M.Sc. BIOINFORMATICS

COURSE OF STUDY AND SCHEME OF ASSESSMENT

(MINIMUM CREDITS TO BE EARNED: 90)

SEMESTER I

		Hours/Week				Maximum Marks		
Code No.	Course	Lecture	Tutorial	Practical	Credits	CA	SEE	Total
CORE 1	Introduction to Bioinformatics	4	0	0	4	40	60	100
CORE 2	Computer Programming in C and C++	4	0	0	4	40	60	100
CORE 3	Enzymes and Metabolism	3	0	2	4	40	60	100
CORE	Practical 1 – Bio programming in C and C++ -	0	0	4	2	40	60	100
DSE 1	Genomics and Transcriptomics	4	0	0	4	40	60	100
DSE 2	Proteomics: Principles and Techniques	4	0	0	4	40	60	100
SEC	Soft skill 1/Sector skill course	2	0	0	2	40	60	100
	Total	**21**	**0**	**6**	**24**			

CA - Continuous Assessment SEE - Semester End Examination

SEMESTER II

Code No.	Course	Hours/Week			Credits	Maximum Marks		
		Lecture	Tutorial	Practical		CA	SEE	Total
CORE 4	Programming in VB and RDBMS	4	0	0	4	40	60	100
CORE 5	Programming in Perl and Bioperl	4	0	0	4	40	60	100
CORE 6	Molecular Evolution and Phylogeny	4	0	0	4	40	60	100
CORE	Practical 2 - Programming in VB and RDBMS	0	0	4	2	40	60	100
CORE	Practical 3 - Programming in Perl and Bioperl	0	0	4	2	40	60	100
CORE	Mini Project	0	0	4	2	40	60	100
DSE 3	Concepts in Artificial Intelligence	4	0	0	4	40	60	100
SEC	Soft skills 2/Sector skill course	2	0	0	2	40	60	100
	Total	**18**	**0**	**12**	**24**			

CA - Continuous Assessment SEE - Semester End Examination

SEMESTER III

Code No.	Course	Hours/Week Lecture	Tutorial	Practical	Credits	Maximum Marks CA	SEE	Total
CORE 7	Computer Aided Drug Designing	4	0	0	4	40	60	100
CORE 8	Advanced Programming in Java	4	0	0	4	40	60	100
CORE 9	Plant Bioinformatics	4	0	0	4	40	60	100
CORE	Practical 4 - Computer Aided Drug Designing	0	0	4	2	40	60	100
DSE 4	Python for Bioinformatics	4	0	0	4	40	60	100
DSE 5	Recent Technologies in OMICS Sciences	4	0	0	4	40	60	100
SEC	Soft Skills 3/Sector Skill Course	2	0	0	2	40	60	100
	Total	**22**	**0**	**4**	**24**			

CA - Continuous Assessment SEE - Semester End Examination

SEMESTER IV

Code No.	Course SEE	Hours/Week Lecture	Tutorial	practical	Credits	Maximum Marks CA	Total
CORE 10	Clinical Research	4	0	0	4	40	60	100
GE	Generic Elective	4	0	0	4	40	60	100
CORE	Main Project	0	0	20	10	40	60	100
	Total	**8**	**0**	**20**	**18**			

CA - Continuous Assessment SEE - Semester End Examination

List of DSE courses is specified after the curriculum:

- **DSE 1 -** Genomics and Transcriptomics
- **DSE 2 -** Proteomics: Principles and Techniques
- **DSE 3 -** Concepts in Artificial Intelligence
- **DSE 4 -** Python for Bioinformatics
- **DSE 5 -** Recent Technologies in OMICS Sciences

Syllabus Core Course

CORE 1- Enzymes and Metabolism 4004

Course Objective: This course will enable the students to understand the fundamentals and complementary aspects of enzyme and metabolism action involved in bioinformatics and wide range of enzymatic activities of different protein classes and their metabolism's which responsible for causing Disorder.

UNIT I INTRODUCTION TO ENZYMES 12

Introduction to enzymes, nomenclature, classification, riboenzyme, general characteristics of theories of enzyme catalysis, substrate specificity, isozymes, coenzymes, cofactors, regulation of enzyme activity, chemical kinetics and enzyme kinetics, Michaelis-Menten equation, effect of various factors on rate of reactions, inhibition of enzymatic reactions and kinetics, multienzyme system and bisubstrate reactions, catalytic mechanisms, regulatory enzymes and immobilised enzyme.

UNIT II INTRODUCTION TO METABOLISM 12

Introduction to metabolism- Overview of anabolic and catabolic pathways of carbohydrates, proteins and lipids. Role of ATP, NAD, FAD and CoA in metabolism. Nucleic Acid Metabolism: Biosynthesis and degradation of purines and pyramidines, nucleosides and nucleotides. Clinical correlation of purine and pyrimidine metabolism. Nucleotides as coenzymes.

UNIT III CARBOHYDRATE METABOLISM 12

Digestion and absorption of carbohydrates. Glycolysis and its significance, Fermentation, Fate of pyruvate, Citric acid cycle, Gluconeogenesis, Cori cycle, Glycogenesis, Glycogenolysis Glycogen storage diseases. HMP shunt, Uronic acid pathway, Metabolism of hexoses other than glucose, Regulation of glycogen metabolism, Glyoxylate pathway, Biosynthesis of oligosaccharides and glycoproteins,

UNIT IV LIPID METABOLISM 12

Digestion and absorption of lipids. Introduction to lipid metabolism, β-Oxidation of fatty acids, Ketogenesis. Biosynthesis of fatty acids, Triacylglycerols and prostaglandins. Metabolism of phospholipids, glycolipids and cholesterol. Lipoproteins: Metabolism of HDL, Disorder of Plasma Lipoproteins, Fatty liver, Obesity, Atherosclerosis, Tay – Sachs disease, Gaucher's disease, Niemann – Pick disease.

UNIT V PROTEIN METABOLISM 12

Digestion and absorption of proteins. General aspects of amino acids metabolism; deaminaton, transamination, transmethylation, transpeptidation, and decarboxylation. Metabolism of ammonia: urea cycle and its regulation, Nitrogen balance, biosynthesis of non- essential amino acids. Metabolic breakdown of individual amino acids. Clinical correlations of protein metabolism. Integration of metabolism.

Total: 60 hours

COURSE OUTCOMES:

CO-1: To Describe the structure, functions and the mechanism of action of enzymes. Learning kinetics of enzyme catalysed reactions and enzyme inhibitions and regulatory process. Ability to perform immobilization of enzymes. Exposure of wide applications of enzymes and future potential.

CO-2: To Understand the fundamental energetics of biochemical processes, chemical logic of metabolic pathways. Knowing in detail about concepts to illustrate how enzymes and redox carriers and the oxidative phosphorylation machinery occur

CO-3: To describe the Metabolism of carbohydrates and its regulation

CO-4: To gain knowledge on Metabolism of lipid and its regulation

CO-5: To obtain and analyse the metabolism of amino acids and their role in maintaining the body function.

Text Book:

1. Shanmughavel P, “Principles of Bioinformatics”, Pointer Publishers, Jaipur, India. 2005.

Reference Books:

1. C. K. Mathews, K. E. Van Holde, & K.G. Ahern, “Biochemistry”,Third Edition, Prentice Hall, 1999.

2. Cesareni Giovanni, Gimona Mario, Sudol Marius, Yaffe Michael (Editors). Modular Protein Domains. Publisher: Weinheim Wiley-VCH. 2005.

CORE 2 - Computer Programming in C and C++ 4004

Course Objective: This course will enable the students to conceptualize and formulate logic and flow for the implementation of a computational task and develop codes using the structured programming approach of 'C' & C++ programming language and also to develop and implement programs to analyze biological data.

UNIT I C PROGRAMMING 10

Concept of variables and constants, structure of a C program. Operators & Expressions: Arithmetic, Unary, Logical, Bit-wise, Assignment & Conditional Operators, Library Functions, Control Statements: while, do While, for statements, Nested loops, if.. else, switch, break, continue and go to statements, Comma operator.

UNIT II FUNCTION, STRING, POINTERS 13

Functions: Defining & Accessing : Passing arguments, Function Prototype, Recursion, Use of Library Functions, Storage Classes: Automatic, External and Static Variables (Register), Arrays: Defining & Processing, Passing to a function, Multidimensional Arrays. String: Operations of Strings (String handling through built-in & UDF: Length, Compare Concatenate, Reverse, Copy, Character Search using array) Pointers: Declarations, Passing to a function, Operations on Pointers, Pointers & Arrays, Array of Pointer, Pointer Arithmetic, Array accessing through pointers, Pointer to structure, Pointer to functions, Function returning pointers, Dynamic Memory Allocations.

UNIT III STRUCTURESAND FILES 12

Structures: Defining & Processing, Passing to a function, Unions (Array within structure, Array of structure, Nesting of structure, Passing structure and its pointer to UDF, Introduction to Unions and its Utilities) Data Files: Open, Close, Create, Process Unformatted Data Files. (Formatted Console I/O functions, Unformatted Console I/O functions, Modes Of Files, Use Of fopen(), fclose(), fgetc(), fputc(), fgets(), fprintf(), fscanf(), fread(),fwrite(), Command Line Arguments). Documentation, debugging, C Processors, Macros. Examples illustrating structured

program development methodology and use of a block structured algorithmic language to solve specific problems.

UNIT IV INTRODUCTION TO OBJECT ORIENTED PROGRAM 10

Introduction to object oriented programming, user defined types, polymorphism, and encapsulation. Getting started with C++ - syntax, data-type, variables, strings, functions, exceptions and statements, namespaces and exceptions, operators. Flow control, functions, recursion. Arrays and pointers, structures.

UNIT V ABSTRACTION MECHANISMS, INHERITANCE 10

Abstraction Mechanisms: Classes, private, public, constructors, destructors, member functions, static members, references etc. Class hierarchy, derived classes. Inheritance: simple inheritance, polymorphism, object slicing, base initialization, virtual functions.

Total: 60 Hours

COURSE OUTCOMES:

CO-1: To understand the basics of C program and their operators using Conditional statements and loops.

CO-2: To utilize the concepts of operators and in build functions to program the control structures and decision-making concept

CO-3: To design the array, structure, pointers, files and unions in the programming.

CO-4: To choose the OOPS concepts and to utilize the constructors and operators

CO-5: To discuss the concepts of files and inheritance

Text Book:

Balagurusamy E. Programming In ANSI C. Publisher: New Delhi Tata McGraw Hill Publishing Company Ltd. 2007. ISBN: 9780070648227

Reference Books:

1. Kanetkar Yashavant. Let Us C 9th Edition. Publisher: New Delhi BPB Publications. 2009. ISBN: 9788183331630.
2. Jonassen Inge, Kim Junhyong. Algorithms in Bioinformatics: 4th International Workshop, WABI 2004 Bergen, Norway, September 2004 Proceedings. Publisher: New York Springer. 2004. ISBN: 3540230181.
3. Kernighan Brian W. Ritchie Dennis M. The C Programming Language 2nd Edition. Publisher: USA, Prentice-Hall, Inc. 1988. ISBN: 0876925964

CORE 3 -Introduction to Bioinformatics 3024

Course Objective: This course will enable the students to understand the nature of biological data and need for biological databases and also to explore major biomolecular sequence databases (organization and contents); search and retrieve data from the databases using their respective search engines. To understand and appreciate the need and significance of sequence analysis and the bioinformatics approaches, algorithms for sequence analysis, the application of methods for analysis of the biomolecular sequence data

UNIT I INTRODUCTION TO COMPUTERS 15

Basics of computing: Introduction to operating systems – WINDOWS, UNIX, LINUX; Advantages of security installation; Use of internet; Graphics – visualization techniques; softwares and hardwares; Computer networking – LAN, WAN, MODEM, Optical vs electronic networking, firewalls; Ethernet and TCP/IP family of protocols.

UNIT II INTRODUCTION TO BIOLOGICAL DATABASES 10

Nucleotide databases (Genbank, EMBL, DDBJ); Protein databases (Swiss-Prot, Tr-EMBL, PIR_PSD, Expasy); Derived Databases (Prosite, PRODOM, Pfam, PRINTS) Specialized Genome databases: (NCBI, EBI, TIGR, SANGER).

UNIT III BIOLOGICALDATABASES II 10

Sequence submission Methods and tools (Sequin, Sakura, Bankit); Sequence retrieval systems (Entrez& SRS); Sequence File Formats and Conversion tools; Metabolic Pathway database (KEGG, EMP, EcoCyc, BioCyc and MetaCyc); Specialized database (IMGT, Rebase, COG, LIGAND, BRENDA); Structural database (CATH, SCOP, and PDBsum).

UNIT IV SEQUENCE ANALYSIS 12

Analysis of protein and nucleic acid sequences, multiple alignment programs, Development of programs for analysis of nucleic acid sequences, Pair wise Sequence Alignment - Similarity, Identity and Homology, Global Alignment, Local Alignment; database search methods-Multiple Sequence Alignment - Multiple alignment programs, Development of programs for analysis of

Nucleic acid sequences, Conversion of various file formats; Phylogenetic Analysis - Concept of dendrograms; Strings and Evolutionary trees.

UNIT V STRUCTURAL ANALYSIS 13

Analysis of structures and correctness of structures, Submission of data to PDB: atomic coordinates and electron density maps; Anatomy of Proteins - Ramachandran plot, Secondary structures, Motifs, Domains, Tertiary and quaternary structures; Calculation of conformational energy for bio-macromolecules; Methods for Prediction of Secondary and Tertiary structures of Proteins.

Total: 60 Hours

COURSE OUTCOMES:

CO-1: To understand the basics of computer, internet and computer networking softwares.

CO-2: To acquire the concepts of different biological databases

CO-3: To study the sequence file formats and retrieval system.

CO-4: To analyze the evolutionary relationship and alignment.

CO-5: To study the structures of protein and their function site.

Text Book:

1. Baxevanis A.D., Davison D.B., Page R. D. M. & Petsko G.A. Current Protocols in Bioinformatics. New York, John Wiley & Sons Inc., 2004. ISBN: 0555015254 Syllabus draft: April 26, 2010.

Reference Books:

1. Korf Ian, Yandell Mark, Bedell Joseph. BLAST: an essential guide to the basic local alignment search tool. Shroff Publishers and Distributors Pvt. Ltd., 2003. ISBN: 8173665125.
2. Lesk, A.M. “Introduction to Bioinformatics:, 1st Edition, Oxford University Press, Oxford, UK , 2002 . ISBN: 90421

CORE: Practical 1 - Bioprogramming in C and C++ 0042

Course Objectives: This course will enable the students to conceptualize and formulate logic and flow for the implementation of a computational task and develop codes using the structured programming approach of 'C' & c++programming language and also to develop and implement programs to analyze biological data.

1. Operators and Expressions, Branching and Looping in C.	3
2. Classes and Objects in C++.	3
3. Program to demonstrate Inheritance in C++.	3
4. Translate DNA sequence to Protein in C & C++.	5
5. Comparing two Sequences.	3
6. Calculate the true length of a Sequence.	3
7. Function Blocks: a. Handling default reference arguments b. Handling inline and overloaded function C++.	5
8. Arrays and String as objects: Insertion, Deletion, reversal sorting of elements into a single in C++.	5

Total: 30 Hours

COURSE OUTCOMES:

CO-1: To understand the basics of C program and their operators using Conditional statements and loops.

CO-2: To utilize the concepts of operators and in build functions to program the control structures and decision-making concept

CO-3: To design the array, structure, pointers, files and unions in the programming.

CO-4: To choose the OOPS concepts and to utilize the constructors and operators

CO-5: To discuss the concepts of files and inheritance

Text Book:

Balagurusamy E. Programming In ANSI C. Publisher: New Delhi Tata McGraw Hill Publishing Company Ltd 2007. ISBN: 9780070648227

Reference Books:

1. Kanetkar Yashavant. Let Us C 9th Edition. Publisher: New Delhi BPB Publications. 2009. ISBN: 9788183331630.
2. Jonassen Inge, Kim Junhyong. Algorithms in Bioinformatics: 4th International Workshop, WABI Bergen, Norway, September 2004 Proceedings. Publisher: New York Springer. 2004. ISBN: 3540230181.

CORE 4 - Programming in VB and RDBMS 4004

Course Objective: Identify the differences between the procedural languages and event – driven languages. Define and modify the properties and methods associated with an object. To load, modify, and save changes made to forms and projects in the Visual Basic Environment. Make clear understand on RDBMS concepts and Database languages such as Oracle and PL/SQL.

UNIT I Introduction to Visual Basic 12

Introduction to Visual Basic: IDE, working with forms, developing an application, variables, datatypes and modules, procedures and control structures, arrays in VB. Working with VB Controls: Creating and using controls, working with control arrays - ODBC and Data Access Objects.

UNIT II User Interfaces 12

Menus Events and Dialog Boxes: Menu and Events definition, Event model in VB, Menu Interfaces, Mouse Events, Dialog Boxes: Definition, Types of Dialog Boxes, Applying dialog. Graphics, MDI and FlexGrid: Graphics for application, Multiple Document Interface and Using the FlexGrid Control

UNIT III VB Classes and Objects 12

Classes: Definition, advantages of classes, class methods. Objects: Definition and methodology. Introduction to VB Classes and Objects, Creating various forms, Objects and projects. Working with objects, Classes and class modules, Creating VB objects.

UNIT IV Introduction to DBMS 12

Advantages and Components of a Database Management Systems - Feasibility Study - Class Diagrams - Data Types - Events - Normal Forms - Integrity - Converting Class Diagrams to Normalized Tables - Data Dictionary. Query Basics - Computation Using Queries - Subtotals and GROUP BY Command - Queries with Multiple Tables Subqueries – Joins, Testing Queries.

UNIT V Introduction to ORACLE 12

ORACLE - Introduction to Oracle, Data definition languages - Data Manipulation language, Data Control Language, Data types in Oracle. Constraints in Oracle, Data and String

Functions, Union and Intersect operator, Sub queries, Introduction to PL / SQL, Simple PL / SQL programs.

Total: 60 Hours

COURSE OUTCOMES:

CO-1: To build the fundamentals of visual basic

CO-2: To utilize the concepts of user interface

CO-3: To utilize the VB classes and objects

CO-4: To design the DBMS and role in database creation

CO-5: To design the ORACLE and its connectivity

Text Books:

1. Steven Holzner, "Visual Basic 6 Programming: Black Book", Dreamtech Press, 2000.
2. C. J. Date, A. Kannan, "Database Systems", Pearson Education Publication, 2006

References Books:

1. Noel Jerke, "Visual Basic 6: The Complete Reference", Tata McGraw Hill, 1999.
2. Kevin Loney, George Kuch, "Oracle – The complete Reference", Tata McGraw Hill Publication, 2005
3. C. J. Date, "Database Systems", Addison Wesley Publication, 1990.

CORE 5 - Programming in Perl and Bioperl 4004

Course Objective: To learn the fundamentals of the Perl programming language and how it can be used to write data reporting and systems administration applications. To discover how to use of the DBI.pm module and related DBD (driver) files with Perl to build database-driven applications.

UNIT I Introduction to Perl. 10

Introduction:- Scalar Data- Numbers, Strings, Scalar Variables, Output with print, Getting User Input, The chomp operator, undef Value, defined function, The if and while control structures, Lists and Arrays:- Accessing elements of an array, Special Array indices, List Literals, List Assignment, Subroutines:- Defining a subroutine, Invoking a subroutine, Return values, Arguments, Private variables in subroutines, the return operator.

UNIT II Expressions 15

Input and Output:- Input from Standard Input, Input from the diamond operator, Invocation arguments, Output to Standard Output, Filehandles, Opening a Filehandle, Hashes:- Hash Element Access, Hash Functions, Regular Expressions, Matching with Regular Expressions:- Matches with m//, Option Modifiers, Anchors, The Binding operator, =~, Interpolating into Patterns, The match Variables, General Quantifiers. Processing Text with Regular Expressions:- Substitutions with s///, The split Operator, The join Function, m// in List context, More Powerful Regular Expressions.

UNIT III Control Structures and Files. 15

Control Structures:- The unless Control Structure, The until Control Structure, Expression Modifiers, The Naked Block Control Structure, The elsif Clause, Autoincrement and Autodecrement, The for Control Structure, Loop Controls, Logical Operators, File Tests:- File Test Operators, The stat and lstat functions, The localtime function, Bitwise Operators, Using the Special Underscore Filehandle, Strings and Sorting:- Finding a Substring with index, Manipulating a Substring with substr, Formatting Data with sprint, Advanced Sorting, Perl Modules:- Finding Modules, Installing Modules, Using Simple Modules.

UNIT IV Introduction to Bioperl . 10

Bioperl:- Introduction, Installing Bioperl, General Bioperl Classes, Sequences (Bio::Seq Class, Sequence Manipulation), Features and Location Classes (Extracting CDS), Alignments

(AlignIO), Analysis (Blast, Genscan), Databases (Database Classes, Accessing a local database), Implementing REBASE

UNIT V Common Gateway Interface (CGI) 10

Common Gateway Interface:- Web Servers and Browsers, HTML tags, table, frames, form elements, GET, POST & HEAD Method, URL Encoding, CGI Environment Variables, Handling forms, Accessing form Input, Extra Path Information, CGI.pm Module, Passing Parameters via CGI, Less Typing, Sever Side Includes, Debugging CGI programs, Stepping through programs, Breakpoints, Line Action

Total: 60 Hours

COURSE OUTCOMES:

CO-1: To build the essentials of Perl using subroutines.

CO-2: To utilize the concepts of expressions with modifiers.

CO-3: To understand the perception of control structures.

CO-4: To develop perl program using procedures and functions to solve the biological problems.

CO-5: To create the perl script for research project purpose and database creation with CGI.

Text Book:

1. Martin C Brown, “Perl the Complete Reference”, Tata McGraw Hill, 2001

References Books:

1. Erick Storm, “Perl CGI Programming”, BPB Publication, 1998.
2. Steven Holzner, “Per: Black Book”, Second Edition, Dreamtech Publication, 2007.
3. Ed Peschko & Michele Dewolf, “Perl Developer’s Guide”, Tata McGraw Hill, 2000.

CORE 6 - Molecular Evolution and Phylogeny 4004

Course Objective:

This course make us to understand DNA can be extracted and sequenced from a diverse range of biological samples, providing a vast amount of information about evolution and ecology. The analysis of DNA sequences contributes to evolutionary biology at all levels, from dating the origin of the biological kingdoms to untangling family relationships.

Unit I Evolution of life 12

History of evolution of life on earth: Chemical basis of evolution, Evolution of DNA, RNA and proteins, origin of the genetic code. Hardy-Weinberg equilibrium; Evolutionary changes by mutation, gene flow, genetic drift and natural selection.

Unit II Homology in molecular evolution 12

The concept of homology in molecular evolution. Role of transitions and transversions; chromosomal deletions and insertions in evolution. Role of repetitive DNA, transposable elements and junk DNA in evolution.

Unit III Theory of molecular evolution 12

Neutral theory (Kimura) and nearly neutral theory (Ohta) of molecular evolution (Kimura). Phylogenetic tree. Reconstruction of phylogenetic trees using distance matrix methods, the Maximum Parsimony method, and Maximum likelihood and Bayesian inference. Selection at the molecular level.

Unit IV Concept of the Molecular Clock 12

The concept of the Molecular Clock. Calibration. Limitation of molecular clock models. Human molecular clock: deducing evolutionary histories through mitochondrial DNA and Y chromosome.

Unit V Evolution of the genome 12

Evolution of the genome: Human Genome Project, ENCODE, Genome 10 K, Genome duplication (Ohno's hypothesis), Gene duplication, Exon Shuffling, Concerted evolution.

Total: 60 Hours

COURSE OUTCOMES:

CO-1: To understand the funadamentals of evolution in life.

CO-2: To analyze the concept of homology between the species and their predictions related to molecular evolution.

CO-3: To apply the basic principles, models, and theory of molecular evolution in life.

CO-4: To design the model using molecular clock system.

CO-5: To discuss the core concepts and advanced technique to find the evolution of human genome thorough hypothesis.

Text Book:

1. Lindelle Bromham,. An Introduction to Molecular Evolution and Phylogenetics- IInd Edition

References Books:

1. Wen Hsiung-Li, Molecular Evolution , Sinauer Associates, Sunderland, MA. ISBN 0878934634. 1997,

2. Ridley .M ,Evolution (3rd Edition) ,Blackwell Science. 2004, ISBN 1-4051-0345-1997

CORE: Practical 2- Programming in VB with RDBMS 0042

Course Objective: Identify the differences between the procedural languages and event – driven languages. Define and modify the properties and methods associated with an object. To load, modify, and save changes made to forms and projects in the Visual Basic Environment. Make clear understand on RDBMS concepts and Database languages such as Oracle and PL/SQL.

VB

1. Creating Simple application forms in Visual Basic. 02
   a) Creating a form for simple Arithmetic Calculations
   b) Creating a form for simple Biological applications
2. Creating application forms using Variables, Data Types and Control structures. 02
   a) Creating Factorial Calculator
   b) Creating GC – Content Calculator
3. Creating application forms using different types of "Objects" in VB. 02
   a) Creating form to find,
      i) Leap Year,
      ii) Currency Exchange,
      iii) Octal, Decimal, Hexadecimal Calculation
      iv) Scroll Bar
   b) Creating form to find
      i) The Complement of given sequence
      ii) The reverse of given sequence
      iii) The frequency of Nucleotides.
4. Creating application forms using Menus, Mouse Events. 02
5. Creating applications forms using Graphics in VB. 02

Oracle, PL/SQL

1.a) Creation of student information records containing Roll number, Name, Subject Code Marks etc.,

b) Finding the total and average marks, result for each student table.

c) Record Manipulations such as Deletion, Modification, Addition and Counting the Record. 02

2. Creating table that demonstrates simple biological applications 02

3. Creating table to demonstrate applications with biological sequences. 03

Database Creation using VB with RDBMS

1. Create a database that demonstrates "Library Information System" with VB forms and Query language.(User Interface with VB) 03

2. Create a database that stores and retrieves simple biological applications. (User Interface with VB). 03

3. Create a database for "Railway Reservation System". (User Interface with VB) 03

4. Create a database that stores and retrieves biological sequences and to find the similarities between two sequences. (User Interface with VB) 04

Total: 30 Hours

COURSE OUTCOMES:

CO-1: To build the fundamentals of visual basic

CO-2: To utilize the concepts of user interface

CO-3: To utilize the VB classes and objects

CO-4: To design the DBMS and role in database creation

CO-5: To design the ORACLE and its connectivity

Text Books:

1. Steven Holzner, "Visual Basic 6 Programming: Black Book", Dreamtech Press, 2000.

2. C. J. Date, A. Kannan, "Database Systems", Pearson Education Publication, 2006

References Books:

1. Noel Jerke, "Visual Basic 6: The Complete Reference", Tata McGraw Hill, 1999.

2. Kevin Loney, George Kuch, "Oracle – The complete Reference", Tata McGraw Hill Publication, 2005

3. C. J. Date, "Database Systems", Addison Wesley Publication, 1990.

CORE: Practical 3- Programming in Perl and Bioperl 0042

Course Objective: To learn the fundamentals of the Perl programming language and how it can be used to write data reporting and systems administration applications. To discover how to use of the DBI.pm module and related DBD (driver) files with Perl to build database-driven applications.

1.	Write a Perl program to find the length of the given sequence?	02
2.	Write a Perl program to reverse and concatenation of the given sequence?	02
3.	Write a Perl program to complement and reverse complement of DNA sequence?	02
4.	Write a Perl program to calculate GC content in the given DNA sequence?	02
5.	Write a Perl program to translate DNA into Protein Sequence?	02
6.	Operators and Expressions.	02
7.	Branching and Looping.	02
8.	Formatting Data.	02
9.	Sort an Array of Strings in Reverse Order.	02
10.	Splitting DNA sequence into Pieces by Using split ().	02
11.	How do I read or write Fasta files using Bioperl?	02
12.	Comparing two Sequences.	02
13.	How do I calculate the true length of a Sequence?	02
14.	How can I parse a PDB file using Bioperl?	02
15.	Translating DNA sequence into Protein Sequence .	02

Total: 30 Hours

COURSE OUTCOMES:

CO-1: To build the essentials of Perl using subroutines.

CO-2: To utilize the concepts of expressions with modifiers.

CO-3: To understand the perception of control structures.

CO-4: To develop perl program using procedures and functions to solve the biological problems.

CO-5: To create the perl script for research project purpose and database creation with CGI.

Text Book:

1. Martin C Brown, “Perl The Complete Reference”, Tata McGraw Hill, 2001

References Books:

1. Erick Storm, “Perl CGI Programming”, BPB Publication, 1998.
2. Steven Holzner, “Per: Black Book”, Second Edition, Dreamtech Publication, 2007.

MINI PROJECT **0042**

COURSE OBJECTIVES:

- For the benefit of the students, it has been mandatory to attend a minimum of two months mini project Programme during semester1 vacation

- Student should go for mini project Programme in any bioinformatics industries or laboratories and learn their laboratory techniques by hands on training.

- After the mini project Programme, student should submit detailed reports about the project work in printed format.

- Evaluation is based on work done, quality of report, performance in viva-voce, presentation etc.

- The report will be evaluated by duly appointed teaching faculty from head of department.

CORE 7 - Computer Aided Drug Designing 4004

Course Objective: This course will enable the students to understand the critical relationship among biomolecular structure, function and force field models. To utilize basic modeling techniques to explore biological phenomena at the molecular level. To emphasize Modelling drug/receptor interactions in detail by molecular mechanics, molecular dynamics simulations and homology modeling.

UNIT I Molecular Modeling and Mechanics 10

Basic Concepts of Molecular Structure: Bond Length, Bond Angle, Torsion Angle, Non-Covalent Interactions and force field parametrisation and transferability – Molecular Structure and Internal Energy – Energy Minimization, Derivative and Non-Derivative Methods, Local and Global Minima.

UNIT II Quantum Mechanics 10

Introduction to Computational Quantum Mechanics: One Electron Atom, Poly Electronic Atoms and Molecules, Hatree Fock Equations, Molecular Properties calculation using Ab initio and Semi Empirical Methods, Density Functional Theory, Moller and Plesset Perturbation Theory.

UNIT III Molecular Modeling and Docking 13

Molecular Modeling in Drug Discovery, Sequence Analysis, Secondary structure prediction, Tertiary Structure prediction- Homology Modeling, Threading and ab-initio methods, Structure validation, Molecular Docking – Introduction, Approaches (Simulation and Shape complementarity approach), Molecular Docking Algorithm, Docking Optimization- Scoring functions, Molecular Docking Application.

UNIT IV Pharmacophore 12

Pharmacophore – Historical Perspective and Features, Viewpoint of Pharmacophore, Pharmacophore modeling- Molecular alignments, handling flexibility, alignment techniques, scoring and optimization, conformational expansion, validation and usage, Applications of pharmacophore model in medicinal chemistry.

UNIT V Molecular Dynamics 10

Molecular Dynamics- Introduction, MD using simple models, MD with continuous potentials, setting up and running a molecular dynamics simulation, Constraint Dynamics,

Monte Carlo Simulation Methods- Monte Carlo simulation of molecules, Simulation Analysis.

Total: 60 Hours

COURSE OUTCOMES:

CO-1: To understand the fundamentals of molecular mechanics and its structure.

CO-2: To analyze the concept of computational quantum mechanics using energy theory.

CO-3: To apply the basic principles, models, and theory of molecular docking in drug designing.

CO-4: To design the model using molecular ligand system and their pharmacophore prediction.

CO-5: To learn the various methods of dynamic approaches in the *Insilco* docking studies.

Text Book:

1. Andrew R. Leach. Molecular Modelling: Principles and Applications, second edition. Pearson Education EMA, January 2001 ISBN 0-582-38210-6

References Books:

1. D. C. Rapaport, The Art of Molecular Dynamics Simulation, 2004, ISBN 0-521-82568-7
2. M. P. Allen, D. J. Tildesley, Computer simulation of liquids, 1989, Oxford University Press, ISBN 0-19-855645-4.
3. R. J. Sadus, Molecular Simulation of Fluids: Theory, Algorithms and Object-Orientation, 2002, ISBN 0-444-51082-6
4. J.M.Haile, Molecular Dynamics Simulation Elementary Methods, John Wiley and Sons, 1997.
5. Satya Prakash Gupta, QSAR and Molecular Modeling, Springer - Anamaya Publishers, 2008.
6. Guy H. Grant and W. Graham Richards. Computational Chemistry Oxford Chemistry Primers, 29 1995. 9780198557401

CORE 8 - Advanced Programming in JAVA 4004

Course Objectives: Understand fundamentals of programming such as variables, conditional and iterative execution, methods, etc. Understand fundamentals of object-oriented programming in Java, including defining classes, invoking methods, using class libraries, etc. Be aware of the important topics and principles of software development. Have the ability to write a computer program to solve specified problems.

UNIT I Fundamental of Java 10

Java features – Java Platform – Java Fundamentals – Expressions, Operators – Arithmetic – Logical - Comparison – Bitwise operators, Control Structures – Looping : while, do while, for, Branching: if, if else, elseif ladder, nested if, Classes, Packages and Interfaces – Exception Handling.

UNIT II Java for WWW 10

Introduction to Java Scripts, Objects in Java Script, and Dynamic HTML with Java Script. XML: Document type definition, XML Schemas, Document Object model, Presenting XML, Using XML Processors: DOM and SAX Review of Applets, Class, Event Handling, AWT Programming.

UNIT III Introduction to Swing 10

JApplet, Handling Swing Controls like Icons – Labels – Buttons – Text Boxes – Combo – Boxes – Tabbed Pains – Scroll Pains – Trees – Tables Differences between AWT Controls & Swing Controls Developing a Home page using Applet & Swing. Java Beans: Introduction to Java Beans, Advantages of Java Beans, BDK Introspection, Using Bound properties, Bean Info Interface, Constrained properties Persistence, Customizers, and Java Beans API.

UNIT IV Introduction to Servelets 15

Lifecycle of a Serverlet, JSDK the Servelet API, The javax.servelet Package, Reading Servelet parameters, Reading Initialization parameters. The javax. servelet HTTP package, Handling Http Request & Responses, Using Cookies- Session Tracking, Security Issues Introduction to JSP, The Problem with Servelet. The Anatomy of a JSP Page, JSP Processing. JSP Application. Design with MVC Setting Up and JSP Environment: Installing the Java Software Development Kit, Tomcat Server & Testing Tomcat

UNIT V Java Application **15**

Biojava: Introduction to Biojava, Installing Biojava, Symbols and Symbol Lists, Sequence and Features, Sequence I/O Basics, viewing molecule structures through BioJava. JSP Application Development: Generating Dynamic Content, Using Scripting Elements Implicit JSP Objects, Conditional Processing – Displaying Values Using an Expression to Set an Attribute, Declaring Variables and Methods Error Handling and Debugging Sharing Data between JSP pages, Requests, and Users Passing Control and Date between Pages – Sharing Session and Application Data – Memory Usage Considerations.

Total: 60 Hours

COURSE OUTCOMES:

CO-1: To understands the fundamentals of Java and OOP technology.

CO-2: To identify classes, objects, members of a class and relationships among them needed for a specific problem

CO-3: To write Java application programs using array and String.

CO-4: To demonstrate the concepts of errors, File handling using Multithreaded Programming

CO-5: To write Java programs to utilizing the java applet code and graphics Programming.

Text Book:

1. E Balagurusamy, “Programming with Java: A Primer”, Fourth Edition, Tata McGraw Hill, 2010

References Books:

1. P. Naughton and H.Schildt- Java2 (The Complete Reference) - Third Edn.TMH 1999.
2. Deital & Deital, “How to Program Java”, Pearson Education, 1999.
3. Cays Horstmann, Gary Cornell, “Core Java 2: Advanced Features”, Sun Micro System, 2007

CORE 9 - Plant Bioinformatics 4004

Course Objective: This understanding is fundamental to allow efficient exploitation of plants as biological resources in the development of new cultivars with improved quality and reduced economic and environmental costs. This knowledge is also vital for the development of new plant diagnostic tools. To understand the genetic and molecular basis of all biological processes in plants that are relevant to the specie.

Unit I Plant Genetics 12

Introduction to Plant genetics – DNA, Gregor Mendel, Modern ways to genetically modify plants, Genetically engineered crops, Benthan and Hooker's classification of plants – Summary, Families and orders in the Bentham & Hooker system – Dicotyledons, Monocotyledons. Types of classifications – artificial – natural – phylogenetic. Biosystematics – binomial nomenclature – herbarium and its uses, herbarium and computer data.

Unit II Plant Genomic Database 12

Identification functional regions within gene products Ensembl Plants, Gramene, PLAZA, SUBA, TAIR and Araport., view of subcellular localization- finding homologs in other species, and explore pre-computed gene trees.

Unit III Expression Analysis 12

Vast databases of gene expression-nifty visualization tools, eFP Browser, Genevestigator, TraVA DB, Araport, NCBI's Genome Data Viewer for RNA-seq data for other plant species-MPSS database of small RNAs and degradation products to Check gene has any potential microRNA targets - patterns of expression across expression data sets using algorithm WGCNA- Organizing the data.

Unit IV Functional Classification and Pathway Visualization 12

AgriGO, AmiGO, tools at TAIR and the BAR, and g:Profiler - onto pathway representations-AraCyc and MapMan – Intrepretation of Omics data. Network Exploration (PPIs, PDIs, GRNs

Unit V Bioinformatics Tools for Plant Genomics 12

PPNEMA, MaizeGDB, TAIR database, CCPMT, Blast2GO, SSR locator Bioinformatics Tools for Inferring Functional Information from Plant Microarray Data – Agbase, Kyoto Encyclopedia of Genes and Genomes (KEGG), Ensembl, Entrez

Total: 60 Hours

COURSE OUTCOMES:

CO-1: Acquire knowledge on fundamentals of plant cells and its functions to incorporate in developing plant databases

CO-2: Originate the chances to understand the classification of plant kingdom and to access through computer-aided learning

CO-3: Adapt the knowledge on plant genetics and design experimental techniques for the agricultural, industrial benefits from plants

CO-4: Explore the basics and databases for information retrieval and data analysis

CO-5: Utilize and assess the plant genomics data to predict novel traits

Text Book:

1. Khalid Rehman Hakeem,Adeel Malik, Fazilet Vardar-Sukan.by Plant Bioinformatics.

References Books:

1. Molecular Plant Taxonomy: Methods and Protocols (Methods in Molecular Biology, 1115) Softcover reprint of the original 1st ed. 2014.
2. David Edward, Plant Bioinformatics Methods and Protocols .

CORE: Practical 4 - Computer Aided Drug Designing 0042

Course Objective:

This course will enable the students to understand the critical relationship among Biomolecular structure, function and force field models. To utilize basic modeling techniques to explore biological phenomena at the molecular level. To emphasize Modelling drug/receptor interactions in detail by molecular mechanics, molecular dynamics simulations and homology modeling.

1.	Small molecule building, using ISIS Draw and CHEM SKETCH.	02
2.	Homology Modeling using SPDBV .	02
3.	Homology Modeling using Modeller.	03
4.	Model structure refinement using SPDBV .	03
5.	Model validation using What Check and Pro Check	03
6.	Docking using Hex.	02
7.	Docking using AUTODOCK .	03
8.	Molecular dynamics using AMBER .	03
9.	Docking using ARGUSLAB.	05
10.	Virtual screening using NCI database.	04

Total: 30 Hours

COURSE OUTCOMES:

CO-1: To design the small molecules using softwares.

CO-2: Able to model the protein structure with the help of modelling softwares.

CO-3: To analyse and validate the structure of protein.

CO-4: To demonstrate the concepts of molecular docking and dynamics using softwares.

CO-5: To perform and handled large sets of compounds using screening method.

Text Book:

1. Andrew R. Leach. Molecular Modelling: Principles and Applications, second edition. Pearson Education EMA, January 2001 ISBN 0-582-38210-6

References Books:

1. D. C. Rapaport, The Art of Molecular Dynamics Simulation, 2004, ISBN 0-521-82568-7
2. M. P. Allen, D. J. Tildesley, Computer simulation of liquids, 1989, Oxford University Press, ISBN 0-19-855645-4.
3. R. J. Sadus, Molecular Simulation of Fluids: Theory, Algorithms and Object-Orientation, 2002, ISBN 0-444-51082-6
4. J.M.Haile, Molecular Dynamics Simulation Elementary Methods, John Wiley 1997.

CORE 10 - Clinical Research 4004

Course Objective:

This course will enable the students to understand the key concepts of research in responsible to the conduct of research and able to conduct research that conforms to the highest standards for the protection of human research subjects.

UNIT I Introduction to Clinical Research 12

Introduction to clinical research, History of clinical research, Clinical Research Degree, Clinical Research Training and an overview of the common research designs. Safety- Sponsor, Local site investigators, Institutional review boards (IRBs), Regulatory agencies. Economics - Sponsor, Investigators, Subjects, Participation as labor. Participating in a clinical trial - Locating trials, Steps for volunteers, Research. an overview of key trail activities in clinical research, clinical research and media.

UNIT II Introduction to Clinical Trails 12

Introduction to clinical trials, Trials of drugs, Trials of devices. History - Development, Modern trials. Types - different phases of clinical trials,. Trial design - Active comparator studies, Master protocol, Clinical trial protocol, Design features, Placebo groups, Duration. Administration – Marketing, Information technology. Ethical aspects - Conflicts of interest and unfavorable studies. Ethical principles that govern clinical trials.

UNIT III Good Clinical Research Practice (GCPR) 12

Introduction to Good clinical research practice – Background, Objectives, Scope, Overview of the clinical research process, Key trial activities include -Development of the trial protocol, . Development of standard operating procedures (SOPs), Development of support systems and tools, Generation and approval of trial-related documents, Selection of trial sites and the selection of properly qualified, trained, and experienced investigators and study personnel, Ethics committee review and approval of the protocol, Review by regulatory authorities. Enrollment of subjects into the study: recruitment, eligibility, and informed consent

UNIT IV WHO Principles 12

WHO principles of GCPR- Principle 1: Ethical Conduct, Principle 2: Protocol, Principle 3: Risk Identification, Principle 4: Benefit-Risk Assessment, Principle 5: Review by Iec/Irb, Principle 6: Protocol Compliance, Principle 7: Informed Consent, Principle 8: Continuing

Review/ Ongoing Benefit-Risk Assessment, Principle 9: Investigator Qualifications, Principle 10: Staff Qualifications, Principle 11: Records. Principle 12: Confidentiality/Privacy, Principle 13: Good Manufacturing Practice, Principle 14: Quality Systems

UNIT V Presentation Skills **12**

Continuing review, investigator and staff qualifications, records confidentiality, Ethical conduct, protocol, risk identification, benefit risk assessment, review, protocol compliance, and informed consent GMP, and quality systems. 6 main Elements of Presentation skills - Be Prepared, Give of Yourself, Stay Relaxed, Use Natural Humor, Plan Your Body & Hand Positions, Pay attention to all details How to present research result (Presentation).

Total: 60 Hours

COURSE OUTCOMES:

CO-1: To understand the basic concepts of clinical research and their trail techniques for the good research.

CO-2: To acquire the knowledge about the clinical research and ethics for novel research.

CO-3: To acquire the knowledge of good clinical research program.

CO-4: To must able to recognize the concepts of GPCR rules.

CO-5: To learn how to present the data and research result.

Text Book:

1. Glasser, Stephen P. Essentials of Clinical Research springer 2014 ISBN 9783319054704

References Books:

1. John I. Gallin. Principles and Practice of Clinical Research (Third Edition). Elsevier Inc 2012. ISBN: 978-0-12-382167-6
2. Gupta SK. Basic Principles of Clinical Research and Methodology. Institute of Clinical research.2007 ISBN 9788184480863
3. Friedman, L.M., Furberg,C.D., DeMets, D., Reboussin, D.M.,Granger, C.B. Fundamentals of Clinical Trials springer 2015 ISBN 978-3-319-18539-2.
4. Dr. Arun Bhatt, Clinical Trials And Good Clinical Practice In India Career Publication ISBN10: 8188513210

MAIN PROJECT **0 0 20 10**

- Student should do research on their own interest or research guide interest on any biotechnology topic for 6 month in the university or any industries or laboratories.

- The candidates shall undertake the major project work in the Sixth Semester either in the Department concerned or in industries, institutes or any other organizations and theproject report shall be submitted at the end of the Sixth semester.

- In case the candidate undertakes the project work outside the Department, the Staff concerned within the Department shall be the Main guide and the Staff/scientist under whom the work is carried out will be the Co-guide. The candidate shall bring the attendance certificate from the place of project work carried out.

- After the research, he/she should submit the detailed reports about the research in a dissertation and should present in an external examiner.

- Evaluation is based on work done, quality of report, performance in viva-voce, presentation etc.

- The report will be evaluated by duly appointed teaching faculty from head of department.

DISCIPLINE SPECIFIC ELECTIVE

DSE 1 - Genomics and Transcriptomics 4004

Course Objective: The course intends to give advanced theoretical knowledge on genomic organization and Genomic methods like microarray and transcriptome analysis

UNIT I Organization and Structure of Genomes 10

General organization and structure of genomes of viruses, prokaryotes, eukaryotes, and organelles (chloroplast, mitochondrion)

UNIT II Genome Mapping and Sequencing 10

Isolation and cloning of genomic DNA, Genome mapping (genetic and physical), STS assembly, ESTs, RAPDs, RFLPs, AFLPs, SSLPs, SNPs, linkage analysis, Restriction mapping, FISH, Chromosome painting, microsatellites, Gene finding, annotation, ORF and functional prediction, Chain termination and chemical degradation sequencing methods, Whole genome shot-gun sequencing.

UNIT III Large Scale Genomics/ Functional Genomics Analyses 15

Genome-wide association (GWA) analysis; Comparative Genomic Hybridization (CGH); Serial Analysis of Gene Expression (SAGE); Massively parallel Signature Sequencing (MPSS); Analysis of alteration in gene expression by Differential Display and Suppression Subtractive Hybridization. Introduction to Next Generation Sequencing (NGS) technologies for genome sequencing.

UNIT IV Microarray Technology and Analysis 10

Designing and producing microarrays; cDNA microarray technology; oligonucleatide arrays and designs; Sample preparation, labeling, hybridization, generation and analysis of microarray data.

UNIT V High-Throughput Transcriptomics Analysis 15

Gene Expression analysis by cDNA and oligonucleotide arrays; Methylome analysis using microarray; ChIP-on-Chip; Bioinformatics analysis of large-scale microarray data for comparative transcriptomics: Data normalization; Cluster analysis; Significance Analysis of Microarrays (SAM); Gene Ontology and Pathway analysis.

Total: 60 Hours

COURSE OUTCOMES:

CO-1: To understand the basics of genome structure and its organelles.

CO-2: To perform a range of practical techniques including DNA extraction and

sequencing, RT-PCR, reporter gene assay, metabolomics and genetic mapping.

CO-3: To design and analyse gene expression technique using Next Generation Sequencing (NGS) technologies.

CO-4: To gain knowledge on Microarray technology.

CO-5: To obtain and analyse information and data relating to specific genes using general and plant-specific databases, proteomics and metabolomics online portals, next generation sequencing tools and next generation mapping portals.

Text Books:

1. S.P. Hunt and F. J. Livesey, Functional Genomics.2000.
2. S. B. Primose. Principles of Genome Analysis.1998.

Reference Books:

1. C. R. Cantor and C. L. Smith. Genomics_ The Science and Technology behind the Human Genome Project,1999.
2. N. K. Spur, B. D. Young, and S. P. Bryant ICRF Handbook of Genome Analysis Volume 1 & 2. 1998.

DSE 2 - Proteomics: Principles and Techniques 4004

Course Objective: To acquaint the student with Proteome organization, identification, expression and applications of proteomics analysis. And its applications

UNIT-I An Introduction to proteomics **10**

Protein structure and function-Amino acids and their properties-Amino acids form polypeptides-Protein structure – four levels of organization-Cellular functions performed by proteins.

UNIT-II An overview of systems biology **10**

Emergence of systems biology-. Evolution from protein chemistry to proteomics-Evolution of proteomics from protein chemistry-Promises of proteomics-Techniques commonly used for proteome analysis.

UNIT-III Analysis of Proteomes I **10**

Analysis of proteomes - Two-dimensional polyacrylamide gel electrophoresis, Sample Preparation, Solubilization, Reduction, Resolution, Reproducibility of 2-DEDetecting proteins in polyacrylamide gels, Image analysis of 2-DE gels.

UNIT -IV Analysis of Proteomes II **15**

Mass spectrometry based methods for protein identification- De novo sequencing using mass spectrometric data- Correlative mass spectrometric based identification strategies, 2-DE gel electrophoresis coupled with mass spectrometry, Micro array techniques- Types of microarrays, designing a microarray experiment, Microarray Technology in Treating Disease.

UNIT-V Applications of Genomics and Proteomics Analysis **15**

Analysis of Genomes – Human, Mouse, Plasmodium falsiparum, Saccharomyces cerevisiae, Mycobacterium tuberculosis. Application of proteome analysis- drug development and toxicology, Pharmaceutical Applications, Proteomics in drug Discovery in human, phage antibodies as tools, Glycobiology and Proteomics in plant genetics and breeding.

Total: 60 Hours

COURSE OUTCOMES:

CO-1: To understand the basics of genome structure and its organelles.

CO-2: To perform a range of practical techniques including DNA extraction and sequencing, RT-PCR, reporter gene assay, metabolomics and genetic mapping.

CO-3: To design and analyse gene expression technique using Next Generation Sequencing (NGS) technologies.

CO-4: To gain knowledge on Microarray technology.

CO-5: To obtain and analyse information and data relating to specific genes using general and plant-specific databases, proteomics and metabolomics online portals, next generation sequencing tools and next generation mapping portals.

Text Books:

1. S. B. Primrose and R.M. Twyman - Principles of Genome Analysis and Genomics, 7th Edition, Blackwell Publishing, 2006.
2. 2. S. Sahai - Genomics and Proteomics, Functional and Computational Aspects, Plenum Publication, 1999.

Reference Books:

1. Andrezej K Konopka and James C. Crabbe, Compact Hand Book - Computational Biology, Marcel Dekker, USA, 2004.

2. 2. Pennington & Dunn - Proteomics from Protein Sequence to Function, 1st edition, Academic Press, San Diego, 1996.

DSE 3 - Concepts In Artificial Intelligence 4004

Course Objective: This Course mainly focuses more on machine learning, deep learning, probabilistic programming, multiagent systems, and includes sections where the AI's utility function is uncertain, rather than certain.

Unit I Introduction 12

What Is AI- the Foundations of Artificial Intelligence- The History of Artificial Intelligence- Intelligent Agents-How Agents Should Act, Structure of Intelligent Agents, Environments

Unit II Search Method 12

Solving Problems by Searching- Problem-Solving Agents, Formulating Problems, Search Strategies, Avoiding Repeated States, Constraint Satisfaction Search- Informed Search Methods- Best-First Search- Heuristic Functions- Memory Bounded Search- Iterative Improvement Algorithms- Game Playing- Introduction, Games as Search Problems, Perfect Decisions in Two-Person Games, Imperfect Decisions, Alpha-Beta Pruning, Games That Include An Element of Chance.

Unit III Logical Reasoning Systems 12

Variations, Using First Order Logic-Introduction to Logical Reasoning system Indexing, Retrieval and Unification- Logical Programming Systems- Theorem Provers- Forward-Chaining Production Systems- Frame Systems and Semantic Networks.

Unit IV Reasoning Under Uncertainty 12

Uncertainty- Acting under Uncertainty- Basic Probability Notation- The Axioms of Probability, Bayes' Rule and its Use- Probabilistic Reasoning Systems- Representing Knowledge in an Uncertain Domain the Semantics of Belief Networks- Inference in Belief Networks, Inference in Multiply Connected

Belief Networks- Non monotonic reasoning- Dealing with ignorance- Dempster Shafer theory- Dealing with vagueness- Fuzzy logic and fuzzy sets.

Unit V Planning and Learning 12

Planning A Simple Planning Agent- From Problem Solving to Planning, Planning in Situation Calculus, Basic Representations for planning, A Partial-Order Planning Example, A Partial-Order Planning Algorithm- Learning- A General Model of Learning Agents, Inductive Learning, Learning Decision Trees- Neural Networks- Bayesian Methods for Learning Belief

Networks- Genetic Algorithms and Evolutionary Programming- Knowledge in Learning- Explanation-Based Learning.

Total: 60 Hours

COURSE OUTCOMES:

CO-1: To compare AI with human intelligence and traditional information processing.

CO-2: To design AI functions and components involved in intelligent systems such as computer games, expert systems, semantic web, information retrieval, machine translation, mobile robots, decision support systems, and intelligent tutoring systems.

CO-3: To analyze the structures and algorithms of a selection of techniques related to searching, reasoning, machine learning, and language processing.

CO-4: To apply the basic principles, models, and algorithms of AI to recognize, model, and solve problems in the analysis and design of information systems.

CO-5: To discuss the core concepts and algorithms of advanced AI, including informed searching, CSP, logic, uncertain knowledge and reasoning.

Text Books:

1. Stuart Russel and Peter Norvig, "Artificial Intelligence- A Modern Approach", Prentice Hall, 1995.

2. George F Luger, "Artificial Intelligence", Pearson Education, 4th Edition, 2001.

References Books:

1. Engene Charniak and Drew Mc Dermott, "Introduction to Artificial Intelligence", Addison Wesley, 2000.

2. Nils J. Nilsson, "Principles of Artificial Intelligence", Narosa Publishing House, 2000.

DSE 4 - Python for Bioinformatics 4004

Course Objective: Read and understand the Python syntax. Be familiar with Python's fundamentals and develop simple applications. Apply the principles and techniques of object-oriented programming. Use sophisticated techniques and Python modules that are particularly useful for bioinformatics programming. Build new Python software tools for life science research. Summarize text patterns using regular expressions.

UNIT I Introduction to Python 12

Introduction to Python, History of Python, Python Features, Python Development Tools, Writing Python Program, Values and Variables:- Numeric Values, Variables and Assignment, Identifiers, Control codes within Structure, Controlling the print Function

UNIT II Expression 12

Expressions and Arithmetic:- Operator Precedence and Associativity, Comments, Errors (Syntax, Run-time errors, Logic Errors), Arithmetic Examples, Conditional Execution - Simple if Statement, if/else statement, Compound Boolean Expressions, Nested Conditionals, Multi-way Decision Statements, Conditional Expressions.

UNIT III Conditional Execution 12

Conditional Execution:- What is conditional statement in Python, Simple if Statement, if/else statement, nested if condition, else – if ladder, Compound Boolean Expressions, Nested Conditionals, Multi-way Decision Statements, Conditional Expressions.

UNIT IV Iteration 12

Iteration:- While Statement, For Statement, Nested Loops, the break statement, the continue statement, Infinite Loops, Computing Square roots, Drawing a Tree, Using Functions – mathematical functions – time Functions, reading the files from existing database using Python.

UNIT V Sequence Analysis through Python 12

Sequence Alignment:- Alphabets, Matching Sequences – Perfect Matches – Insertions and Deletions – Rearrangements – Global Versus Local Alignments – Sequence Length, Simple Alignment (Direct Alignment), Statistics:- Simple Statistics, Distributions, Normalizations, Multivariate Statistics, Probabilities, Odds.

Total: 60 hours

COURSE OUTCOMES:

CO-1: To understand why Python is a useful scripting language for developers.

CO-2: To learn how to design object-oriented programs with Python classes.

CO-3: To learn how to use indexing and slicing to access data in Python programs.

CO-4: To learn how to write functions and pass arguments in Python.

CO-5: To learn how to use exception handling in Python applications for error handling

Text Book:

1. Jason Kinser, "Python for Bioinformatics", Jones and Bartlett Publishers, Sudbury, Massachusetts 2009

References Books:

1. Richard L., Halterman, "Learning to Program With Python", 2011
2. Kent D. Lee, "Python Programming Fundamentals: Second Edition", Springer, 2010
3. Cody Jackson, "Learning to Program Using Python", Second Edition, 2013
4. Mark Lutz, "Learning Python", Third Edition, O'Reilly, 2007

DSE 5 - Recent Technologies in OMICS Sciences 4004

Course Objective: This course will enable the students to understand the knowledge in large scale microarray data, Next Generation Sequencing Technology, and its applications.

UNIT I Micro Array Singenomics 12

Designing and producing microarrays; types of microarrays; cDNA microarray technology; oligonucleatide arrays; Sample preparation, labeling, hybridization, generation of microarray data. Gene Expression analysis by cDNA and oligonucleotide arrays; ChIP-on-Chip; Bioinformatic analysis of large-scale microarray data for comparative transcriptomics

UNIT II Next Generation Sequencing Technologies 12

Introduction to Next Generation Sequencing (NGS) technologies; Principles of NGS by Roche/454, Illumina, Life Technologies, Pacific Biosciences, Ion Torrent technologies; Applications of NGS to disease diagnosis and personalized medicine.

UNIT III Protein Micro Arrays 12

Types of protein arrays; Protein microarray fabrication; Experimental analysis of proteins arrays. Data acquisition and processing; Applications of protein microarray types.

UNIT IV 2D-Gel Electrophoresis of Proteins 12

Sample preparation, First-dimension IEF with IPG; Second dimensional separation of proteins; Image analysis of 2-DE gels; Protein expression profiling and comparative proteomics of complex proteomes using 2-DE.

UNIT V Mass-Spectrometry 12

Basics of Mass-spectrometry (MS) and bimolecular analysis; Common ionization methods for peptide/protein analysis (MALDI and ESI); Principles of Time of Flight (TOF), Ion Trap (IT), Quadrupole (Q), Fourier Transform-Ion cyclotron Resonance (FT-ICR), and Orbitrap mass analyzers; Collision-Induced Dissociation (CID) of peptides; Analysis of complex protein mixtures using Nano-liquid chromatography (Nano-LC) coupled to Mass-spectrometry analysis; Analysis of metabolites using Gas-chromatograpgy coupled to Mass-spectrometry; Massspectrometry analysis of Post-Translational Modifications of proteins (Phosphorylation and glycosylation). Accurate quantitation of peptides and small molecules using SRM/MRM approach.

Total: 60 hours

COURSE OUTCOMES:

CO-1: To understand the basic of Microarray and chip technology

CO-2: To attain the knowledge about Next Generation sequencing

CO-3: To learn the Experimental techniques of protein microarray.

CO-4: To analyze the protein expression profiling by 2D gel Method.

CO-5: To acquire the knowledge of spectrometric techniques.

Text Books:

1. Schena M. (2000) DNA Microarrays _ A Practical Approach. Oxford University Press.

2. Rinaldis E. D. and Lahm A (2007) DNA Microarrays. Horizon bioscience.

References Books:

1. Muller H. J. and Roder T. (2006) Microarrays. Elsevier Academic Press

2. Causton H. C., Quackenbush J., and Brazma A. (2004) A Beginner's Guide _ Microarray. Gene Expression Data Analysis. Blackwell Publishing.

3. Schena M. (2005) Protein Microarrays. Jones and Bartlett Publishers

7. Assessment Methods:

It is important that the students of PG Bioinformatics program achieve the desired results in terms of the learning outcomes to be professionally sound and competitive in a global society. Achieving the desired learning outcomes is also imperative in terms of job employment leading to a happy and prosperous individual further leading to a happy and prosperous family and thereby a happy and prosperous society or nation. The assessments tasks are pivotal to get an authentic feedback for the teaching learning process and for mid-course corrections and further improvements in future. The assessment tasks are carried out at various stages of the duration of the PG Bioinformatics programme like Mid-term assessments, End-term assessments, Semester examinations, Regular assessments, viva-voce etc.

The assessment tasks are listed below:

- **Multiple Choice Questions (MCQ)** are one of the predominant form of assessment Tasks. This task is used during all kinds of term and semester examinations.
- **Short-Answer Questions** during term and semester examinations are used to assess the ability of the student to convey his thoughts in a coherent way where prioritization of the information in terms of their significance is tested.
- **Surprise Quizzes** are regularly used during continuous assessment while the teaching learning process is continuing which prepares the student to quickly recall information or quickly analyses a problem and come up with proper solutions.
- **Visual/Pictorial Quizzes** are used to sharpen the comprehension of the students after looking at all the components of a system.
- **Impromptu Opinions** on Biocomputing problems are sought from student during regular teaching learning which helps them to think quickly in a given context. This helps build their ability to come up with solutions to problems which the students might not have confronted previously.
- **Problem Solving** question are generally given during the laboratory work.
- **Data Interpretation** is also another assessment task which is used to develop analytical skills of the students. This assessment is used during laboratory work as well as during conduction of project work.
- **Paper/ Project presentations** are used to assess the articulation skills of the student. These are carried out both during the duration of the teaching learning processes as well as during end-Semester examinations.

- **Report Writing** is used to assess the keenness of the students for details related to Biocomputing while visiting laboratories/industries as students invariably are required to submit a report after such visits.
- **Assignment Writing** is used to assess the writing abilities of the students during midterm vacations.
- **Viva-voce** during the laboratory working hours and during laboratory examination are used to assess the over-all knowledge and intelligence of the students.

SOFT SKILLS

SOFTSKILLS – I **- 2 0 0 2**

Course Objective:

- To enable participants Business Communication Skills
- To enhance participants E-mail writing skills
- To impart Leadership and Team Bonding skills

Credit Hours

1. READING COMPREHENSION AND VOCABULARY **06**

Filling the blanks – Cloze Exercise – Vocabulary building – Reading and answering Questions.

2. LISTENING AND ANSWERING QUESTIONS. **06**

Listening and writing – Listening and sequencing sentences – Filling in the blanks – Listening and answering questions.

3. GROUP DISCUSSIONS **06**

Why GD part of a selection process – Structure of a GD – strategies in GD – Team Work – Body Language

4. CONVERSATION. **06**

Face to face Conversation and Telephone conversation.

5. SELF- INTRODUCTION AND ROLE PLAY **06**

Total **30 Hours**

Course Outcome

At the end of this course the students will be able to,

CO1 Understand the importance of communication skills in English
CO2 Learn the important effective communication techniques
CO3 Prepare the students to meet an interview.
CO4 Introduce the way of communication with others.
CO5 Teach the basic etiquette to face large group of audience with confidence.

Books Recommended

- Barun K. Mitra. Personality Development and Soft Skills. Oxford University Press. New Delhi.2011.
- S.P. Sharma. Personality Development. Pustaq Mahal. New Delhi. 2010.Meenakshi Raman and Sangeetha Sharma. Technical Communication. Oxford University Press. New Delhi. 2009.
- Tiko, Champa & Jaya Sasikumar. Writing with a Purpose.OUP. New Delhi. 1979

Web Source:

- https://www.skillsyouneed.com/ips/communication-skills.html
- https://blog.smarp.com/top-5-communication-skills-and-how-to-improve-them
- https://blog.hubspot.com/service/phone-etiquette

SOFT SKILLS – II **- 2 0 0 2**

Course Objective:

- To enable students to develop their communication skills effectively
- To enhance students Reading, Writing, Listening and Speaking skills
- To develop their self-confidence through communication

Credit Hours

1. **PRESENTATION SKILLS** **06**
   Elements of an effective presentation – structure of presentation – voice modulation – Audience analysis – Body language

2. **SOFT SKILLS** **06**
   Time Management – Articulateness – Assertiveness – Stress management

3. **RESUME / REPORT PREPARATION / LETTER WRITING** **06**
   Structuring the resume / Report – Business letters – E-Mail Communication

4. **INTERVIEW SKILLS** **06**
   Kinds of Interviews – Required by Skills – Corporate Culture – Mock Interviews

5. **30 FREQUENTLY ASKED QUESTIONS** **06**

Total **30 Hours**

Course Outcome

At the end of this course the students will be able to,

CO1 Illustrate the essential of presentation skills, thoughts, structure, voice modulation, audience analysis and body language

CO2 Utilize the psychological skills pertaining to time management, articulation, assertion and stress management

CO3 Construct methodology for preparation of resume, reports, business letters and email communication

CO4 Appraise learners with varied skills needed for expose to interviews

CO5 Categorize the nature of questions asked usually in interviews

Books Recommended

- Barun K.Mitra. Personality Development and soft skills. Oxford University Press. New Delhi. 2011.
- S P Sharma. Personality Development. Pustaq Mahal. New Delhi. 2010.
- Meenakshi Raman and Sangeetha Sharma. Technical Communication. Oxford University Press. New Delhi. 2009.

Web Sources:

- https://www.skillsyouneed.com/ips/communication-skills.html
- https://www.businessnewsdaily.com/5836-top-interviewing-skills.html
- https://gdpi.hitbullseye.com/Group-Discussion.php

SOFT SKILLS III **2 0 0 2**

Course Objective:

- To enable students to develop their soft skills and Body Language
- To enhance students Reading, Writing, Listening and Speaking skills
- To develop their self-confidence to excel at Interviews

	Credit Hours
UNIT–I	**06**
Powerful Presentation	
UNIT–II	**06**
Reinforcement	
UNIT–III	**06**
Using visual aids	
UNIT–IV	**06**
Types and Methods of Presentations	
UNIT–V	**06**
Obstacles to Presentation	
Total	**30 Hours**

Course Outcome:

CO1 To develop participants social and professional skills
CO2 To help participants manage time effectively
CO3 To build a strong resume to suit corporate requirements
CO4 To face interviews confidently
CO5 To enhance their aptitude abilities

Books Recommended:

- Roz Townsend: Presentation Skills for the Upwardly Mobile, Emerald, Chennai.
- Prasad, H. M. How to Prepare for Group Discussion and Interview. New Delhi: Tata McGraw-Hill Publishing Company Limited, 2001.
- Pease, Allan. Body Language. Delhi: Sudha Publications, 1998.

Web Sources:

- https://www.skillsyouneed.com/ips/communication-skills.html
- https://venngage.com/blog/presentation-skills/
- https://gdpi.hitbullseye.com/Group-Discussion.php