2), Inference of biological events with help of statistical inference and,
(3) application of sampling techniques in biological data analysis.

Competency Developed:

(1) Applying the concepts of statistical inference, estimation for real biological problem
(2) Learn the ability to analyze complex real-life data
(3) Create the ability of algorithm development with the help of statistical as well as computational techniques.

| **Theory (Cr. 2)** | **BINFCCT0203N - Computer programming for Bioinformatics** |
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| **Course Objectives:** | The course introduces the-<br>(1) basic concepts of algorithm writing and flowchart<br>(2) Programming script writing using R and PERL<br>(3) Usage of programming script for bioinformatics data analysis. |
| **Course Outcomes:** | The student who completes the course will have the ability-<br>● to develop algorithm for solving complex biological problem<br>● to write problem specific script for biological data analysis<br>● to write programming script for algorithm development |
| **Practical (Cr. 2)** | **BINFCCP0204N - Genomics and Proteomics** |

**Course Objectives:**

Knowledge acquired:

(1) Principles of several important analytical methods that are relevant to a functional genomics approach

Skills gained:

(1) Technical skills and knowledge development on versatile techniques in omics
(2) Being able to: design and conduct a proteomics experiment, including the mass spectrographic analysis; explain how the data should be analyzed

Competency Developed:

(1) Suggesting and outlining a solution to theoretical and experimental problems in Genomics, Transcriptomics, and Proteomics fields

| **Practical (Cr. 2)** | **BINFCCP0205N - Advanced statistical techniques for Bioinformatics** |
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| Knowledge acquired:<br>(1) statistical estimation procedure for estimating parameter with reference to biological data,<br>(2) hypothesis testing procedure considering the problem of simultaneous hypothesis testing,<br>(3) sampling and resampling techniques.<br>Skills gained:<br>(1) biological data analysis with the help of linear estimation techniques,<br>(2), Inference of biological events with help of statistical inference and,<br>(3) application of sampling techniques in biological data analysis.<br>Competency Developed:<br>(1) Applying the concepts of statistical inference, estimation for real biological problem<br>(2) Learn the ability to analyze complex real-life data<br>(3) Create the ability of algorithm development with the help of statistical as well as computational techniques. | |
| **Practical (Cr. 2)** | **BINFCCP0206N - Computer programming for Bioinformatics** |
| | Knowledge acquired:<br>(1) basic concepts of algorithm writing and flowchart<br>(2) Programming script writing using R and PERL<br>(3) Usage of programming script for bioinformatics data analysis.<br>Skills gained:<br>(1) stepwise algorithm development<br>(2) syntax of R, PERL programming and,<br>(3) defining and calling function/subroutine in programming.<br>Competency Developed:<br>(1) Ability to develop algorithm for solving complex biological problem<br>(2) Writing problem specific script for biological data analysis<br>(3) Writing programming script for algorithm development |

**Semester III**

| **Core Course** | |
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| **Theory (Cr. 2)** | **BINFCCT0301N - Structural Bioinformatics** |
| **Course Objectives:** | This course introduces the concept of how the biomolecules act, their structural properties and how their products interact. The students will learn about different computational resources available for structural bioinformatics |
| **Course Outcomes:** | A student who completes this course is expected to:<br>● Know the structure of the different biological molecule<br>● Predict the structures and grasp the idea of experimental structure and determination using x-ray crystallography<br>● To explain the structural Bioinformatics strategies and apply bioinformatics tools for the same |

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| **Practical (Cr. 2)** | **BINFCCP0302N - Structural Bioinformatics** |
| | Knowledge acquired:<br>(1) Understand how the Biomolecules act and how their products interact<br>(2) Learn different computational resources available for Structural Bioinformatics<br><br>Skills gained:<br>(1) Able to explain the structural Bioinformatics strategies and apply bioinformatics tools for the same<br><br>Competency Developed:<br>(1) Formulate and assess experimental design for solving theoretical and experimental problems in Structural Bioinformatics |
| **Department Skill Enhancement (DSE) (Any Three to be chosen)** | |
| **Theory (Cr. 1)** | **BINFDET0301A - Web-based Programming and Database management systems** |
| **Course Objectives:** | This course is intended to provide students with an in-depth understanding of the web page designing using CSS, HTML, PhP etc. and database development and management using SQL, ORACLE. The concept of establishment the connectivity of web page with database will also be introduced. |
| **Course Outcomes:** | After completion of the course the learners will be able to<br>(1) Understand the procedure of creation of biological database and its management<br>(2) Develop webpage as graphical interface of algorithm<br>(3) Handle database integration with the webtool for storing data. |
| **Theory (Cr. 1)** | **BINFDET0301B - Phylogeny and Phylogenomics** |
| **Course Objectives:** | The main goal of this course is to help students in learning the basic concepts and computational methods involved in the molecular evolutionary analysis of genes and proteins |
| **Course Outcomes:** | After completion of the course the learners will be able to:<br>● understand the theoretical aspects of classical, molecular evolution and applications.<br>● Measuring the rate of evolution and concept of molecular clock hypothesis.<br>● Various algorithms and their comparison for deducing phylogenetic tree among species |
| **Theory (Cr. 1)** | **BINFDET0301C - NGS and expression data analysis** |
| **Course Objectives:** | The major goal of this course provides the student with a strong foundation for principles, methods and concepts of sequencing, Impact of transcriptomics on biology and familiarize them with tools and method to analyze the NGS, Microarray, RNA-Seq data |
| **Course Outcomes:** | After completion of the course the learners will be able to: |
| **Theory (Cr. 1)** | **BINFDET0301D - Advance computer programming for Bioinformatics** |

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| **Course Objectives:** | This lab course introduces the basic concept of of python and R programming and develop programming capability to write scripts to solve bioinformatics problems |
| **Course Outcomes:** | After completion of the course the learners will be able to:<br>● Understand Python programming syntax<br>● Able to write python scripts for various bioinformatics applications.<br>● Implement statistical application for solving biological problems using R packages. |
| **Theory (Cr. 1)** | **BINFDET0301E - Data Mining and Machine learning techniques for Bioinformatics** |
| **Course Objectives:** | The course gives an idea of the different algorithms to be used to train and test systems along with mining relevant data from a system. This course will also introduce the basics of data analysis with machine learning techniques. |
| **Course Outcomes:** | After completion of the course the learners will be able to-<br>● Learn the different classification and clustering algorithms<br>● Biological data analysis using supervised and unsupervised techniques for better understanding of biological events<br>● Integration of biological data using machine learning and data mining techniques. |
| **Theory (Cr. 1)** | **BINFDET0301F - Advanced omics technologies** |
| **Course Objectives:** | This course will familiarize the students with advanced tools and techniques used in omics studies. They will learn about different computational resources available for high throughput data coming from different omics platform |
| **Course Outcomes:** | After completion of the course the learners will be able to:<br>● Explain the Peptidomics, Allergens, Metabolomics, Interactomics, etc<br>● Understand the principles of integrative analysis methods for biological system analysis and interactions<br>● Implement database search and suits for –omics<br>● Analyze data coming from different omics experiments |
| **Practical (Cr. 1)** | **BINFDEP0301A - Web based programming and database management** |
| | Knowledge acquired:<br>(1) Web page designing using CSS, HTML, PhP,<br>(2) database development and management using SQL, ORACLE,<br>(3) establishment the connectivity of webpage with database.<br>Skills gained:<br>(1) development of webtool,<br>(2) database development, and,<br>(3) integration of webpage and database.<br>Competency Developed:<br>(1) Creation of biological database and its management<br>**(2)** Webpage development as graphical interface of algorithm and database integration with the webtool for storing data. |
| **Practical (Cr. 1)** | **BINFDEP0301B - Phylogeny and Phylogenomics** |

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| | Knowledge acquired:<br>(1) Concepts of molecular evolution and the nature of data for deriving molecular phylogeny<br>(2) logical basis and computational details of various tree-building algorithms and associated methods of hypothesis testing, as well as novel applications of phylogenetic analysis in various fields of biology<br><br>Skills gained:<br>(1) Able to analyse the genomic data using phylogenetics and infer the evolutionary explanation of a biological phenomenon<br><br>Competency Developed:<br>(1) Application of statistical approaches and models for phylogenetic analysis and tree reconstruction<br>(2) An ability to apply knowledge of computing, biology, statistics and mathematics appropriate to the discipline |

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| **Practical (Cr. 1)** | **BINFDEP0301C - NGS and expression data analysis** |
| | Knowledge acquired:<br>(1) Strong foundation for principles, methods and concepts of sequencing, Impact of transcriptomics on biology<br>(2) Comprehend the ideas of Genome projects of model organisms , Next Generation Sequencing technology<br>(3) Methods for analyzing the Gene expression, Differential expression, Allele-specific expression and Statisitcal considerations<br><br>Skills gained:<br>(1) Skills for Big Data handling and analysis including NGS, Microarray, RNA-Seq data<br>(2) Understand basic use of R statistical package in biological data<br><br>Competency Developed:<br>(1) Provide the competence to use NGS technology within life science ranging from microbiology to human biology. |
| **Practical (Cr. 1)** | **BINFDEP0301D - Advance computer programming for Bioinformatics** |
| | Knowledge acquired:<br>(1) basic of python and R programming,<br>(2) importing different function/package for biological data analysis.<br>Skills gained:<br>(1) complex data analysis using different modules of python<br>(2) implementing statistical methods using R packages for analyzing biological data.<br>Competency Developed:<br>(1) Solving the biological problem using python modules<br>(2) Implementing statistical application for solving biological problems using R packages. |
| **Practical (Cr. 1)** | **BINFDEP0301E - Data Mining and Machine learning techniques for Bioinformatics** |
| | Knowledge acquired:<br>(1) data analysis with machine learning techniques,<br>(2) different data mining techniques with application in biological data mining,<br>(3) validation of techniques using proper validation procedure.<br>Skills gained:<br>(1) machine learning techniques to solve biological problems,<br>(2) mining information from biological data, and,<br>Competency Developed:<br>(1) Biological data analysis using supervised and unsupervised techniques for better understanding of biological events<br>(2) Integration of biological data using machine learning and data mining techniques. |

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| **Practical (Cr. 1)** | **BINFDEP0301 Advanced omics technologies** |
| | Knowledge acquired:<br>(1) Understand different advanced fields of Omics technologies<br>(2) Learn different computational resources available for Advanced Omics technologies<br><br>Skills gained:<br>(1) Able to explain the Peptidomics, Allergens, Metabolomics, Interactomics, etc<br><br>Competency Developed:<br>(1) Formulate and assess experimental design for solving theoretical and experimental problems in the latest technologies in the Omics studies |
| **Generic Elective (GE) (Any One to be chosen)** | |
| **Theory (Cr. 2)** | **BINFGET0301A - Biological data analysis** |
| **Course Objectives:** | The main objective of this course is to introduce general concepts of computational methods of biological data analysis to the allied department students of the university |
| **Course Outcomes:** | After completion of the course the learners will be able to:<br>● Understand the essential features of the interdisciplinary field of science for better understanding biological data.<br>● Look at a biological problem from a computational point of view<br>● Find out the methods for analyzing the structure, function and expression of DNA, RNA and proteins<br>● Interact with algorithms, tools and data in current scenario |

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| **Theory (Cr. 2)** | **BINFGET0301B - Cheminformatics** |
| **Course Objectives:** | This course will familiarize the students with tools and techniques used in Cheminformatics, especially Computer-aided drug discovery. The course is designed to provide basic understanding of computational drug design and applicability of tools for novel drug discovery |
| **Course Outcomes:** | Students would be able to-<br>● Get insights on the modern drug discovery and development process<br>● Identify the drug targets and understand the mode of action<br>● Knows the basics of drugs, the rules that govern drug behavior and its classification<br>● Learn different computational resources available for Structural Bioinformatics |
| **Practical (Cr. 2)** | **BINFGEP0301A - Biological data analysis** |
| | Knowledge acquired:<br>(1) Knowledge of general biology and understanding of biological data generation technologies<br>(2) Understanding of data structure (databases) used in bioinformatics and interpret the information (especially: find genes; determine their functions), understand and be aware of current research and problems relating to this area<br><br>Skills gained:<br>(1) Students from other departments gained the skills of how to utilize bioinformatics resources<br>(2) Understand a biological problem from a computational point of view<br><br>Competency Developed:<br>(1) An ability to use current techniques, skills, and tools necessary for computational biology practice |
| **Practical (Cr. 2)** | **BINFGEP0301B Cheminformatics** |
| | Knowledge acquired:<br>(1) Understand how to deal with drug targets and drugs<br>(2) Learn how drugs and its targets interact<br>(3) Learn different computational resources available for Structural Bioinformatics<br><br>Skills gained:<br>(1) Able to explain the Cheminformatics strategies and apply Cheminformatics tools for the same<br><br>Competency Developed:<br>(1) Formulate and assess experimental design for solving theoretical and experimental problems in Cheminformatics |

**Semester-IV**

| **Core Course** | |
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| **Theory *(Cr. 2)*** | **BINFCCT0401N - Research Methodology & Scientific Writing** |
| **Course Objectives:** | The major objective of this course is to provide an overview of how to identify research problems and conduct research. |
| **Course Outcomes:** | After completion of the course the learners will be able to:<br>● Understand the basics of how to design, conduct research, analyze and communicate the results to research community<br>● Organize and conduct research (advanced project) in a more appropriate manner<br>● Explain and apply techniques for scientific writing and research methodology to prepare the writing of a scientific report |

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| **Theory *(Cr. 2)*** | **BINFCCT0402N - Bioethics, Biosafety, and IPR** |
| **Course Objectives & outcomes:** | Knowledge acquired:<br>(1) Understand the Ethical aspects that the biologist needs to have<br>(2) Learn about the safety precautions that need to be taken in the laboratory<br>(3) Understand the IPR and how to get patents for the discovery<br><br>Skills gained:<br>(1) Able to explain the Bioethics, Biosafety, and IPR strategies<br><br>Competency Developed:<br>(1) Formulate and assess experimental design for solving theoretical and experimental problems in Bioethics, Biosafety, and IPR |
| **Practical *(Cr. 2)*** | **BINFCCP0403N - Research Methodology & Scientific Writing** |
| | Knowledge acquired:<br>(1) Understand different scientific research designs and methods<br>(2) Learn how to set up a research study<br>(3) Understand correct ways to refer to and cite from scientific literature<br><br>Skills gained:<br>(1) Discuss and explain differences between different research methods<br>(2) Perform literature reviews and reference relevant scientific literature<br>(3) Formulate a research plan<br><br>Competency Developed:<br>(1) Critically assess different research designs<br>(2) Analyse, set as contrast, compare and review scientific literature<br>(3) Discuss own view in relation to the published research |
| **Practical *(Cr. 2)*** | **BINFCCP0404N - Bioethics, Biosafety, and IPR** |

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| | Knowledge acquired:<br>(4) Understand the Ethical aspects that the biologist needs to have<br>(5) Learn about the safety precautions that need to be taken in the laboratory<br>(6) Understand the IPR and how to get patents for the discovery<br><br>Skills gained:<br>(2) Able to explain the Bioethics, Biosafety, and IPR strategies<br><br>Competency Developed:<br>(2) Formulate and assess experimental design for solving theoretical and experimental problems in Bioethics, Biosafety, and IPR |
| **Department Skill Enhancement (DSE) (Any One to be chosen)** | |
| **BINFDEP0401A Dissertation/ Project work and Viva *(Cr. 2)*** | Student will learn the ability to apply the knowledge with real dataset. It will also help students to research problem identification, writing research proposal and accomplishing the research work. |
| **BINFDEP0401A Internship *(Cr. 2)*** | Student will learn the ability to apply the knowledge with real dataset. It will also help students to research problem identification, writing research proposal and accomplishing the research work. |
| **Generic Elective (GE) (Any one to be chosen)** | |
| **Theory *(Cr. 2)*** | **BINFGET0401A - Comparative and Functional Genomics** |
| **Course Objectives:** | This course will provide an overview of the concept of comparative and functional Genomics and contemporary approaches used to understand the genome functionalities. |
| **Course Outcomes:** | After completion of the course the learners will be able to:<br>● To familiarize students with the tools and databases available for genomic analysis, with an appreciation of the quantitative concepts that form the basis of those tools<br>● understand and perform genome-level comparative studies of molecular sequences isolated from multiple individuals within and across species<br>● Understand the basics of pharmacogenomics and its application in personalized medicine |
| **Theory *(Cr. 2)*** | **BINFGET0401B Computational System Biology**<br>Knowledge acquired:<br>(1) Application of mathematical approaches for biological problem solving<br>(2) Biological network construction techniques<br>(3) Biological relevance with respect to network inference<br>Skills gained:<br>(1) Statistical techniques for complex data analysis<br>(2) Nodes and edges in graph theory.<br>Competency Developed:<br>(1) Graph theory to visualize the network |
| **Practical *(Cr. 2)*** | **BINFGEP0401A - Comparative and Functional Genomics** |

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| | Knowledge acquired:<br>(1) learn how scientists solve problems at the genome level and make new discoveries<br>(2) Compare genomes of different species, gene finding, and gene regulation<br>(3) Perspective on the emergence of Pharmacogenomics as a new field<br>(4) Application of genomics in improving the problems in drug therapy optimization<br><br>Skills gained:<br>(1) Utilization of software tools and resources in the field of comparative genomics<br><br>Competency Developed:<br>(1) Develop the skills and knowledge to apply genomic technologies and data interpretation to clinical practice or scientific research |

| **Practical *(Cr. 2)*** | **BINFGEP0401B Computational System Biology** |
|---|---|
| | Knowledge acquired:<br>(1) Application of mathematical approaches for biological problem solving<br>(2) Biological network construction techniques<br>(3) Biological relevance with respect to network inference<br>Skills gained:<br>(1) Statistical techniques for complex data analysis<br>(2) Nodes and edges in graph theory.<br>Competency Developed:<br>(1) Graph theory to visualize the network |