Program outcomes, program specific outcomes and course outcomes for all programs offered

S. No.	Program outcomes		Program specific outcomes
	Name of the Program	Outcome	
1.	M.Sc Bioinformatics	To work with confidence and conscience in Fundamentals of Biological problem for instance to identify the structural and functional aspects of small and macromolecule in a typical biological laboratory and also to be aware of contamination issues.	Students will be able design, conduct experiments, analyze and interpret data for investigating problems in Biotechnology and allied fields.
		To identify suitable leads against targets responsible towards disease onset and progression that provides a regimen for drug discovery and development proves. Exclusively, at the end of the program the graduates are molded as finer competent against the thriving competition from the students of premier institutes of India.	Higher studies (M.Phil, Ph.D) can be pursued in order to attain research positions. Various examinations such as CSIR-NET, ARS-NET GATE, ICMR, DBT and many other opens channels for promising career in research.
		To understand the concepts and specific features of the subject that is further perceived as application across the disciplines of Computational and Biosciences. In addition to have established knowledge in scientific writing, on how to give a scientific presentation, how to evaluate a scientific paper, and research ethics and as well as to apply their learned skills in the techniques within the chosen area of research.	Entrepreneurship ventures such as consultancy and training centers can be opened.
		To fulfill needs of the industry for the manpower with the specific skills sets related to Bioinformatics.	Students will be able to understand the potentials, and impact of biotechnological innovations on environment and their implementation for finding sustainable solution to issues pertaining to environment, health sector, agriculture, etc.

Course outcomes (M.Sc Bioinformatics)	
SEMESTER-I	
Name of the Course	**Outcome**
Introduction to Bioinformatics (502101)	Bioinformatics involves the integration of computers, software tools, and databases in an effort to address biological system.
	Knowledge and awareness of the basic principles and concepts of biology, computer science and mathematics.
	Existing software effectively to extract information from large databases and to use this information in computer modeling.
	Problem-solving skills, including the ability to develop new algorithms and analysis methods.
	Bioinformatics is the application of tools of computation and analysis to the capture and interpretation of biological data.
	Bioinformatics is essential for management of data in modern biology and medicine.
	The bioinformatics toolbox includes computer software programs such as BLAST and Ensembl, which depend on the availability of the internet.
	Analysis of genome sequence data, particularly the analysis of the human genome project, is one of the main achievements of bioinformatics to date.
	Prospects in the field of bioinformatics include its future contribution to functional understanding of the human genome, leading to enhanced discovery of drug targets and individualized therapy.
Biomolecules (502102)	Understand the principles, concepts and facts of the structure and their related functions of proteins.
	Explain the essential principles of enzymology and solve problems in enzyme catalyses and kinetics.
	Apply the basic biochemical techniques on enzyme characterization.
	Recognize the structure and properties of simple carbohydrates, oligosaccharides and polysaccharides.
	To understand the structure properties and biological functions of lipids and biological membranes.
	Understanding of structure properties and biological roles heterocyclic bases nucleotides and nucleic acids in living organism.
Mathematics and Biostatistics (502103)	Formulate as well as analyze mathematical and statistical problems, precisely define the key terms, and draw clear and reasonable conclusions.
	Use mathematical and statistical techniques to solve well-defined problems and present their mathematical work.
	Read, understand and construct correct mathematical and statistical proofs and use the library and electronic data-bases to employ information on mathematical problems.
	Explain the importance of mathematics and its techniques to solve real life problems and provide an alternative paradigm for the limitations of such techniques and validate the results accordingly.
	Propose new mathematical and statistical questions and suggest

	possible software packages and/or computer programming to find solutions to these questions.
	Continue to acquire mathematical, statistical knowledge and skills appropriate for professional activities and demonstrate highest standards of ethical issues in mathematics.
	Biostatistics is essential to ensure that the knowledge has been incorporated in places such as public health sector and biomedicine to henceforth bring viable solutions that could ease the complexity of biological problems.
	Assessing the impact of chance and variability on the interpretation of research findings and subsequent recommendations for public health practice and policy.
	Biostatistics can be applied in major areas of drug design and discovery for example to evaluate the different hypotheses using ANOVA, t-test, correlation and regression generated during the exercise of computational technique.
Molecular Cell Biology & Genetics (502104)	Describe in general terms how life began on earth and how early scientists important roles in furthering our understanding of cellular life.
	Able to list the organic and inorganic molecules that are necessary for life, further they can easily explain the structure and function of organelles in plant and animal cell.
	They will be proficient listing the similarities and difference animal and plant cell.
	They will be talented in explaining protein synthesis in eukaryotic cells and photosynthetic reaction in chloroplast of plant cells.
	This course completed graduates can able to explain genetic disorders in humans and genes responsible for it.
Lab-I Programming in C and C++ (502105)	Be able to implement, test, debug, and document programs in C and C++.
	Understand low-level input and output routines.
	Program with pointers and arrays, perform pointer arithmetic, and use the pre- processor. Be able to write programs that perform explicit memory management.
	Understand how to write and use functions, how the stack is used to implement function calls, and parameter passing options.
	Understand and use the common data structures typically found in C programs - namely arrays, strings, lists, trees, and hash tables.
	Create programs that measure or simulate performance and use them to analyze behavior.
	Use UNIX commands to manage files and develop programs, including multi-module programs and make files
ELECTIVES –I (502501)	
IPR, Biosafety and Bioethics	Understand the principles, function and basic legal rules of IP Law.
	Recognize the relevant criteria for generating and protecting intellectual works.

	Understand the relevance and impact of IP Law on academic/scientific works/studies.
	Recognize the intellectual property likely to be produced in the academic and professional environment.
	Understand the different forms of violation of intellectual property rights.
	It is expected that students will be more confidant to practice and implement all these policies in their future endeavor.
Fundamentals of Computing	To understand the basics of computer system, its architecture, database and networks.
	To understand the basic concepts, terminology of computer science and familiar with the use of IT tools.
	To learn and explore new IT techniques in various applications and to identify the issues related to security.
	To learn the working knowledge of hardware and software of computer.
	To learn the use of database such as Microsoft access predictive modeling, and identifying new trends and behaviors.
	To learn the various features of MS-office.
	Create, send and receive email.
	Perform basic word processing functions.
	Demonstrate basic file management techniques.
	Use CCRI online tools.
	To familiarize the students with the network devices and the internet.
General Chemistry	Be able to know how the atoms are arranged in molecules and ions
	Be able to differentiate between parent compounds and obtained new compounds
	Be able to name of new chemical compounds
	Be able to address biological problems with chemistry
	Be able to make high potential to contribute academic and industrial environments.
	Be able to recognize the need and obstacles in drug discovery system
	Be able to get innovative idea for mini project work
SEMESTER-II	
Algorithm and Computational Biology (502201)	The student should be able to understand the integration of computer science with genetics and molecular biology.
	Students will create computer programs using the learned algorithms that facilitate bioinformatics.
	Students will interpret relationships among living things and analyze and solve biological problems, from the molecular to ecosystem level using basic biological concepts, grounded in foundational theories.
	Students will be able to conduct basic bioinformatics research and examine the source and underlying principle of large datasets and conclude which molecular processes of living organisms are informed by such data.
	Students will be aware of current research and problems

	relating to this area and will be able to complete a project in bioinformatics using databases, current data analysis techniques and the development of appropriate computer software.
	The student should be able to investigate computational methods for genomic data and analyze metabolomic, proteomics, and protein-protein interaction experiments.
Computational Approaches to Phylogeny (502202)	This course covers the basic methods of phylogenetic analysis and their application in fields such as systematics, comparative biology, and molecular evolution.
	The course will enable students to use computational approaches for phylogenetic analysis.
	Learn to explore and use packages available for molecular phylogeny
	Lectures will emphasize the 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.
	Computer-based labs will give students the opportunity to implement these methods using a variety of phylogenetic software.
Molecular Modeling and Drug Design (502203)	The students would know the steps for designing new drugs, target identification and validation
	They would be able to apply concepts of molecular modeling, quantum and molecular mechanics, bond and bond angles in molecular interactions, energy concepts and its importance in drug action
	They would be able to perform protein structure prediction, loop searching, generating methods and analysis
	They would be able to understand the concepts of molecular dynamics with constant temperature, pressure, time-dependent properties and solvent effects
	They would be able to perform drug designing basis on structure, ligand and de novo, screening types
	They would be able to understand the theory of inhibition and inactivation of enzymes, drug deactivation and susceptibility
Lab – II Molecular Biology and Biochemical Methods (502204)	Carry out various types of practical laboratory work (chemical, biochemical and molecular genetics) in a safe way by means of oral and written laboratory instructions and be able to analyze, interpret and present the results with theoretical background in forms of different laboratory reports.
	Students will explain/describe the synthesis of proteins and nucleic acids their role in metabolic pathways along with their regulation at the epigenetic, transcriptional, translational, and post-translational levels including RNA and protein folding, modification, and degradation. Regulation by non-coding RNAs will be tied to the developmental and physiological functioning of the organism.
	Students will analyze structure-function relationships of genes

	and proteins from bacteria to eukaryotes using genomic methods based on evolutionary relationships.
	Students will use current biochemical and molecular techniques to plan and carry out experiments.
	They will generate and test hypotheses, analyze data using statistical methods where appropriate and appreciate the limitations of conclusions drawn from experimental data.
	Master various methods for gene cloning, mutagen zing DNA and protein sequences.
Lab-III: Programming in PERL and MYSQL (502205)	Perl takes the best features from other languages, such as C, awk, sed, sh, and BASIC, among others.
	Perls database integration interface DBI supports third-party databases including Oracle, Sybase, Postgres, MySQL and others.
	Perl supports both procedural and object-oriented programming
	Perl interfaces with external C/C++ libraries through XS or SWIG.
	Perl is extensible. There are over 500 third party modules available from the Comprehensive Perl Archive Network (CPAN).
ELECTIVES –II (502502)	
Immunology and Immunotechnology	Students will be able to describe the cell mediated and humoral immunity and the role of lymphoid organs in the differentiation and maturation of T and B lymphocytes.
	Students will be able to explain the types of antigens and antibodies. The mechanism of antigen and antibody reaction including agglutination and opsonization.
	Students will be able to describe the hypersensitivity types, immunodeficiency diseases and role of major histocompatibility complex in transplantation reaction.
Data Warehousing and Data Mining	Understand data mining principles and techniques: Introduce DM as a cutting edge business intelligence method and acquaint.
	To understand concepts of Data warehousing, components of data warehousing and design schemas
	To understand the concepts of OLAP and OLAP tools. To understand the clustering methods and apply algorithms to datasets.
	The concepts of mining methods and classification types and apply the algorithms to datasets
	DM techniques for building competitive advantage through proactive analysis, predictive modelling, and identifying new trends and behaviors'.
	Learning how to gather and analyze large sets of data to gain useful business understanding.
	Learning how to produce a quantitative analysis report/memo with the necessary information to make decisions.
	Describing and demonstrating basic data mining algorithms, methods, and tools, Identifying business applications of data mining.

	Overview of the developing areas - web mining, text mining, and ethical aspects of data mining.
	Differentiate database system from file system by enumerating the features provide by database system and describe each in both function and benefit.
Database Management	Describe biological databases and how they are used.
	How to choose an appropriate biological database for a given problem.
	Define Bioinformatics of a genome wide analysis.
	Decide which probabilistic method is the best one for sequence alignment.
	Apply the bioinformatics principles discussed in the design of genome comparison and pattern recognition problems. Critically review bioinformatics research studies and new technologies.
	Students will learn about structure of databases and different types of databases.
	Students will gain knowledge about database management, warehousing and security related issues.
Cell Communication and Cell Signaling	Students will learn about Morphogenesis and organogenesis to describe how cells exploit signaling components to assemble the specific signaling pathways.
	Student will be able to learn components and properties of major cell signaling pathways in control of gene expression and cellular metabolism.
SEMESTER-III	
Principles of Gene Manipulation (502301)	Apply the basic principles of Mendelian genetics to single locus traits.
	Adequate completion of non-graded homework problems in inheritance.
	Participation in class discussion of problems in inheritance.
	Passing grade on midterm/final containing problems in inheritance.
	Recognize mechanisms of gene regulation and differences between prokaryotic and eukaryotic systems.
	Understand the importance of enzymatic processes in maintenance of genetic fidelity.
	Adequate completion of non-graded homework problems in DNA metabolism
	Participation in class discussion of problems in DNA metabolism.
	Passing grade on midterm/final containing problems in DNA metabolism.
	Students will apply the principles of natural selection to problems in population genetics.
	Students will understand the role of various natural DNA alterations in generation of genetic variability.
	Adequate completion of non-graded homework problems in population genetics.
	Participation in class discussion of problems in variability and

	selection.
	Passing grade on midterm/final containing problems in evolution.
	Students will design hypothetical gene cloning experiments.
	Students will understand the molecular basis of regulated gene expression in coordinating biochemical and developmental processes in both unicellular and multicellular organisms.
	Adequate completion of non-graded homework problems in recombinant DNA technology.
	Participation in class discussion of problems in gene manipulation.
	Passing grade on midterm/final containing problems in molecular genetics.
Structural Biology (502302)	To offer new insights on the improved methods available for isolation, purification, and stabilization of native and modified proteins.
	Basic research on crystallization and the development of new methods for crystal manipulation that could lead to novel structure determination that would have immediate contribution to the established structural research communities.
Genomics and Pharmacogenomics (502303)	The goal of the course is to give students an understanding of the principles of human genetics and genomics as they apply to improving the problems in drug therapy optimization and patient care.
	Students completing this course will gain an understanding of how genetic differences between individuals can impact the outcome of drug therapy in a positive and negative way.
	The genetic basis of variability in drug response can contribute to drug efficacy and toxicity, adverse drug reactions and drug-drug interactions.
	Understanding of the basics of Pharmacogenomics will enable students to better understand and manage the new genomics based tools as they become available as well as make best treatment choices.
	It is hoped that by the end of the course, students will be able to read, understand and critique literature regarding Pharmacogenomics.
	In order to achieve its objectives, the course will utilize formal PowerPoint presentations, review of selected current literature, case studies, group discussions, and student presentations.
Lab-IV: Computer Aided Drug Design (CADD) (502304)	The students would be able to perform all the computational methods on their own
	They would be able to explain the concepts of molecular modeling, pharmacophore, virtual screening, molecular docking, 3D QSAR etc.,
	They would be well aware of the advantages and limitations of the available computational tools
	They would be able to analyze the problem which could arise in drug designing methods
PYTHON Programming and	Understand the concepts of object-oriented programming as

Internet Computing (502305)	used in Python: classes, subclasses, inheritance, and overriding. Understand the basics of OO design.
	Have knowledge of basic searching and sorting algorithms, and knowledge of the basics of vector computation. (k)
	Understand principles of Python
	Understand the pros and cons on scripting languages vs. classical programming languages (at a high level)
	Understand how Python can be used for application development as well as quick networking, QA and game programming
	To understand the basic concepts of Internet programming and protocols used
	To create applications using HTML, DHTML, CSS and Java Script.
	To develop applications using SERVELETS and to work with JDBC, Web Databases and XML
ELECTIVES-III (502503)	
Nanotechnology and Advanced drug delivery system	Comprehend the principles behind nanomedicine
	Gain a broad understanding of concepts and applications of nanomedicine
	Impart the knowledge to apply these nano-drug delivery systems for the diagnosis and therapy
	Understand the concepts of nanomedicine to a focused clinical area of their choice
Biosensor	Be able to know how to use bio-molecules as biosensor.
	Be able to analyze what types of material are used for biomedical applications.
	Be able to use multivariate data analysis.
	Be able to design a biosensor system for a specific analyte.
	Be able to understand the importance of biosensors in the medical and environmental fields.
	Be able to estimate the future economic potential of biomedical sensors.
	Be able to realize how to use biosensor in future health care system.
Molecular Interactions	How changes in a DNA nucleotide sequence can result in a change in the polypeptide produced.
	Connection between the sequence and the subcomponents of a biological polymer and its properties.
	Predict and justify that changes in the subcomponents of a biological polymer affect the functionality of the molecule.
	Evaluate scientific questions of the concerning organisms that exhibit complex properties due to the interaction of their constituent parts.
	Define representations and models that illustrate the interactions between biochemistry, parts and reactions.
	Analyze data to identify how molecular interactions affect structure and function.
	Explanations based on evidence of how variation in molecular units provides cells with a wider range of functions.

	Describes the relationship between enzyme structure and function
	Predict the effect of various environmental conditions/changes to the function of enzymes.
	Determine the biologically important factors affecting enzyme activity.
Introduction to Neural Networks	To introduce the neural networks for classification and regression.
	To give design methodologies for artificial neural networks.
	To provide knowledge for network tuning and over fitting avoidance.
	To offer neural network implementations in Mat lab.
	To demonstrate neural network applications on real-world tasks.
Employability Skills	This course trains the students to compete in an interview with the important skill sets that are required to lead a successful corporate life carrier and excel in it.
SEMESTER-IV	
Omics and System Biology (502401)	Describe the development of Omics technologies, with emphasis on genomics and proteomics.
	To synthesize information to discuss the key technological developments that enabled modern genomic and proteomic studies.
	Describe advanced genomics and proteomics technologies and the ways in which their data are stored.
	To use bioinformatics techniques to query examples of genomic and proteomic databases to analyze cell biology.
	Describe the different types of genome variation and their relationship to human diseases.
	Discuss how biological systems information relating to the genes, proteins and cellular structures can be used to model living cells, and even to create new synthetic cells.
	Omics science provides global analysis tools to study entire systems.
	Understand the principles of integrative analysis methods for biological system analysis and interactions.
	Implement database search and suits for –omics.
	Manage to analyze complex protein samples.
Lab VI-Small and Macromolecular Crystallography (502402)	Design the process steps leading to determination of crystal structures of small and macro molecules.
	Define what a crystal is and describe the differences in properties of molecular and macro molecular crystals.
	Explain the differences between crystallization of small molecules and macromolecules; choose proper methods for protein crystallization. Analyze crystallization experiments under a polarization microscope.
	Characterize X-ray sources and types of detectors, explain a diffraction experiment based on the Evald construction, process diffraction images, and validate data.
	Characterize methods of phase problem solving and choose

	proper methods for molecular and macromolecular structures.
	Build protein models based on experimental electron density maps and know procedures of map improvement. Explain algorithms for automatic model building.
	Define electron density maps and choose the proper algorithms for structure refinement. Use specific crystallographic software for structure visualization and refinement. Validate the final structures.
ELECTIVES- IV (502504)	
Big data analysis and Next Generation Sequencing	The student should be able to understand basic use of R statistical package in biological data
	The student will have the capacity to comprehend the ideas of Genome projects of model organisms , Next Generation Sequencing technology
	The students will be able to demonstrate Microarray data analysis, Genome-wide annotation methods; identification of synteny between various genomes and challenges
	The students will be able to analyze SNPs, SNVs, translocation, copy number variation, Concepts and algorithms to measure transcriptional regulation
	The student should understand the Differential expression analysis of gene, the statistical methods on rare variants
General Microbiology	Knowledge on historical perspective of Microbiology
	Basic knowledge on different structure of microbes
	Differentiate the morphology of different algae and fungi
	Ideas on different type of microscope
Open Source in Bioinformatics	Access and browse structural data repositories to find out whether appropriate structural information exists, together with the use of structure- quality information.
	Use a range of tools to perform data analyses.
	Construct a structural model for a protein having a structurally characterized relative and assess its quality.
	Examine the prospective impact of genetic variation on a structure.
	Establish the potential function of a protein based on sequence and structure data.
	Gain knowledge about tools and resources for drug discovery.
	Submit data to public resources for metagenomics.
	Discuss the drawbacks and challenges in the field.
Biodiversity, Agriculture, Ecosystem, Environment and Medicine	Describe major social, cultural, and bio-behavioral patterns of health and health behavior in community settings.
	Explain causes and consequences of leading health behaviors, including tobacco exposure, dietary patterns, physical activity, alcohol consumption, and sexual practices.
	Illustrate major theories of health and social behavior, e.g., social learning theory and stages-of-change model, and their application in the conduct of research and practice in public health.
	Portray basic research from epidemiology and public health on

	leading health conditions.
	A good understanding of inter-relationship between climate change, environment, food security and sustainability at global and regional (India) level.
	To understand the concept of food security and issues in achieving it.
	Understand ways of adapting to climate change and managing the environment keeping in mind food security and sustainability.
	Students can explain fundamental principles of evolutionary theory, and then use this knowledge to explore the evolution of biodiversity on earth.
	By the end of the course, students will be familiar with the major groups of organisms, including when they arrived on earth and how they are related to one another. Students will also learn basic ecological theory and begin to use these principles in understanding and proposing solutions to the major environmental problems facing the biosphere.
Project work (502999)	Analyze, interpret, and participate in reporting to their peers on the results of their laboratory experiments.
	Participate in and report orally on team work investigations of problem-based assignments.
	Build on their knowledge and understanding in tackling more advanced and specialized courses, and more widely to pursue independent, self-directed and critical learning.
	Formulate hypotheses based on current concepts in the field and design, conduct, and interpret their own research projects.
	Present research results in peer-reviewed publications and in a dissertation.
	Communicate research results effectively through oral presentations at scientific seminars, conferences, and other venues.
	Write a competitive application for research funding.
	Develop ancillary skills, where necessary, to obtain positions outside of scientific research.

S. No.	Program outcomes		Program specific outcomes
	Name of the Program	Outcome	
2.	M.Phil Bioinformatics	To comprehend the scope and concepts of Structural Biology, CADD, Structural Pharmacogenomics and Structural Bioinformatics that will provide a profound impact on Scientific research.	Some of the major pharmaceutical and drug companies' highering biotechnological professionals include Dabur, Ranbaxy, Hindustan Lever and Dr Reddy's Labs, food processing industries, chemical industry and textile industry as well. Beside this industries also employ bio-technological professionals in their marketing divisions to boostup business in sectors where their products would be required.
		To build libraries of therapeutic interests for screening purposes after the target of interest has been identified (Structural and Functional aspects) thereon to propose a lead molecule with modifications that could enrich the drug-likeness for human uses which tend to be specific based on molecular fingerprints of human.	
		Key information for one's research purposes can be obtained from the knowledgebase that is built using structured programming languages	Several career opportunities are available for students with biotechnology background abroad especially in countries like Germany, Australia, Canada, USA and many more where biotechnology is a rapidly developing field.
		To understand and review the relative effectiveness among the different methods and techniques in Structural Biology, Drug Discovery and Pharmacogenomics	

Course outcomes (M.Phil Bioinformatics)	
SEMESTER-I	
Name of the Course	**Outcome**
Research Methodology in Bioinformatics (505101)	Applying statistical techniques for data analysis: measurement of standard deviation, dispersion and regression analysis.
	Understand intellectual property rights and patent profiling
	Learn sequence analysis methods and tools used for gene prediction.
	Student will learn to draw chemical structures and the uses of molecular modeling tools and their applications.
	Learn the concept of graphs, vector algebra and matrices.
	Phylogenetic tree construction and application of phylogenetic analysis in evolutionary studies
Advanced Topics in Bioinformatics (505102)	Transform raw data into meaningful information by applying computational techniques.
	Read, understand and create biological databases and gene network/maps.
	Study the behavior and properties of molecular systems. Specifically, the techniques employed in the fields of computational biology and chemistry.
	Study of RNA, in any of its forms and expression profiling, examines the expression level of mRNAs based on DNA microarray technology.
	Describe and understand the operation of complex biological systems and ultimately to develop predictive models of human disease.
	Gain knowledge in computer simulations.
General Skills in Science (505103)	Develop more effective English language communication skills
	Identifies hardware components, starts an application and create a document.
	Creates a simple slide show, recognizes the elements of a multi-media presentation
	Understands the general structure of an email address
	Use new technologies of teaching methods.
	Write scientific reports, note-making, journal paper, review etc.
SEMESTER-II	
Research Area Specialization (505104)	To offer new insights on the improved methods available for isolation, purification, and stabilization of native and modified proteins.
	Define electron density maps and choose the proper algorithms for structure refinement. Use specific crystallographic software for structure visualization and refinement. Validate the final structures.
	Explicate about interactions that modulate protein-protein complexes (small-molecule, nucleic acids, biomolecules) which later on can be designed as therapeutic markers
	The capacity to pertain the ideas of identifying and validating the target, structure and ligand based methods,

	modelling of the target – small molecule interaction, Molecular dynamics simulation, Structure activity relationships, Quantum and Molecular mechanics.
	They will find it easy for the understanding of the Molecular Dynamics simulation using the simple models, continuous potentials at constant temperature and pressure
	Explain the principles/steps required for cloning, PCR, sequencing, RT-PCR and blotting techniques.
	Use bioinformatics to search a genome database, annotate the structure of a gene, find mutations in it, identify encoded proteins, compare protein sequences and propose gene/protein functions.
	Will be able to study the importance of chromatography and thermal analysis.
	Will be able to find the materials properties and progress of chemical reactions
	Will be able to separation of individual chemical substance
Dissertation (505999)	To comprehend the scope and concepts of Structural Biology, CADD, Structural Pharmacogenomics and Structural Bioinformatics that will provide a profound impact on scientific research.
	To build libraries of therapeutic interests for screening purposes after the target of interest has been identified (structural and functional aspects) thereon to propose a lead molecule with modifications that could enrich the drug-likeness for human use which tend to be specific based on molecular fingerprints of human.
	Key information for one's research purposes can be obtained from the knowledgebase that is built using structured programming languages.
	To understand and review the relative effectiveness among the different methods and techniques in Structural biology, Drug discovery and Pharmacogenomics.

S. No.	Program outcomes		Program specific outcomes
	Name of the Program	Outcome	
3.	PhD Bioinformatics	To familiarize and manage with the structure determination process in order to deduce the structure and functionality aspects hence to decipher the mechanism of action in a biological phenomenon	Ability to understand the biological problem at hand and device appropriate computational/bioinformatic strategies to solve it and interpret the results.
		To develop potential leads of desired therapeutic indices that could be obtained from computational combinatorial screening and also the techniques of the identification process are evolving and keeping up with the change is much appreciated.	
		To propose, plan and manage well defined research and design projects involving a team individuals followed by reasoned interpretation and critically assess existing theories and models within this field of specialization	
		To be familiar with the publication process of scientific results and be able to select the appropriate publication outlets for articles reporting on their research work.	

Course outcomes (PhD Bioinformatics)	
Name of the Course	**Outcome**
Research Methodology (15611)	Applying statistical techniques for data analysis: measurement of standard deviation, dispersion and regression analysis.
	Understand intellectual property rights and patent profiling.
	Learn sequence analysis methods and tools used for gene prediction.
	Student will learn to draw chemical structures and the uses of molecular modeling tools and their applications.
	Learn the concept of graphs, vector algebra and matrices.
	Phylogenetic tree construction and application of phylogenetic analysis in evolutionary studies
Proteomics and Chemoinformatics (15612)	Learn the organization of protein structure and methods of protein structure determination
	Understanding conformations of protein and multienzyme complex
	Distinguish the various types of descriptors that describe the topology of a compound in order to apply quantum based approaches to the biological system
	Knowledge of molecular descriptors and calculation of physical and chemical data
	Novel approaches of drug designing and pharmacokinetics action of drug on human body
	Aptly choose the appropriate force field to simulate a biological complex
	Feasibility to perform drug design and proceed to pharmacological testing/analysis
Structural biology & Bio-Computing (15613)	Design the process steps leading to determination of crystal structures of small and macro molecules.
	Define what a crystal is and describe the differences in properties of molecular and macro molecular crystals.
	Explain the differences between crystallization of small molecules and macromolecules; choose proper methods for protein crystallization.
	Characterize methods of phase problem solving and choose proper methods for molecular and macromolecular structures.
	Define electron density maps and choose the proper algorithms for structure refinement. Use specific crystallographic software for structure visualization and refinement. Validate the final structures.
	Explicate about interactions that modulate protein-protein complexes (small-molecule, nucleic acids, biomolecules) which later on can be designed as therapeutic markers
	Learn the concept of computer networking
	Writing codes for biological data analysis.
Molecular Modeling and Structural Bioinformatics (15613 B)	The student would be able to identify the steps for designing new drugs, target identification and validation
	They would acquire the capacity to apply the ideas of atomic displacement, Quantum and Molecular Mechanics,

	bonded interactions, hydrogen bondings and its significance in the application of drug development
	They would be able to execute protein structure prediction and would be able to predict the derivatives of the molecular mechanics energy function
	They will find it easy for the understanding of the Molecular Dynamics simulation using the simple models, continuous potentials at constant temperature and pressure
	They will be very capable to present the docking strategies based on the ligand, receptor and de novo ligand design.
	Understanding of the combinatorial chemistry and library design, virtual screening and compound filtering.
	They would be able to understand the theory of inhibition and inactivation of enzymes, drug deactivation and susceptibility
Pharmacogenomics And Phylogenetics (15613 C)	The goal of the course is to give students an understanding of the principles of human genetics and genomics as they apply to improving the problems in drug therapy optimization and patient care.
	Students completing this course will gain an understanding of how genetic differences between individuals can impact the outcome of drug therapy in a positive and negative way.
	The genetic basis of variability in drug response can contribute to drug efficacy and toxicity, adverse drug reactions and drug-drug interactions
	Understanding of the basics of Pharmacogenomics will enable students to better understand and manage the new genomics based tools as they become available as well as make best treatment choices.
Dissertation	Research on crystallization and the development of new methods for crystal manipulation that could lead to novel structure determination that would have immediate contribution to the established structural research communities.
	Develop potential leads of desired therapeutic indices that could be obtained from computational combinatorial screening and also the techniques of the identification process are evolving and keeping up with the change is much appreciated.
	Build libraries of therapeutic interests for screening purposes after the target of interest has been identified (structural and functional aspects) thereon to propose a lead molecule with modifications that could enrich the drug-likeness for human use which tend to be specific based on molecular fingerprints of human.
	Key information for one's research purposes can be obtained from the knowledgebase that is built using structured programming languages.
	Propose, plan and manage well defined research and design projects involving a team of individuals followed by

	reasoned interpretation and critically assess existing theories and models within his field of specialization.
	Familiar with the publication process of scientific results and be able to select the appropriate publication outlets for articles reporting on their research work.

S. No.	Program outcomes		Program specific outcomes
	Name of the Program	Outcome	
4.	PG Diploma in Structural Pharmacogenomics	To create personnel's well trained in structural pharmacogenomics with not only tools to build what tomorrow will be but also with the knowledge of the today they must work in	To provide interdisciplinary theory, knowledge of computational and statistical biosciences.
		To develop drugs with better selectivity and potency by utilizing from the knowledge obtained at the end of the course	To give the theory and experimental insights to interactions between small chemical compounds and bio-molecules such as proteins and nucleic acids.
		To develop an interactive network of investigators that elevates the field of Structural Pharmacogenomics with the knowledge, tools and resources	To identify suitable leads against targets responsible disease through the computational modern tools.
		To enhance the practical experience with theoretical concept in the apprentice	

Course outcomes (PG Diploma in Structural Pharmacogenomics)	
Name of the Course	**Outcome**
Molecular Cell Biology & Genetic Engineering (510101)	Describe in general terms how life began on earth and how early scientists important roles in furthering our understanding of cellular life.
	Technical know-how on versatile techniques in recombinant DNA technology.
	Able to list the organic and inorganic molecules that are necessary for life, further they can easily explain the structure and function of organelles in plant and animal cell.
	An understanding on application of genetic engineering techniques in basic and applied experimental biology.
	Proficiency in designing and conducting experiments involving genetic manipulation.
	They will be proficient listing the similarities and difference animal and plant cell.
	They will be talented in explaining protein synthesis in eukaryotic cells and photosynthetic reaction in chloroplast of plant cells.
	This course completed graduates can able to explain genetic disorders in humans and genes responsible for it.
Pharmacoenomics (510102)	Students completing this course will gain an understanding of how genetic differences between individuals can impact the outcome of drug therapy in a positive and negative way.
	The genetic basis of variability in drug response can contribute to drug efficacy and toxicity, adverse drug reactions and drug-drug interactions
	Understanding of the basics of Pharmacogenomics will enable students to better understand and manage the new genomics based tools as they become available as well as make best treatment choices.
	It is hoped that by the end of the course, students will be able to read, understand and critique literature regarding Pharmacogenomics.
Small and Macromolecular X-ray Crystallography (510103)	Design the process steps leading to determination of crystal structures of small and macro molecules.
	Define what a crystal is and describe the differences in properties of molecular and macro molecular crystals.
	Explain the differences between crystallization of small molecules and macromolecules; choose proper methods for protein crystallization.
	Characterize methods of phase problem solving and choose proper methods for molecular and macromolecular structures.
	Define electron density maps and choose the proper algorithms for structure refinement. Use specific crystallographic software for structure visualization and refinement. Validate the final structures.
	Explicate about interactions that modulate protein-protein complexes (small-molecule, nucleic acids, biomolecules)

	which later on can be designed as therapeutic markers
Molecular Modeling and Drug Designing (510104)	The students would understand the means for designing new drugs, target identification and validation
	They would be able to observe ideas of molecular modeling, quantum and molecular mechanics, bond and bond angles in molecular interactions, energy principles and its significance in drug action
	They would be able to perform QSAR, Pharmacophore modeling, Virtual Screening, binding site prediction and molecular Docking
	They would have the capacity to comprehend the ideas of molecular dynamics with consistent temperature, weight, time-subordinate properties and solvent effects
	They would be able to perform drug designing basis on structure, ligand and *de novo*, screening types, ADME calculation and clinical trials
	They would be capable to understand the difference between the *in silico* and *in vitro* drug designing
ELECTIVES-I (510501)	
Fundamentals of Computing	To understand the basics of computer system, its architecture, database and networks.
	To understand the basic concepts, terminology of computer science and familiar with the use of IT tools.
	To learn and explore new IT techniques in various applications and to identify the issues related to security.
	To learn the working knowledge of hardware and software of computer.
	To learn the use of database such as Microsoft access predictive modelling, and identifying new trends and behaviour's.
	To learn the various features of MS-office.
	Create, send and receive email.
	Perform basic word processing functions.
	Demonstrate basic file management techniques.
	Use CCRI online tools.
	To familiarize the students with the network devices and the internet.
Sequence Analysis	The student should be able to understand basic research methods in bioinformatics.
	The student will choose biological data, submission and retrieval it from databases and design databases to store the information.
	The students will be able to demonstrate the most important bioinformatics databases, perform text- and sequence-based searches, and analyze the results in light of molecular biological knowledge.
	The students will be able to experiment pair wise and multiple sequence alignment and will analyze the secondary and tertiary structures of protein sequences.
	The student should understand the 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.
Immunoinformatics	Have knowledge of immune responses to various pathogens by integrating genomics and proteomics with bioinformatics strategies.
	Proficient in computer aided vaccine design.
	Talented in explaining the immune system, its components and their functions
	Explain the study informatics-based approaches for prediction of epitopes, design of vaccines and immuno-diagnostic tools
	Continue to acquire and explore sequence and structural databases relevant in the area of immunology.
	Explore sequence and structural features of antibodies using computational tool
	Characterize and understand principles of antigen-antibody interactions.
	Explain algorithms and methods for prediction of epitopes.
	Explore and use approaches for vaccine design.
	Explain the structure and function of an antibody/B cell receptor.
	Identify the used germ-line genes in a final rearrangement of antibody encoding genes.
	Use web based methods to assembe genomes and predict proteomes from next generation sequence data and describe the background for this.
	Construct a phylogenetic tree from related nucleotide sequences using the PAUP program, and identify positively selected sites by likelihood ratio testing on a suitable set of alternative models, as implemented in the program PAML.
Lab I Computer Aided Drug Designing (510105)	The student would be able to identify the steps for designing new drugs, target identification and validation
	They will find it easy for the understanding of the Molecular Dynamics simulation
	They will be very capable to present the docking strategies based on the ligand, receptor and de novo ligand design.
	Understanding of the ADME prediction, visualization tools, Pharmacophores and sequence analysis
	They would have the capacity to comprehend the Finger print searching, QSAR and Biological database usage.
Lab-II Structural Biology (510106)	Design the process steps leading to determination of crystal structures of small and macro molecules.
	Define what a crystal is and describe the differences in properties of molecular and macro molecular crystals.
	Explain the differences between crystallization of small molecules and macromolecules; choose proper methods for protein crystallization.
	Characterize methods of phase problem solving and choose

	proper methods for molecular and macromolecular structures.
	Define electron density maps and choose the proper algorithms for structure refinement. Use specific crystallographic software for structure visualization and refinement. Validate the final structures.
	Explicate about interactions that modulate protein-protein complexes (small-molecule, nucleic acids, biomolecules) which later on can be designed as therapeutic markers
SEMESTER-II	
Dissertation Work (510999)	To create personnel(s) well trained in structural pharmacogenomics with not only tools to build what tomorrow will be but also with the knowledge of the today they must work in.
	To develop drugs with better selectivity and potency by utilizing from the knowledge obtained at the end of the course
	To develop an interactive network of investigators that elevates the field of Structural Pharmacogenomics with the knowledge, tools and resources.
	To enhance the practical experience with theoretical concept in the apprentice.

S. No.	**Program outcomes**		**Program specific outcomes**
	Name of the Program	**Outcome**	
5.	PG Diploma in Bioinformatics	To create personnel(s) well trained in Bioinformatics with not only tools to build what tomorrow will be but also with the knowledge of the today they must work in.	Interpret correctly the outputs from tools used to analyze biological data and make meaningful predictions from these outputs.
		To support existing demands and anticipate exciting new developments at the crossroads of computational and biomedical science.	Survey a selected field within Bioinformatics, synthesize information from primary literature, and coherently report your findings in a written document
		To provide competence in computational biology/bioinformatics through lectures and practical training in the areas of basic biology, computer science, statistics and bioinformatics, to graduates from diverse backgrounds.	Explain the basic principles that underpin Bioinformatics analyses, and apply these principles when analyzing biological data

Course outcomes (PG Diploma in Bioinformatics)	
Name of the Course	**Outcome**
Introduction to Bioinformatics (247101)	The student should be able to understand basic research methods in Bioinformatics.
	The student will choose biological data, submission and retrieval it from databases and design databases to store the information.
	The students will be able to demonstrate the most important Bioinformatics databases, perform text- and sequence-based searches, and analyze the results in light of molecular biological knowledge.
	The students will be able to experiment pair wise and multiple sequence alignment and will analyze the secondary and tertiary structures of protein sequences.
	The student should understand the 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.
	The student should be able to carry out gene and protein expression patterns and modeling cellular interactions and processes.
Basics of Computer and C Programming (247102)	To understand the basics of computer system, its architecture, database and networks.
	To understand the basic concepts, terminology of computer science and familiar with the use of IT tools.
	To familiarize the students with the network devices and the internet.
	Be able to implement, test, debug, and document programs in C and C++.
	Understand and use the common data structures typically found in C programs - namely arrays, strings, lists, trees, and hash tables.
	Program with pointers and arrays, perform pointer arithmetic, and use the pre- processor. Be able to write programs that perform explicit memory management.
Introduction to Molecular and Structural Biology (247103)	Describe in general terms how life began on earth and how early scientists important roles in furthering our understanding of cellular life.
	Able to list the organic and inorganic molecules that are necessary for life, further they can easily explain the structure and function of organelles in plant and animal cell.
	To offer new insights on the improved methods available for isolation, purification, and stabilization of native and modified proteins.
	Basic research on crystallization and the development of new methods for crystal manipulation that could lead to novel structure determination that would have immediate contribution to the established structural research communities.
	The students would understand the means for designing new drugs, target identification and validation
ELECTIVES-I (247501)	

Computational Biology and Chemistry	The student should be able to understand the integration of computer science with genetics and molecular biology.
	Students will create computer programs using the learned algorithms that facilitate bioinformatics.
	Students will interpret relationships among living things and analyze and solve biological problems, from the molecular to ecosystem level using basic biological concepts, grounded in foundational theories.
	Students will be able to conduct basic bioinformatics research and examine the source and underlying principle of large datasets and conclude which molecular processes of living organisms are informed by such data.
	Students will be aware of current research and problems relating to this area and will be able to complete a project in bioinformatics using databases, current data analysis techniques and the development of appropriate computer software.
	Be able to address biological problems with chemistry
	Be able to make high potential to contribute academic and industrial environments.
	Be able to recognize the need and obstacles in drug discovery system
	Be able to get innovative idea for mini project work
Lab-I Bioinformatics (247105)	The student should be able to understand basic research methods in Bioinformatics.
	The student will choose biological data, submission and retrieval it from databases and design databases to store the information.
	The students will be able to demonstrate the most important bioinformatics databases, perform text- and sequence-based searches, and analyze the results in light of molecular biological knowledge.
	The students will be able to experiment pair wise and multiple sequence alignment and will analyze the secondary and tertiary structures of protein sequences.
	The student should understand the 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.
SEMESTER-II	
Computer Aided Drug Designing (247201)	The student would be able to identify the steps for designing new drugs, target identification and validation
	They will find it easy for the understanding of the Molecular Dynamics simulation
	They will be very capable to present the docking strategies based on the ligand, receptor and de novo ligand design.
	Understanding of the ADME prediction, visualization tools, Pharmacophores and sequence analysis
	They would have the capacity to comprehend the Finger print

	searching, QSAR and Biological database usage.
ELECTIVE-II (247502)	
Open Source in Bioinformatics	Access and browse structural data repositories to find out whether appropriate structural information exists, together with the use of structure- quality information.
	Use a range of tools to perform data analyses.
	Construct a structural model for a protein having a structurally characterized relative and assess its quality.
	Examine the prospective impact of genetic variation on a structure.
	Establish the potential function of a protein based on sequence and structure data.
	Gain knowledge about tools and resources for drug discovery.
	Submit data to public resources for metagenomics.
	Discuss the drawbacks and challenges in the field.
Lab-II Bioinformatics (247202)	The student would be able to identify the steps for designing new drugs, target identification and validation
	They will find it easy for the understanding of the Molecular Dynamics simulation
	They will be very capable to present the docking strategies based on the ligand, receptor and *de novo* ligand design.
	Understanding of the ADME prediction, visualization tools, Pharmacophores and sequence analysis
	They would have the capacity to comprehend the Finger print searching, QSAR and Biological database usage.
	To understand the different tools and open sources available to solve three dimensional structures of macromolecules and its subsequent valication
Dissertation Work (247999)	To create personnel(s) well trained in Bioinformatics with not only tools to build what tomorrow will be but also with the knowledge of the today they must work in.
	To develop drugs with better selectivity and potency by utilizing from the knowledge obtained at the end of the course
	To develop an interactive network of investigators that elevates the field of Bioinformatics with the knowledge, tools and resources.
	To enhance the practical experience with theoretical concept in the apprentice.
ELECTIVES	
IPR, Biosafety and Bioethics	Understand the principles, function and basic legal rules of IP Law.
	Recognize the relevant criteria for generating and protecting intellectual works.
	Understand the relevance and impact of IP Law on academic/scientific works/studies.
	Recognize the intellectual property likely to be produced in the academic and professional environment.
	Understand the different forms of violation of intellectual property rights.

	It is expected that students will be more confidant to practice and implement all these policies in their future endeavor.
Database Management	Describe biological databases and how they are used.
	How to choose an appropriate biological database for a given problem.
	Define Bioinformatics of a genome wide analysis.
	Decide which probabilistic method is the best one for sequence alignment.
	Apply the bioinformatics principles discussed in the design of genome comparison and pattern recognition problems. Critically review bioinformatics research studies and new technologies.
	Students will learn about structure of databases and different types of databases.
	Students will gain knowledge about database management, warehousing and security related issues.
Biodiversity, Agriculture, Ecosystem, Environment and Medicine	Describe major social, cultural, and bio-behavioral patterns of health and health behavior in community settings.
	Explain causes and consequences of leading health behaviors, including tobacco exposure, dietary patterns, physical activity, alcohol consumption, and sexual practices.
	Illustrate major theories of health and social behavior, e.g., social learning theory and stages-of-change model, and their application in the conduct of research and practice in public health.
	Portray basic research from epidemiology and public health on leading health conditions.
	A good understanding of inter-relationship between climate change, environment, food security and sustainability at global and regional (India) level.
	To understand the concept of food security and issues in achieving it.
	Understand ways of adapting to climate change and managing the environment keeping in mind food security and sustainability.
	Students can explain fundamental principles of evolutionary theory, and then use this knowledge to explore the evolution of biodiversity on earth.
	By the end of the course, students will be familiar with the major groups of organisms, including when they arrived on earth and how they are related to one another. Students will also learn basic ecological theory and begin to use these principles in understanding and proposing solutions to the major environmental problems facing the biosphere.
Introduction to Computational Biology & Chemistry	The student should be able to understand the integration of computer science with genetics and molecular biology.
	Students will create computer programs using the learned algorithms that facilitate bioinformatics.
	Students will interpret relationships among living things and analyze and solve biological problems, from the molecular to

	ecosystem level using basic biological concepts, grounded in foundational theories.
	Students will be able to conduct basic bioinformatics research and examine the source and underlying principle of large datasets and conclude which molecular processes of living organisms are informed by such data.
	Students will be aware of current research and problems relating to this area and will be able to complete a project in bioinformatics using databases, current data analysis techniques and the development of appropriate computer software.
	Be able to address biological problems with chemistry
	Be able to make high potential to contribute academic and industrial environments.
	Be able to recognize the need and obstacles in drug discovery system
	Be able to get innovative idea for mini project work
Cell Communication and Cell Signaling	Students will learn about Morphogenesis and organogenesis to describe how cells exploit signaling components to assemble the specific signaling pathways.
	Student will be able to learn components and properties of major cell signaling pathways in control of gene expression and cellular metabolism.
Commercial Applications of Bioinformatics	The student would be able to identify the steps for designing new drugs, target identification and validation
	To develop an interactive network of investigators that elevates the field of Bioinformatics with the knowledge, tools and resources.
	To enhance the practical experience with theoretical concept in the apprentice.
	Be able to make high potential to contribute academic and industrial environments.
	Be able to recognize the need and obstacles in drug discovery system
	Be able to get innovative idea for mini project work
Introduction to Neural Networks	To introduce the neural networks for classification and regression.
	To give design methodologies for artificial neural networks.
	To provide knowledge for network tuning and over fitting avoidance.
	To offer neural network implementations in Mat lab.
	To demonstrate neural network applications on real-world tasks.