

KARNATAKA STATE AKKAMAHADEVI WOMEN'S UNIVERSITY, VIJAYAPURA

POSTGRADUATE PROGRAM IN BIOINFORMATICS (M.Sc. BIOINFORMATICS)

Programme Outcome

PO1. Provide education that helps to understand the fundamental and advanced concepts in the relevant field and prepare the students to communicate it effectively.

PO2. Instigate confidence to develop hypothesis, design experiments and interpret the results.

PO3. Prompt the students to work individually and synergistically.

PO4. Enable students to think independently and critically.

PO5. Make the students competent to identify their field of interest and find suitable employment in Industry and academia.

Programme Specific Outcome

The postgraduate program in Bioinformatics (MSc Bioinformatics) offers science graduates a conceptual understanding of the objectives and limitations of both computer and biological sciences disciplines, along with the knowledge to make use of computational tools for acquisition, storage, analysis and visualization of biological data. This way the program essentially aims to be a solid stepping stone for a career either in academia or in industries involved in the R&D of biomedicine, environment, food, beverage, etc. The first two semesters, along with the basics of bioinformatics and programming concepts, focus on introductory courses on cell and molecular biology, microbiology, immunology, biochemistry, biophysics, perl, python, bioinstrumentation, statistics, R-programming, genomics and proteomics to bring uniformity in foundation across students from diverse disciplines, such as biology, physics, chemistry, computer science, engineering, etc. The third semester deals with critically advanced areas of bioinformatics such as systems biology, drug designing, genetic engineering, protein engineering, artificial intelligence, image processing, sequence analysis, medical bioinformatics, along with entrepreneurship and start-up enlighten them with cutting-edge topics, e.g. systems biology, next generation sequencing data analysis, computational neuroscience, metagenomics and microbiome, big data solutions in bioinformatics, etc. Each of these subjects individually has the capacity to lead the students toward their excellence in academic or industrial research and product development. The specific interest of every student is further nourished through the final dissertation semester in the student's selected area of research, either under the supervision of in-house faculty members or in high-quality research labs outside in India, thereby making the candidate ready for the world in the field of bioinformatics.

M.Sc(Bioinformatics) I Semester Syllabus Under CBCS (w.e.f. 2020-21 and onwards)

Course Code	Course Name	Course Objectives	Course Learning Outcomes
BI. HCT-1.1	Cell and Molecular Biology	To provide the knowledge about cell, cell division, DNA replication, Transcription, translation, cell communication, cell signaling, mutations, etc. these concepts will helpful to understand the biology in molecular level and it is essential for bioinformatics.	Students completing this course will have understanding of complete basics of cell and molecular biology it will helps in understanding the concepts of bioinformatics in further semester.
BI. HCP-1.2	Cell and Molecular Biology lab	From this lab students will learn the different experiments of cell and molecular biology such as chromatography, mitosis and meiosis, isolation of DNA's, etc.	<ul style="list-style-type: none"> • Students will get hands on experiments to study the different cellular and molecular biology techniques. • They will understand chemical preparations and types of isolations and analysis.
BI. HCT-1.3	C-Programming and C++	To introduce the students about basic programming languages like c and c++ in the field of bioinformatics.	<ul style="list-style-type: none"> • Students will understand about programming languages and concepts of c and c++. • Student will gain the knowledge how to write the programs of c and c++.
BI. HCP-1.4	C-Programming and C++ lab	This lab will aid in understanding and learning the basics of C and C++ programs and how to write some biological programs using C and C++.	<ul style="list-style-type: none"> • Students will understand how to write the C and C++ basic programs, flowcharts and algorithms. • Students will get idea about how the biological problems can be solving by writing the programs.
BI. HCT-1.5	Fundamentals of Bioinformatics	To provide the knowledge about computer system, working processor of computer, operating systems. Introducing the bioinformatics and different biological databases	<ul style="list-style-type: none"> • Students will able to understand working with computer system. • They able to understand bioinformatics, Biologically Data Acquisition and biological databases, sequential file formats. • They will also understand how the

			biological data can be access, retrieval and submission of sequences to databases.
BI. HCP-1.6	Fundamentals of Bioinformatics lab	This lab will proved the knowledge about accessing, retrieving and analysis of different biological information through database.	<ul style="list-style-type: none"> • Students can access different type of search engines and biological databases such as Entrez and literature searches, SRS of biological databases, sequence analysis databases. • They can also work with some biological software's and visualization tools to understand the structure of biomolecules.
BI. SCT-1.7	BI. SCT-1.7.1 Biostatistics and R-Programming	<ul style="list-style-type: none"> • To introduce the statistics in bioinformatics, basic concepts of statistics used to analyze the biological data. • Introducing R programming for management of the biological data analysis. 	<ul style="list-style-type: none"> • Students will understand the role of statistics in biology and different types of methods like classification, tabulation, Measures of central tendencies, measures of dispersion, bivariate statistical methods, time variables and concept of probability. • Students get idea about how to analyse the biological data by different types of statistical methods and graphs using R-programming.
	BI. SCT-1.7.2 Structural Bioinformatics	To provide knowledge about structural aspects of biomolecules such as nucleic acids and proteins and also explains the methods to predict the structure	<ul style="list-style-type: none"> • Students will understand the structural features of proteins and nucleic acids and proteins. • Students will also understand the molecular interactions and methods to predict the structures of biomolecules
	BI. SCT-1.7.3 Bioinstrumentation	This course provides the knowledge about Chromatographic techniques and Mass spectrometry, Electrophoresis, Flowcytometry, Microscopy, Spectroscopy, Omics technologies.	Students will get clear idea about bioinstruments such as Chromatographic techniques and Mass spectrometry, Electrophoresis, Flowcytometry, Microscopy, Spectroscopy, Omics technologies.
BI. SCP-1.8	BI. SCP-1.8.1 Biostatistics and R-Programming	<ul style="list-style-type: none"> • This lab will help the student to produce diagrammatical and graphical representation of data and different statistical problems can be solved with example problems. 	<ul style="list-style-type: none"> • Students will understands how the biological data can be represented through diagrammatically and graphically. • Understand how to use R- programming in

		<ul style="list-style-type: none"> Use of R-software and writing R programs based on our requirement data analysis like measures of central tendency, dispersion, probability and correlation and regression analysis. 	solving and analyzing biological data.
	BI. SCP-1.8.2 Structural Bioinformatics	This lab will helps the students to understand how to work with Structural prediction software's and databases	From this lab students will able to handle variety of tools, databases and software's of Structure prediction of proteins and nucleic acids and molecular interaction.
	BI. SCP-1.8.3 Bioinstrumentation	This lap will provides hands on training of Column chromatography, Estimation of Nucleic Acid and Protein through spectrophotometer, Electrophoresis of DNA and Protein, Observation of Cell Morphology and Cell division under inverted microscope, Demonstration of Conventional and Real time PCR for gene amplification, etc	From this lab students will able to hand all the bioinstruments and students will get hands on training of Column chromatography, Estimation of Nucleic Acid and Protein through spectrophotometer, Electrophoresis of DNA and Protein, Observation of Cell Morphology and Cell division under inverted microscope, Demonstration of Conventional and Real time PCR for gene amplification, etc
BI-OE1.9	Open Elective Offered by Dept. of women's Studies		

M.Sc(Bioinformatics) II Semester Syllabus Under CBCS (w.e.f. 2020-21 and onwards)

Course Code	Course Name	Course Objectives	Course Learning Outcomes
BI. HCT-2.1	Biophysics, Biochemistry and Immunology	This course will provides the information regarding concepts of biophysics(Newton's laws of motion , Thermodynamics laws, Conservation laws), Biochemistry(Nucleic acids, amino acids, protein structures, protein purification and sequencing techniques) and immunology(antibodies, antigens and classification of immunology, immune cells, etc).	<ul style="list-style-type: none"> • Students will understand the concept of biophysics how physics works in biology. • Students will get clear idea about biomolecules structure and function. • They understand protein structure, motifs, folding and flexibility, protein purification and sequencing techniques. • Students will understand the basic concept of immunology.
BI. HCP-2.2	Biophysics, Biochemistry and Immunology lab	This lab will provide hands on experiments of biochemical and immunology experiments.	<ul style="list-style-type: none"> • Student will able to do experiments of qualitative and quantitative analysis of carbohydrates, proteins, amino acids, nucleic acids. • Students can able to perform some immunological assays. • They can able to handle bioinstrumentation like Thin layer chromatography, column chromatography, HPLC, AGE, PAGE.
BI. HCT-2.3	Biostatistics-II	This course provides the continuation of Biostatics-I in that student can learn the distribution concepts, parametric models, interval estimations, testing hypothesis.	Students can able to understand the statistical concept of distributions, parametric models, interval estimations, testing hypothesis.
BI. HCP-2.4	Biostatistics-II lab	This lab provides the example problems of discrete distribution, continous distribution, Consistency, Sufficiency, Efficiency & Unbiasedness, Chi-Square, T & F-Statistics, Testing of Hypothesis, Non Parametric Test.	Students can understand and solve the statistical problems based on the concept of discrete distribution, continous distribution, Consistency, Sufficiency, Efficiency & Unbiasedness, Chi-Square, T & F-Statistics, Testing of Hypothesis, Non Parametric Test.
BI. HCT-2.5	Applied Bioinformatics	This course aim is to give clear idea about how to analyse the sequences such as alignment methods, similarity search tools, phylogenetic analysis method and software's	<ul style="list-style-type: none"> • Students can clearly understand the sequence analysis like sequence alignment methods, sequence similarity search tools. • Students can able to analysis the

		and comparative genome analysis. Gene and protein structure prediction concepts and tools.	<p>phylogenetic relationships by using different methods and tools.</p> <ul style="list-style-type: none"> • They can also learn about how to compare the genomes with some tools and methods. • Students can able to analyze the structure of gene and proteins with databases and tools.
BI. HCP-2.6	Applied Bioinformatics lab	This lab provides hands on training of sequence analysis packages, sequence analysis tools, protein structural prediction tools, phylogenetic analysis tools, genome annotation and comparison tools.	Students will get hands on training of how to use the sequence analysis, phylogenetic analysis, comparative genomics, gene and protein structure prediction tools and software's.
BI. SCT-2.7	BI. SCT-2.7.1 JAVA and Python	<ul style="list-style-type: none"> • This course provides information of java concepts like oops concept, operators, control statements, classes, objects, constructors, exception handling, multithreaded programs, applets. • It also provides the concept of biopython. 	<ul style="list-style-type: none"> • Students will get knowledge of java concepts and java programming how to apply in bioinformatics. • They will get idea about biopython and how to write the python programs to analyse the sequences.
	BI. SCT-2.7.2 Immunology and Systems Biology	<ul style="list-style-type: none"> • This course provides the knowledge about Immunology concepts like introduction to antibodies, generation of antibodies, immune cells, etc • It also provides introduction to system biology, system biology networking, simulation of pathways and different databases and tools for pathway prediction. 	<ul style="list-style-type: none"> • Students get basic knowledge about immunology: immune cells, introduction to antibodies and generation of antibody, etc. • Student will also get knowledge about system biology, system biology networking, simulation of pathways and different databases and tools for pathway prediction.
	BI. SCT-2.7.3 Image Processing	This course introduces the image processing concepts like Digital images, image pre-processing, segmentation, Image enhancement in different domains, morphology, etc.	Students will get knowledge about image processing concepts and students can work on that.

BI. SCP-2.8	BI. SCP-2.8.1 JAVA and Python	From this lab students will understand the program writing skills of java and python to analysis the sequences.	<ul style="list-style-type: none"> • This lab will help students to write java programs and working with java platform. • Students will learn how to write the python programs to store DNA sequence, concatenation, and reverse compliant. • Students can write sequence files and Sequence alignment using python programming
	BI. SCP-2.8.2 Immunology and Systems Biology	This lab will provide hands on experiments of immunology experiments and working with system biology tools and databases.	This lab helps the students to get hands on training to do immunology experiments. Students can also learn how to work with system biology practical's like analyzing the networks, designing pathways, etc.
	BI. SCP-2.8.3 Image Processing	This lab provides how to do image processing using MATLAB.	By this lab students can work with MATLAB based image processing practicals.
BI-OE-2.9	Open Elective Offered by Dept. of women's Studies		

M.Sc (Bioinformatics) III Semester Syllabus Under CBCS (w.e.f. 2020-21 and onwards)

Course Code	Course Name	Course Objectives	Course Learning Outcomes
BI. HCT-3.1	Genomics, Proteomics and System Biology	The main objective of this course is to introduce the concept of genomics and its methods, proteomics concepts and methods, concept of system biology.	<ul style="list-style-type: none">• Students can acquire the knowledge of genomics: the study of genes, genomes, sequencing methods, gene expression analysis methods, etc• Students can understand the proteomics: the study of proteome analysis methods, protein interaction analysis, etc.• Students will understand the system biology: networks and pathways, simulation of pathways, pathway databases.
BI. HCP-3.2	Genomics, Proteomics and System Biology lab	This lab will help the students to understand how to work with genomics, proteomics and system biology databases and tools.	From this lab students will be able to handle a variety of tools, databases and software's of genomics, proteomics and system biology pathway designing databases.
BI. HCT-3.3	Multivariate Techniques	This course provides the multivariate techniques to analyze biological data. It includes Multiple and Partial Correlation and Regression Coefficient, Cluster Analysis, Discriminant Functions Analysis, Factor Analysis, Analysis of Variances.	Students can be able to understand and analyze the biological data with multivariate techniques those are Multiple and Partial Correlation and Regression Coefficient, Cluster Analysis, Discriminant Functions Analysis, Factor Analysis, Analysis of Variances.
BI. HCP-3.4	Multivariate Techniques lab	This lab will teach how to solve the problems on multivariate techniques.	Students will understand how to solve the example problems on Multiple and Practical Correlation Coefficient, Cluster Analysis, Discriminant Analysis, Factor Analysis, One Way, Two Way Analysis of Variance, CRD, RBD, LSD.

BI. SCT-3.5	BI. SCT-3.5.1 Database Management System	<ul style="list-style-type: none"> To study database management systems architecture. To understand the concept of oracle and structured query language. To develop an understanding of essential DBMS concepts. 	<ul style="list-style-type: none"> After completing this course students will have a clear understanding of DBMS components and its practical uses. Design ER-models to represent simple database application scenarios. Write SQL commands to create tables and indexes, insert/alter/delete data in DBMS. Improve the database design by normalization.
	BI. SCT-3.5.2 Molecular Modeling and Molecular Dynamics	To introduce the basic concepts and techniques involved in molecular modeling and molecular dynamics approach also explains about drug discovery process.	<ul style="list-style-type: none"> Students will gain knowledge on modern approaches used in molecular modeling and dynamics concepts. Students can also understand the drug discovery process.
	BI. SCT-3.5.3 IPR, Entrepreneurship and Bioethics	This course provides the knowledge about IPR concepts, patents and patent laws. It provides basic concept of entrepreneurship. This course also give knowledge about bioethics	<ul style="list-style-type: none"> Students will get complete idea about IPR concept, patent and its laws. From this course students can understand how to become an entrepreneur and they will get an idea about entrepreneurship. Students will understand the bioethics.
BI. SCP-3.6	BI. SCP-3.6.1 Database Management System	The purpose of this lab is to provide hand-on training to use DBMS package for creating and managing databases and creating/modifying/deleting/renaming tables.	<ul style="list-style-type: none"> Students will able to creating, selecting database and creating/ modifying/deleting tables by SQL commnds. Students can able to use the MySQL operators.
	BI. SCP-3.6.2 Molecular Modeling and Molecular Dynamics	This lab will provide the knowledge about different tools and database of molecular modeling and molecular dynamics. Students can also learn some software's and tools of	From this lab students can learn different types of tools, databases and software's of molecular modeling and molecular dynamics and also drug discovery process.

		drug discovery processes	
	BI. SCP-3.6.3 IPR, Entrepreneurship and Bioethics	This lab provides working with problem based exercise, process of patenting and how to prepare business plans, clinical trials etc.	<ul style="list-style-type: none"> • From this lab students will understand process of patenting, case based study on patents. • Student will understand how to prepare business plans. • Students will also understand bioethics and clinical trials.
#BI-SCP-3.7	Entrepreneurship and start up studies	Objective of this course is to develop business idea among the students, making a business plan, visiting industry, presenting a business at the end of the course	Student will acquaint on thinking innovative ideas and transforming into a business plan. Students will get familiar on making complete business plan.
BI. OET-3.7	Open Elective Biological databases and Tools	<ul style="list-style-type: none"> • The objective of this course will help the students in understanding bioinformatics, biologically data acquisition, different types of biological databases, common sequencing file formats. • To learn how data can access, retrieval and submission to databases. • To provide the knowledge about how to access gene and pathway prediction databases and tools and also provides the learning of drug discovery software's. 	<ul style="list-style-type: none"> • Upon completion of this course, the student will be able to describe the bioinformatics concepts. • Students will understand the biological databases how to access and retrieve the data. • Student will understand the analysis of DNA and protein sequences through different databases and tools • They will also understand the pathway prediction databases and drug discovery software's.

MSc(Bioinformatics) IV Semester Syllabus Under CBCS (w.e.f. 2020-21 and onwards)

Course Code	Course Name	Course Objectives	Course Learning Outcomes
BI. HCT-4.1	Chemo-informatics and Drug Designing	This course provides the information regarding chemoinformatics and drug discovery: basics, technology and strategies and also provides the different types of tools and software's for drug discovery. Pharmacogenomics concept.	<ul style="list-style-type: none"> • Students will get knowledge about chemoinformatics includes functional groups and their biological properties of drugs, pharmacodynamics and pharmacokinetics properties of drug, etc. • Students will understand the Drug Designing techniques and approaches. • They will learn the drug designing software's.
BI. HCP-4.2	Chemo-informatics and Drug Designing lab	The lab will provide the step by step strategies of discovering the drug using variety of tools and software's.	<ul style="list-style-type: none"> • From this lab students will able to access the chemical databases and draw the chemical compounds. • Understand how to analyse the target protein and can able to study the binding sites. • Students can perform docking to study the interaction between protein and ligand molecule, so on.
BI. SCT-4.3	BI. SCT-4.3.1: Perl and CGI	<ul style="list-style-type: none"> • This course provides the introduction and working of Perl programming in bioinformatics. • Providing information regarding CGI concept. 	<ul style="list-style-type: none"> • Students can understand the concepts of Perl language and they can use the programming in bioinformatics work. • Students can get knowledge about CGI programming.
	BI. SCT-4.3.2: Medical Bioinformatics and Big Data Analytics	This course provides the information regarding medical informatics, medical standards, medical data storage and automation, Health informatics, Recent trends in medical informatics	<ul style="list-style-type: none"> • Students can able to understand medical informatics, medical standards, medical data storage and automation, • Health informatics, Recent trends in medical informatics

	BI. SCT-4.3.3: Molecular Simulation	This course will provides detailed information regarding molecular simulation and different types of software's used for simulation will be explained such as GROMACS, CHARMM, AMBER, etc	<ul style="list-style-type: none"> From this course students will understand the concept of molecular simulation and they will also learn available software's to do the simulation work.
BI. SCP-4.4	BI. SCP-4.4.1: Perl and CGI	<ul style="list-style-type: none"> Aim of this lab to give knowledge about how to write basic perl programs and how to work with bioperl. To learn how to work with CGI. 	<ul style="list-style-type: none"> From this lab students can learn how to work with perl and bioperl platforms and writing the programs according to the bioinformatics requirements. They will also able to understand and write the CGI programs.
	BI. SCP-4.4.2: Medical Bioinformatics and Big Data Analytics	<ul style="list-style-type: none"> This lab provides how to work with medical bioinformatics aspect and how to analyse the data with different working producer using tools and databases. 	<ul style="list-style-type: none"> From this lab students will understand how to analyze the medical data and how to study the disease mechanism. Students will understand analyzing the human genome and variant analysis, etc.
	BI. SCP-4.4.3: Molecular Simulation	<ul style="list-style-type: none"> This lab provides hands on working producer of molecular simulation tools 	<ul style="list-style-type: none"> From this lab students will trained how to work with molecular simulation tools.
BI-HCPW-4.5	Project Work	<ul style="list-style-type: none"> To get hands on experience on research in bioinformatics 	<ul style="list-style-type: none"> At the end of the course students will be acquainted on carrying out the independent research, familiar with research processes, writing the thesis, and presentation.

BI. OET-4.4	Open Elective Applied Bioinformatics	<ul style="list-style-type: none">• The objective of this course will help the students to understand the sequence alignment methods, sequence similarity searches and alignment tools, phylogenetic analysis, comparative genome analysis, gene and protein structure prediction concepts and tools.	<ul style="list-style-type: none">• Students can able to analyse the sequences by sequence similarity searches and sequence alignment methods by using different types of tools.• Students can able to analyse the phylogenetic relationship.• They can get clear idea about comparative genome analysis concept.
-------------	--	---	---
