INSTITUTE OF SCIENCE, TECHNOLOGY & ADVANCED STUDIES (VISTAS)
(Deemed to be University Estd. u/s 3 of the UGC Act, 1956)
PALLAVARAM - CHENNAI
NAAC ACCREDITED WITH 'A' GRADE
Marching Beyond 25 Years Successfully

B.Sc.

BIOCOMPUTING

Curriculum and Syllabus

(Based on choice based credit system)

Effective from the Academic year

2018 - 2019

Department of Bioinformatics
School of Life Sciences

PROGRAM EDUCATIONAL OBJECTIVES (PEO)

PEO-1: An ability to develop the practical knowledge related to Life science, Computer science and information technology in an interdisciplinary manner for providing innovative ideas to solve the biological problems and promote the research globally.

PEO-2: The extraordinary skills to analyze the scientific big data, create a novel objective, implement methodology to derive a key finding and apply this knowledge for welfare of society. Students should be able to develop as computational expert and follow the ethical rules on areas related to Life sciences and Bioinformatics.

PEO-3: Develop as a resource person with interdisciplinary knowledge who can finish the advance tasks related to biology and computer science in a challenging scientific environment.

PEO-4: Update knowledge on programming and database development on biological data and information and help the scientific research community.

PEO-5: U.G. program and its knowledge give confidence to the students and shine in the booming bioinformatics careers related to academics, research and development and industry.

PROGRAM OUTCOME (PO)

The B.Sc. program (Biochemistry, Biotechnology, Bioinformatics and Microbiology) at VISTAS has documented measurable outcomes that are based on the needs of the programme's stakeholders. The programme outcomes that the department presently adapts to future graduates are as follows:

PO-1: Scientific knowledge: Graduates will acquire biochemistry/biotechnology / bioinformatics/ microbiology specific knowledge including recent techniques in the respective fields coupled with hands-on skills and leadership skills for a successful career.

PO-2: Problem analysis: Graduates will be able to analyse, solve and troubleshoot problems in implementation of biochemistry/biotechnology/ microbiological protocols.

PO-3: Design/development of solutions: Graduates will develop creative thinking and cooperate with each other to solve problems in the field of biochemistry/biotechnology/bioinformatics/ microbiology.

PO-4: Conduct investigations of complex problems: Graduates will acquire practical skills – which help in planning and designing protocols to validate hypothesis and execute experimental techniques independently as well as assimilate, analyse and interpret subsequent data.

PO-5: Modern tool usage and communication: Graduates will effectively be able to manage resources and time using ICT and computer enabled devices and accomplish ability to understand and communicate all ideas effectively.

PO-6: Environment sustainability and Ethics: Graduates will get adequate knowledge to use information and implement solutions for environmental protection and remediation. Graduates will be aware of their role and responsibility in handling and use of microbes including genetically modified microorganisms.

PO-7: Lifelong learning: Graduates will carry on to learn and adapt in a world of constantly evolving technology.

PROGRAMME SPECIFIC OUTCOME (PSO)

PSO-1: The primary goal is to make the students to understand biological concepts.

PSO-2: To acquire knowledge on the basics of computer and the principles of programming languages.

PSO-3: To understand the levels of programming language and its application in various fields of biology.

PSO-4: To be well versed in handling the biological data from the different database available online at present.

PSO-5: To obtain the knowledge on basics in designing the webpage for a database as well as online tools and softwares.

PSO-6: To gain a sound knowledge on the application of computer techniques in the field of chemistry, plants, microbes, etc.

PSO-7: To implement the computer programming knowledge in the design and maintenance of database to utilize the complex form of biological data in a simpler format.

PSO-8: To utilize the bioinformatics skill to venture in development of fields like pharmaceutical and biotechnological concerns.

Department of Bioinformatics

Board of Studies Members

B.Sc. BIOCOMPUTING

S.No	Name	Post	Contact address	Designation
1.	Dr. Radha Mahendran	Associate Professor/ Head Dept of Bioinformatics	VISTAS P.V. Vaithiyalingam Road Pallavaram Chennai - 117 Mobile no: 09003237145	Chairman
2.	Mrs. Suganya.J	Asst Professor/ Dept of Bioinformatics	VISTAS P.V. Vaithiyalingam Road Pallavaram Chennai - 117 Mobile no: 09042112221	Internal Members
3.	Dr. M.N Ponnusamy	Emeritus professor, Dept of crystallography and biophysics	University of Madras, Guindy Campus, Chennai 600 025 Phone: 044 - 22300122 Email: mspy@hotmail.com	External expert
4.	Dr. J. Senthil Kumar	Asst Professor/ Dept of computer science	Loganatha Narayanasamy Government College (Autonomous). Ponneri. Chennai-204	External expert
5.	Ms. K.Hemamalaini	II Year B.Sc., Biocomputing	VISTAS P.V. vaithiyalingam Road, pallavaram, Chennai -117	Student Member

VELS INSTITUTE OF SCIENCE, TECHNOLOGY AND ADVANCED STUDIES (VISTAS)

CHENNAI - 600 117

REGULATIONS

CHOICE BASED CREDIT SYSTEM

B.Sc. BIOCOMPUTING

1. DURATION OF THE PROGRAMME

1.1. Three years (six semesters)

1.2. Each academic year shall be divided into two semesters. The odd semesters shall consist of the period from July to November of each year and the even semesters from January to May of each year.

1.3 There shall be not less than 90 working days for each semester.

2. ELIGIBILITY FOR ADMISSION

Candidates for admission to the first year of the degree of Bachelor of BioComputing shall be required to have passed the Higher Secondary Examination with Maths/Biology or Computer Science (Academic Stream) conducted by government of Tamilnadu or an examination accepted as equivalent thereof by the syndicate of VISTAS.

3. CREDIT REQUIRMENTS AND ELIGIBILITY FOR AWARD OF DEGREE

A Candidate shall be eligible for the award of the Degree only if he/she has undergone the prescribed course of study in a College affiliated to the University for a period of not less than three academic years and passed the examinations of all the Six Semesters prescribed earning a minimum of 140 credits as per the distribution given in for Part I, II, III, IV & V and also fulfilled such other conditions as have been prescribed thereof.

4. COURSE OF STUDY, CREDITS AND SCHEME OF EXAMINATION

The Course Components and Credit Distribution shall consist Part I, II & III:

(Minimum number of Credits to be obtained)

Credit Assignment Each course is assigned certain number of credits based on the following: Contact period per week CREDITS

1 Lecture Period - 1 Credit

1 Tutorial Period - 1 Credit

2 Practical Periods - 1 Credit

(Laboratory / Seminar / Project Work / etc.)

5. REQUIREMENTS FOR PROCEEDING TO SUBSEQUENT SEMESTER

5.1. Eligibility:

Students shall be eligible to go to subsequent semester only if they earn sufficient attendance as prescribed therefore by the Board of Management from time to time.

5.2. Attendance:

All Students must earn 75% and above of attendance for appearing for the University Examination. (Theory/Practical)

5.3. Condonation of shortage of attendance:

If a Student fails to earn the minimum attendance (Percentage stipulated), the HODs shall condone the shortage of attendance up to a maximum limit of 10% (i.e. between 65% and above and less than 75%) after collecting the prescribed fee towards the condonation of shortage of attendance. Such fees collected and should be remitted to the University.

5.4. Non-eligibility for condonation of shortage of attendance:

Students who have secured less than 65 % but more than 50 %of attendance are NOT ELIGIBLE for condonation of shortage of attendance and such Students will not be permitted to appear for the regular examination, but will be allowed to proceed to the next year/next semester of the program

5.5. Detained students for want of attendance:

Students who have earned less than 50% of attendance shall be permitted to proceed to the next semester and to complete the Program of study. Such Students shall have to repeat the semester, which they have missed by rejoining after completion of final semester of the course, by paying the fee for the break of study as prescribed by the University from time to time.

5.6. Condonation of shortage of attendance for married women students:

In respect of married women students undergoing UG programs, the minimum attendance for condonation (Theory/Practical) shall be relaxed and prescribed as 55% instead of 65% if they conceive during their academic career. Medical certificate from the Doctor together with the attendance details shall be forwarded to the university to consider the condonation of attendance mentioning the category.

5.7. Zero Percent (0%) Attendance:

The Students, who have earned 0% of attendance, have to repeat the program (by rejoining) without proceeding to succeeding semester and they have to obtain prior permission from the University immediately to rejoin the program.

5.8. Transfer of Students and Credits:

The strength of the credits system is that it permits inter Institutional transfer of students. By providing mobility, it enables individual students to develop their capabilities fully by permitting them to move from one Institution to another in accordance with their aptitude and abilities.

5.8.1. Transfer of Students is permitted from one Institution to another Institution for the same program with same nomenclature. Provided, there is a vacancy in the respective program of

Study in the Institution where the transfer is requested. Provided the Student should have passed all the courses in the Institution from where the transfer is requested.

5.8.2. The marks obtained in the courses will be converted and grades will be assigned as per the University norms.

5.8.3. The transfer students are not eligible for classification.

5.8.4. The transfer students are not eligible for Ranking, Prizes and Medals.

5.8.5. Students who want to go to foreign Universities upto two semesters or Project Work with the prior approval of the Departmental/College Committee are allowed to get transfer of credits and marks which will be converted into Grades as per the University norms and are eligible to get CGPA and Classification; they are not eligible for Ranking, Prizes and Medals.

6. EXAMINATION AND EVALUATION

6.1. Register for all subjects:

Students shall be permitted to proceed from the First Semester up to Final Semester irrespective of their failure in any of the Semester Examination. For this purpose, Students shall register for all the arrear subjects of earlier semesters along with the current (subsequent) Semester Subjects.

6.2. Marks for Internal and End Semester Examinations for PART I, II, III

6.2.1 There shall be no passing minimum for Internal.

6.2.2 For external examination, passing minimum shall be 40% [Forty Percentage] of the maximum marks prescribed for the paper for each Paper/Practical/Project and Viva-Voce.

6.2.3 In the aggregate [External/Internal] the passing minimum shall be of 40%.

6.2.4. He/She shall be declared to have passed the whole examination, if he/she passes in all the papers and practical wherever prescribed as per the scheme of the examinations by earning 140 CREDITS in PartI, II, and III.

7. MAXIMUM PERIOD FOR COMPLETION OF THE PROGRAMS TO QUALIFY FOR A DEGREE

A Student who for whatever reasons is not able to complete the programs within the normal period (N) or the Minimum duration prescribed for the programme, may be allowed two years period beyond the normal period to clear the backlog to be qualified for the degree. (Time Span = N + 2 years for the completion of programme)

8. REVISION OF REGULATIONS, CURRICULUM AND SYLLABI

The University may from time to time revise, amend or change the Regulations, Curriculum, Syllabus and Scheme of examinations through the Academic Council with the approval of the Board of Management.

VELS INSTITUTE OF SCIENCE, TECHNOLOGY AND ADVANCED STUDIES (VISTAS)

B.Sc., BIOCOMPUTING DEGREE COURSE

COURSES OF STUDY AND SCHEME OF ASSESSMENT

(MINIMUM CREDITS TO BE EARNED: 140)

Code No.	Course	Hours/Week			Credits	Maximum Marks		
		Lecture	Tutorial	Practical		CA	SEE	Total
SEMESTER 1								
LANG	Tamil I/ Hindi / French	5	0	0	5	40	60	100
ENG	English I	5	0	0	5	40	60	100
CORE	Introduction to Computer, Algorithm and Statistics	5	0	0	5	40	60	100
CORE	Cell Biology and Biochemistry	4	0	0	4	40	60	100
CORE	Basic Concepts and Algorithm in Computer Practical	0	0	4	2	40	60	100
CORE	Techniques in Biochemistry Practical	0	0	4	2	40	60	100
		19	0	8	23			
SEMESTER 2								
LANG	Tamil II / Hindi / French	5	0	0	5	40	60	100
ENG	English II	5	0	0	5	40	60	100
CORE	Programming in C	5	0	0	5	40	60	100
CORE	Biological Databases and sequence analysis	4	0	0	4	40	60	100
CORE	Programming in C Practical	0	0	4	2	40	60	100
CORE	Biological Databases and sequence analysis Practical	0	0	4	2	40	60	100
		19	0	8	23			

CA - Continuous Assessment

SEE - Semester End Examination

VELS INSTITUTE OF SCIENCE, TECHNOLOGY AND ADVANCED STUDIES

Programme: B.Sc., BIOCOMPUTING DEGREE COURSE

Code No.	Course	Hours/Week			Credits	Maximum Marks		
		Lecture	Tutorial	Practical		CA	SEE	Total
SEMESTER 3								
LANG	Tamil III / Hindi / French	5	0	0	5	40	60	100
ENG	English - III	5	0	0	5	40	60	100
CORE	Programming in C++	4	0	0	4	40	60	100
CORE	Plant Bioinformatics	4	0	0	4	40	60	100
CORE	Bioinformatics in Microbiology, Immunology and Nanotechnology	3	0	0	3	40	60	100
CORE	Programming in C++ Practical	0	0	3	1	40	60	100
CORE	Plant Bioinformatics Practical	0	0	3	1	40	60	100
SEC	Soft Skills - I	2	0	0	2	40	60	100
		23	0	6	25			
SEMESTER 4								
LANG	Tamil IV / Hindi / French	5	0	0	5	40	60	100
ENG	English IV	5	0	0	5	40	60	100
CORE	Cheminformatics	4	0	0	4	40	60	100
CORE	Operating System and Computer Networks	3	0	0	3	40	60	100
CORE	Medical Coding and Transcription	3	0	0	3	40	60	100
CORE	Cheminformatics Practical	0	0	4	2	40	60	100
AECC	Environmental Studies	2	0	0	2	40	60	100
SEC	Soft Skills - II	2	0	0	2	40	60	100
		24	0	4	26			

CA - Continuous Assessment

SEE - Semester End Examination

VELS INSTITUTE OF SCIENCE, TECHNOLOGY AND ADVANCED STUDIES

Programme: B.Sc., BIOCOMPUTING DEGREE COURSE

Code No.	Course	Hour / Week				Maximum Marks		
		Lecture	Tutorial	Practical	Credits	CA	SEE	Total
SEMESTER 5								
DSE	DSE – 1	4	0	0	4	40	60	100
DSE	DSE – 2	4	0	0	4	40	60	100
DSE	DSE – 3	4	0	0	4	40	60	100
DSE	Programming in Java Practical	0	0	4	2	40	60	100
DSE	Perl and Bioperl Practical	0	0	4	2	40	60	100
GE	Generic Elective - I	3	0	0	3	40	60	100
SEC	NSS	2	0	0	2	40	60	100
		17	0	8	21			
SEMESTER 6								
DSE	DSE – 4	3	0	0	3	40	60	100
DSE	DSE – 5	3	0	0	3	40	60	100
DSE	DSE – 6	3	0	0	3	40	60	100
DSE	Programming in Visual Basics and Python Practical	0	0	4	2	40	60	100
GE	Generic Elective - II	3	0	0	3	40	60	100
SEC		2	0	0	2	40	60	100
DE	Project Work	0	0	12	6	40	60	100
		14	0	16	22			

CA - Continuous Assessment

SEE - Semester End Examination

DISCIPLINE SPECIFIC ELECTIVE COURSES

1. PROGRAMMING IN JAVA
2. PROGRAMMING IN JAVA – PRACTICAL
3. PROGRAMMING IN PERL AND BIOPERL
4. PERL AND BIOPERL - PRACTICAL
5. GENOMICS AND PROTEOMICS
6. PROGRAMMING IN VISUAL BASICS AND RDBMS
7. PROGRAMMING IN VISUAL BASICS AND PYTHON - PRACTICAL
8. PROGRAMMING IN PYTHON
9. ENZYMES AND METABOLISM
10. MATHEMATICS FOR BIOINFORMATICS
11. VIROLOGY
12. BIOPHYSICAL CHEMISTRY
13. CLOUD COMPUTING BASICS
14. RECOMBINANT DNA TECHNOLOGY
15. DATA WAREHOUSING AND DATA MINING

GENERIC ELECTIVE COURSES

1. INTRODUCTION TO BIOINFORMATICS
2. CHEMINFORMATICS
3. MOLECULAR MODELING AND DRUG DESIGNING
4. STRUCTURAL BIOINFORMATICS
5. PROGRAMMING IN PERL AND BIOPERL
6. PYTHON FOR BIOINFORMATICS
7. CONSUMER AFFAIRS
8. DISASTER MANAGEMENT

SKILL ENHANCEMENT COURSES

1. NSS PAPER I
2. NSS PAPER II
3. SOFT SKILLS I
4. SOFT SKILLS II
5. SWAYAMPRABHA I
6. SWAYAMPRABHA II

Introduction to Computer, Algorithm and Statistics 5 0 0 5

Course Objectives: To gain a fundamental understanding of the power and limits of basic models of computation, and to gain comfort with associated proof techniques. This course is designed to provide the non- science/ mathematics/ engineering/ business student a intense foundational introduction to the fundamental concepts in statistics. After completing the course the student should be able to work basic problem and word problems in logic, set theory, counting methods, probability, and statistics.

Course Outcome

CO - 1: To gain basic knowledge on history of computers and generations.

CO - 2: To know the basic parts of computers and the role understand the molecular basis of the cell.

CO - 3: To acquire the basics of computer hardware, software and operating systems.

CO - 4: To understand the usage of internet, e-mail and Microsoft utilities.

CO - 5: To understand the concepts of statistics in the data collection, maintenance and interpretation.

CO - 6: To understand the role of questionnaire and the techniques to be followed in the field of data management.

CO - 7: To gain information about the classification of data and its importance.

CO - 8: To understand the usage of various representations of data includes diagrammatic and tabular form.

CO - 9: To be well versed with the mathematical derivations of mean and average.

CO - 10:To acquire knowledge on computing the median, mode and deviation.

UNIT I INTRODUCTION TO COMPUTERS 10

History of computer - Computer Generations, Types of computer, Computer components – CPU – I/P Devices and O/P devices, Functionalities of a Computer, Advantages and disadvantages, Applications of computer. Memory and memory types RAM and RAM types, ROM and ROM types, Mother Board, Memory Units, Ports.

UNIT II COMPUTER HARDWARE AND SOFTWARE 12

Hardware – Types – Working methods, Software – System software and application software (MS Word, Excel and PowerPoint), Operating system, Example of Operating System. Microsoft Word, Microsoft Excel, Microsoft PowerPoint, Introduction to Internet, Working of Internet, Internet Services, Internet addressing, E-Mail Basics- Web Development Tools, Introduction TO HTML.

UNIT III INTRODUCTION OF PROGRAMMING CONCEPTS 18

Introduction of programming concepts-Input, process and output-Programs and programmingLanguages-Tools Used in problem Solving - Representing the Programming logic UsingFlowcharts and Algorithms-Problem Solving Using Flowcharts & Algorithm - Processes in a Flowchart - Representing the Programming logic Using Flowcharts-Problem Solving Using Flowcharts -Representing Decision and Repetition Processes in a Flowchart.

UNIT IV PROGRAMMING LOGIC USING ALGORITHM 15

Representing the Programming Logic Using Algorithm/Pseudocode-Problem Solving UsingPseudocode-Variables and Constants-Data Types-Using Operators-Conditional Execution - Understanding Iterations and Modular Programming-Implementation Iterative Processes-Modular Approach to programming-Dividing Programs into Modules-Types of modules - Working with Large Volumes of Data-Working with Arrays.

UNIT V STATISTICAL ANALYSIS 20

Statistics: Classification- Quantitative, Geographical, Chronological.Tabulation, Frequency, Distribution, Diagrammatic Representation- Bar diagram, Percentage Bar Diagram, Pie Diagram, Pictogram, Graphical representation, Frequency curve, Cumulative Frequency, Ogive,LorenzCurve.Measures of Averages- Introduction, Arithmetic Mean, Weighted Arithmetic Mean, Formula for calculating AM in a frequency distribution, Properties of AM, Combined Mean (CM), Geometric Mean (GM), Harmonic Mean (HM), Median, Quartiles and Deciles, Mode, Merits and Demerits. Quartile Deviation, Its Merits and Demerits, Mean Deviation, Definition, Relative Measures, Merits and Demerits, Standard Deviation (SD), Formula for

calculating SD, Merits and Demerits, Relative Measure, combined Mean and SD.

Total: 75 Hours

Text Books:

1. Anita Goel, "Computer Fundamentals", Pearson Education India, 2010.
2. P.R.Vittal, "Mathematical Statistics", Margham Publication, 3rd Edition, 2012.

Reference Books:

1. SangheraKamaljeet, "Fundamentals of Computing", Kendall Hunt Publishing Company, 2nd Edition, 2007.
2. AnuragSeetha, "Introduction To Computers And Information Technology",Ram Prasad & Sons, McGraw Hill, 2011
3. S.K.Basandra, "Computers Today", Galgotia Publications, 2006
4. Alexis Leon & Mathews Leon, "Fundamentals of Information Technology", Vikas Publishing House, New Delhi, 2009.

Cell Biology and Biochemistry 4 0 0 4

Course Objective: This course covers basic properties of cells and cell organelles.It also examines properties of differentiated cell systems and tissues. The Principal aim of the course is to equip students with a basic knowledge of the structural and functional properties of cells and also understanding the biological principles, and the ability to make connections across different levels of biological organization, from molecules to cells, to whole organisms, populations and ecosystems.

Course outcome:

CO-1: To develop the knowledge towards functional accept of the cells present in our body

CO-2: To understand the working of the different types of tissues present in the human body

CO-3: To determine biological importance of carbohydrates in living organisms

CO-4: To acquire the basic information about the structure, function of DNA and RNA

CO-5: To obtained the overall information about the vitamins especially its metabolic function and daily requirement.

CO-6: To develop the knowledge towards the amino acid which play an important role in protein formation.

CO-7: To understand the biological importance of protein that are responsible for some biological processes.

CO-8: To achieve knowledge about metabolic pathways that are involved for the production of energy

CO-9: To acquire the skill to separate and purify the biomolecules by three key analytical and purification methods (electrophoresis chromatography centrifugation).

CO-10: To develop the skill for detecting and characterizing biomolecules using electrophoresis chromatography centrifugation techniques.

UNIT I Cell and Cell Cycle 16

Cell: Cells as a unit of life, structure of prokaryotic and eukaryotic cells. An overview of organelles (Mitochondria, Chloroplasts, ER, Golgi, Ribosomes, Lysosomes and Peroxisomes, Nucleus and Nucleolus). Cell Cycle: Mitosis - Phases of mitosis (Early Prophase, Later Prophase, Metaphase, Anaphase, Telophase), Cytokinesis. Meiosis - Phases of meiosis, Meiosis I (Prophase I, Metaphase I, Anaphase I, Telophase I), Meiosis II (Prophase II, Metaphase II, Anaphase I, Telophase II).

UNIT II Cell Signaling and Central Dogma 16

Cell Signaling:Overview of cell signaling, Forms of signaling, Paracrine signaling, Synaptic signaling, Autocrine signaling, Endocrine signaling, signaling through cell-cell contact. DNA replication (Replication Fork Formation, Primer Binding, Elongation, Termination), Replication Enzymes. Transcription (RNA polymerase, Initiation, Elongation, Termination), Eukaryotic RNA modifications. Translation (Getting started: Initiation, Extending the chain: Elongation, Finishing up: Termination), genetic code.

UNIT III Molecules of Life: Protein and Amino Acids 12

Protein: Definition, properties, occurrence and biological importance of protein, Different levels of organization-Primary, secondary tertiary and Quaternary structures. Amino acids: Definition, composition, structure, properties, stability and biological importance of Amino Acid, Formation Peptide bond, Identification of C and N terminal residues of amino acids

UNIT IV Molecules of Life: Carbohydrates and Nucleotides 12

Introduction to carbohydrates-Monosaccharides and their derivatives, Disaccharides, Polysaccharides. Nucleic acids – Purines, pyrimidines, Nucleosides and Nucleotides. Types of Nucleoside – DNA (deoxyribonucleic acid), RNA (Ribonucleic acid)

UNIT V Mutation and Chromosomal 14

Mutation – Types of mutations, types of mutagenic agents and their molecular mechanism; DNA repair; Chromosomal types and structure; Mechanism by which genome undergoes changes, recombination, mutation, inversion, duplication, and transposition

Total: 70 Hours

Text Books:

1. Channarayappa, “Cell Biology”, Universities Press, 2010.
2. P.S.Verma& V.K. Agarwal, “Cell Biology (Cytology, Biomolecules and molecular biology”, S. Chand Publishing, 2015.

Reference Books:

1. Lehninger, A. L. 1984. Principles of Biochemistry. CBS publishers and distributors, New
2. Delhi, India
3. Horton, Moran, Ochs, Rawn, Scrimgeour Principles of Biochemistry Prentice Hall Publishers.
4. David. E. Sadava Cell Biology: Organelle Structure and Feunction Jones & Bartlett publishers.

Basic Concepts and Algorithm in Computer Practical 0 0 4 2

Course Objective: To Train the students to operate computer systems and make use of application software. To understand and learn the concept of MS Word, MS Excel and MS PowerPoint and its applications. To ensure the clear practical knowledge on HTML tags.

Course Outcome

CO - 1: To gain basic practical knowledge on computers.

CO - 2: To know the basics of operating systems and browsers.

CO - 3: To understand the mode of surfing internet and search engines options.

CO - 4: To understand the usage of email and the various options.

CO - 5: To know the steps of windows installation and error debugging.

CO - 6: To understand the basics of word processing by knowing notepad and MS word options.

CO - 7: To gain information on spreadsheet applications using MS Excel.

CO - 8: To understand the usage of MS PowerPoint and its usage in presentation.

CO - 9: To be well versed with the web page creation using HTML.

CO - 10: To acquire knowledge on dynamic web page creation by using advance tags of HTML.

1. Hands-On experience: - Utilities of Windows (XP) – Browsers (I.E., Chrome, Mozilla Firefox) – Surfing the Internet – Search Engines – E-Mail (Sending and Receiving mail, attaching folders on mail) **05**
2. Downloading and installing software/plug-ins on Windows – Searching / Surfing on the WWW. **05**
3. Word Processing (Notepad and MS Word) **10**
    - Creating, Saving & Opening a document
    - Editing, Inserting, Deleting, Formatting, Moving & Copying Text
    - Find & Replace, Spell Checker & Grammar Checker (Thesaurus), Document Enhancement (Borders, Shading, Header, Footer), Printing document (page layout, Margins)
    - Introduction to the use of Wizards & Templates, Working with Graphics (Word Art), working with Tables & Charts, Inserting pictures and files.

4. Spreadsheet Applications (MS Excel) **15**
    - Worksheet Basics - Entering information in a worksheet, Saving & Opening a worksheet, Editing, Copying & Moving data, Inserting, Deleting & Moving Columns & Rows, Clearing Cells & Formatting cells
    - Working with workbooks, Working with formulae and functions, Printing worksheets
    - An introduction to the use of advanced spreadsheet concepts, sorting records, Finding records, Adding & Deleting records, Filtering records in a worksheet.
    - Working with Macros, Creating and using multiple worksheets.

5. Presentation Applications (MS PowerPoint) **10**
    - Creation of slides, Rapid Presentation design using wizards
    - Inserting graphs & charts Action buttons
    - Transitions, Build and Animation effects.
6. HTML BASICS **10**
    - Creating Sample HTML page using Editors, Basic, Elements, Attributes, Headings and Paragraphs. Creating Sample HTML page using Styles, Formatting, Quotations and Comments. Creating Sample HTML page using Links, Images, Tables and Lists.
7. Solving problems using algorithm and flowchart **05**

Total: 60 Hours

Text Book:

1. Anita Goel, "Computer Fundamentals", Pearson Education India, 2010

Reference Books:

2. SangheraKamaljeet - Fundamentals of Computing –. Kendall Hunt Publishing Company, 2007
3. Introduction To Computers And Information Technology By AnuragSeetha, Ram Prasad McGraw Hill 2011.

Techniques in Biochemistry Practical **0 0 4 2**

Course Objective: The course aims to provide an advanced understanding of the core principles and topics of Biochemistry and their experimental basis, and to enable students to acquire a specialized knowledge and understanding of selected aspects by means of a stem/branch lecture series and a research project.

CO-1: To identify the quantitate analysis of sugar monosaccharides – Aldose.

CO-2: Through biochemical techniques the quantitative analysis of saccharides were analyzed.

CO-3: To identify carbohydrates from samples using biochemical procedures.

CO-4: To find the qualitative analysis of polysaccharides.

CO-5: To analyze the aromatic amino acids.

CO-6: To observe the presence of sulphur containing amino acids qualitatively.

CO-7: To gain knowledge on the analyses the basic aminoacids.

CO-8: To estimate the presence of glycine by Sorrenson's Formal Titration.

CO-9: To learn about the estimate and observe the ascorbic acid by 2,3 Dichlorophenol Indophenol.

CO-10: To learn about the estimation of protein by Lowry's method.

1. Qualitative analysis of monosaccharides – Aldose. **05**
2. Qualitative analysis of monosaccharides – Ketose. **05**
3. Qualitative analysis of disaccharides. **05**
4. Qualitative analysis of polysaccharides. **05**
5. Qualitative analysis of aromatic amino acids. **05**
6. Qualitative analysis of sulphur containing amino acids. **05**
7. Qualitative analysis of basic amino acids. **05**
8. Estimation of glycine by Sorrenson's Formal Titration. **05**
9. Estimation of ascorbic acid by 2,3 Dichlorophenol Indophenol. **05**
10. Estimation of glucose by Ortho Toluidine method. **05**
11. Estimation of protein by Lowry's method. **05**
12. Separation of amino acids by thin layer chromatography. **05**

Total: 60 Hours

Text Book:

1. Horton, R, Moran, L, Scrinmgeour, G, Perry, M, Ravon, D "Principles of Biocehmistry", 4th edition, Prentice-Hall of India. 2005.

References:

1. Voet, D., and J.G. Voet. "Biochemistry" 3rd edition. Hoboken, NJ: Wiley. 2004.

Programming in C **5 0 0 5**

Course Objective: To provide the clear concepts on programming methodology. To make the students to understand the various programming concepts in C language and to make clear understanding on C applications and make use of c programming for various calculation methods.

Course Outcome

CO - 1: To understand the fundamentals of C programming.

CO - 2: To understand the basic terminology used in computer programming.

CO - 3: To write, compile and debug programs in C language.

CO - 4: To use different data types in a computer program.

CO - 5: To design programs involving decision structures, loops and functions.

CO - 6: To choose the loops and decision making statements to solve the problem.

CO - 7: To implement different Operations on arrays.

CO - 8: To use functions to solve the given problem and to understand the dynamics of memory by the use of pointers.

CO - 9: To understand pointers, structures and unions.

CO -10:To use different data structures and create/update basic data files.

Unit I **Introduction to C** **16**

Introduction: History of C Language, C Programming structures and building blocks. Fundamentals: Character set, Tokens, Keywords, Identifiers, Data Types - Integer, float, character and double, Variables , Constant, Comments – Single line comment and multiline comment.

Unit II` **Introduction to Programming** **15**

Operators and Built in Functions: Arithmetic, Unary, Relational and logical, Assignment and Conditional Operators, precedence and Associative - Library functions - Data input and output functions. Writing C Programs:Declarations - Expressions – Statements - Simple C programs

Unit III **Control Structures** **16**

Control Structures:Flow of control –Decision making, loop control - if, if-else, while, do-while, for loop, Nested control structures – switch, break and continue, go to statements – comma operator. Solving Problems:Problem solving concepts and techniques - Steps in problem solving - Algorithms and flowcharts – Examples.

Unit IV **Functions, Arrays, Structures and Unions** **14**

Functions:Basic types of function, Declaration and definition, Function call, Types of function, Parameter passing, Call by value, Call by reference, Scope of variable, , Recursion. Arrays:Arrays- Defining and processing Arrays,Structures & Unions.

Unit V **Pointers and Files** **14**

Pointers:Declarations, Pointer Variables, Operation on Pointers- Files:File Input / Output - Creating, Reading and Writing files, processing, opening and closing file data.

Total: 75 Hours

Text Book:

1. E. Balagurusamy, Programming in ANSI C, 6th Edition, Tata Mc-Graw Hill, 2015.

References:

1. Kanetkar Y., Let us C, BPB Publication, New Delhi, 1999.
2. H. Schildt, C: The Complete Reference, 4th Edition, TMH Edition, 2000.
3. Ashok N. Kamthane, Programming with ANSI and Turbo C, Pearson Education, 2006.

Biological databases and sequence Analysis 4 0 0 4

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.

Course Outcome

CO-1: To acquire the skill of constructing algorithms and there by determining the computational complexity of algorithms by knowing the basic biological information.

CO-2: To provide the necessary biological (Gene and protein) background which are required solve the problem that arise during the designing of algorithm.

CO-3: To map an unknown segment of DNA by breaking it into pieces and then by identifying the locations of the breakpoints in the gene.

CO-4: To follow the problem solving heuristic of making the locally optimal choice at each stages with the hope of finding a global optimum.

CO-5: To solve many different types of complex problem by breaking down into a collection of simpler sub biological problems and by solving each of those biological problems one by one until expected solutions arrived.

CO-6: To analyze the previously solved sub problems and combine their solutions along with the achieved result to give the best solution for the given biological problem

CO-7: To divide the given problem, at least into 2 sub-problems and the combination of the results arrived by sub problem is much more easier than finding the solution of the initial problem directly

CO-8: To prove an algorithm for the given biological problem is often necessary to replace the original problem with a more complicated problem in order to initialize the recursion.

CO-9: Mathematical approach to solving certain types of biological problem like sequence alignment, gene detection, structure prediction, data-mining literature

CO-10: The problem is not directly noticeable, but the output of the problem dependent on the result predicted by the probability distribution.

Unit I **Bioinformatics and Databases** **14**

Introduction to Bioinformatics, Bioinformatics: Applications and research, Present bioinformatics scenario in India – Government Organizations, Private Organizations, Informatics Research, Academic Scenario in India, Characteristics of Bioinformatics databases, Types of database, Data source, Data Access, navigating databases, Information Retrieval system, storage system of Database.

Unit II **Sequences Databases and Structural Database** **16**

Sequences Databases:Nucleotide Sequence databases, Secondary Nucleotide databases, Protein databases, secondary and specialized protein sequence database, Information Retrieval System: Entrez and SRS. Structural Database: Structural File format, Protein structural database collaboration, PDB, MMDB, CATH, FSSP, DALI, SCOP.

Unit III **Data Submission Tool and Analysis Tools** **10**

Data Submission Tool: Nucleotide sequence submission tools, Protein submission tools, command line tools for Genbank. Sequence Analysis Tools: Tools for Nucleotide sequence analysis, Tools for Protein sequence analysis.

Unit IV **Prediction tools and Modelling Tools** **14**

Prediction Tools: Phylogenetic Trees and phylogenetic analysis - Phylip, Phyml. Gene Prediction – Genscan, GrailEXP. Protein structure and Function Prediction – Prosite, 3DPSSM. Modelling Tools: Tools for 2D protein modelling – Rasmol. Tools for 3D protein modelling - DeepViewer.

Unit V **Data analysis Algorithms** **16**

Sequence comparison algorithms, Substitution matrices algorithms – PAM, BLOSUM, Sequence alignment Algorithm- Pairwise Alignment – Global Sequence alignment, Local Sequence alignment Multiple Alignment - FASTA, BLAST.

Total: 70 Hours

Text Book:

1. OrpitaBosu, SimminderkaurThukral. “Bioinformatics – Databases, Tools and Algorithms”, Oxford University Press, 2007.

Reference Books:

1. D. Higgins and W. Taylor. (Eds), “Bioinformatics: Sequences, Structures and databanks”, Oxford University Press, Oxford, UK. 2008.
2. N.Gautham, “Bioinformatics”,Narosa Publishing Company, New Delhi, 2006.
3. V.R.Srinivas, “Bioinformatics: Sequences and genomics analysis”, Cold Spring Harbor Laboratory press,Cold Spring harbor,USA, 2005

Programming in C Practical **0 0 4 2**

Course Objective: To provide the clear concepts on programming methodology. To make the students to understand the various programming concepts in C language and to make clear understand on C applications and make use of c programming for various calculation methods.

Course Outcome

CO - 1: To understand computer programming and its roles in problem solving.

CO - 2: To understand and develop well-structured programs using C language.

CO - 3: To learn the basic data structures through its implementation in C language.

CO- 4: Problem solving through computer programming and to understand the basic terminology used in computer programming.

CO - 5: To implement different Operations on arrays.

CO - 6: To familiarity of programming environment in Linux/Ubuntu operating system.

CO -7: Ability to use different memory allocation methods and to deal with different input/output methods.

CO - 8: Ability to use different data structures.

CO - 9: To use functions to solve the given problem.

CO -10: To understand the dynamics of memory by the use of pointers.

1. Simple Arithmetic Calculation **07**
   a) Program to demonstrate the Simple Arithmetic Calculation
   b) Program to find the Simple Interest

2. If Control **07**
   a) Program to find even/odd number.
   b) Program to determine whether given year is leap year or not using ‘if’ and ‘if else’
   c) Program to find the sum of digits of given number using ‘else-if ladder’.

3. While and Do While **07**
   a) Program to find the factorial value of given number using while.
   b) Program to find the Fibonacci series for given number using do-while.

4. Arrays and For control **07**
   a) Program to find the number of alphabets in given word sequence.
   b) Program to find the frequency of Nucleotides in given DNA sequence.
   c) Program to find the G-C content value of given DNA sequence.

5. Switch and Functions **07**
   a) Program to find the complement and reverse complement of given DNA sequence using functions.

6. Structures and Unions: **07**
   a) Program to create student data using Structures/Unions.
   b) Program to create ‘cm – feet’ converter using Structures/Unions.
   c) Program to concatenate the two DNA sequences using Structures/Unions.

7. Pointers: **09**
   a) Arithmetic operations using pointers.

8. File: **09**
   a) Sample Program to read and write an external file.

Total: 60 Hours

Text Book:

1. E. Balagurusamy, Programming in ANSI C, 6th Edition, Tata Mc-Graw Hill, 2015.

References:

1. Kanetkar Y., Let us C, BPB Publication, New Delhi, 1999.
2. H. Schildt, C: The Complete Reference, 4th Edition, TMH Edition, 2000
3. Ashok N. Kamthane, Programming with ANSI and Turbo C, Pearson Education, 2006

Biological Databases and sequence analysis Practical 0 0 4 2

Course Objectives: To understand various computational techniques employed to analyze biological data with the use of sequence information. Finally acquire skills to use different approaches for prediction of protein structure. This course also aims to provide students with a practical and hands-on experience with common bioinformatics tools and databases. Students will be trained in the basic theory and application of programs used for database searching, protein and DNA sequence analysis.

Course outcome

CO1: To acquire skills to use different approaches for Retrieval of DNA Sequence.

CO2: To develop the skills to Retrieval of protein Sequence from the protein databases. .

CO3: To determine the three dimensional structure of protein

CO4: To develop the knowledge to retrieve the particular information from the specialized databases.

CO5: To achieve knowledge for the visualization of the Protein 3D Structure.

CO6: To determine the functional information of the protein using functional databases

CO7: To predict the classification of the protein based on its structural alignment.

CO8: To retrieve the particular family information in which the specific protein belongs to.

CO9: To identified the domain region for the known protein

CO10: To develop the skill for retrieving the gene information.

1. Retrieval of DNA Sequence using Sequence Databases: NCBI, DDBJ, EMBL. **04**
2. Gene prediction using GenScan tool. **04**
3. Retrieval of Protein Sequence using Sequence Databases: UNIPROT, Tr-EMBL. **04**
4. Retrieval of Protein Structural information using SCOP, CATH. **04**
5. Protein sequence analysis (ExPASy proteomics tools). **04**
6. Retrieval of 3D Protein Structure Using Protein Data Bank. **04**
7. Molecular visualization of Protein Structure Using Pymol, Rasmol. **04**
8. Sequence similarity searching (NCBI BLAST). **04**
9. Multiple sequence alignment (Clustal). **04**
10. Protein function prediction Tools – Introscan, Phobius, Pratt, RADAR. **04**
11. Molecular phylogeny (PHYLIP). **05**

Total: 45 Hours

Text Book:

1. D. Higgins and W.Taylor, (Eds), 'Bioinformatics: Sequences, Structures and databanks 'oxford University Press, Oxford, UK. 2008.

2. V. R. Srinivas, "Bioinformatics: Sequences and genomics analysis" cold Spring Harbor Laboratory press, Cold Spring harbor, USA, 2005.

Reference Books:

1. N.Gautham, "Bioinformatics",Narosa Publishing Company, New Delhi, 2006.
2. D.Higgins and W.Taylor, "Bioinformatics: Sequences, Structures and databanks", Oxford University Press, Oxford, UK, 2008.

PROGRAMMING WITH C++ **4 0 0 4**

Course Objectives To provide hands on experience on Programming. To make clear understand on Object Oriented Program methodology. To make the students to think and write their own C++ program by understanding the concepts of programming clearly. Be familiar with writing recursive methods.

Course Outcome

CO - 1: To gain a better understanding of Object Oriented design and program implementation using OOPS language features.

CO - 2: To be able to develop, design and implement simple computer programs.

CO - 3: To understand the functions and parameter passing.

CO - 4: To be able to understand the difference between object oriented programming and procedural oriented language and data types in C++.

CO - 5: To familiarize the students with language environment.

CO - 6: To understand the features of C++ supporting object oriented programming.

CO - 7: To understand how to apply the major object-oriented concepts to implement object oriented programs in C++, encapsulation, inheritance and polymorphism.

CO - 8: To understand the relative merits of C++ as an object oriented programming language.

CO - 9: To design, introduce and develop various techniques for representation of data in the real world.

CO -10: To course may serve as a foundation for further studies in Computer Science.

UNIT I INTRODUCTION TO C++

Introduction: Basic Elements of C++ Programming, I/O Streams. Control Structures: Control and Looping Statements.

UNIT II OBJECT ORIENTED METHODOLOGY

Object Oriented Methodology: Basic Concepts/Characteristics of OOP. Advantages and Application of OOPs, Procedural Programming Vs OOP. Classes and Objects: Specifying a Class, Creating Objects, Private & Public Data Members and Member Functions

UNIT III FUNCTIONS

Functions: Function Prototyping, Call by value and call by Reference, Inline Function, Defining Inline Member Functions Default Arguments, Function Overloading, Arrays, Static Data Members and Member Functions.

UNIT IV CONSTRUCTORS AND DESTRUCTORS

Introduction Parameterized Constructors, Multiple Constructors in A Class, Constructors With Default Arguments, Dynamic Initialization of Objects, Copy Constructors, Dynamic Constructors, and Destructors.

UNIT V OPERATOR OVERLOADING, INHERITANCE AND FILE PROCESSING

Operators Overloading**:** Definition, Unary and Binary Overloading, Rules for Operator Overloading,

Inheritance: Defining Derived Classes, Types of Inheritance, Constructors and Destructors in Derived Classes. Files**:** Opening, Closing a File, File Modes, File Pointers and their Manipulation. Updating a File, Random Access, and Error Handling During File Operations.

Total: 60 Hours

Text Book:

1. E Balagurusamy, "Object Oriented Programming with C++ ", 6th Edition, Tata McGraw Hill Publishing Company Limited, New Delhi, 2013

Reference:

1. K.R.Venugopal, Rajkumar, T. Ravishankar, "Mastering C++", Tata McGraw Hill, New Delhi, 1999: 25th Reprint, 2006
2. D. Ravichandran, "Programming with C++", Third Edition, Tata McGraw Hill, 2010.
3. Horowitz, Sahni & Mehta, "Fundamentals of Data Structures in C++", 2nd Edition, Silicon Press, 2006

Plant Bioinformatics **4 0 0 4**

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.

Course Outcome:

CO-1: To acquire sound knowledge on Plant cell architecture.

CO-2: To understand the molecular basis of the cell.

CO-3: To acquire knowledge on earlier and modern view of classification on living organisms, in specific the classification of plant kingdom.

CO-4: To understand the basis of genetics in hereditary, inheritance, therefore to develop genetically engineered crops.

CO-5: To understand the steps involve in the preparation of herbarium and its importance

CO-6: To understand the cache architecture and different cache mapping techniques.

CO-7: To acquire the knowledge on Bioinformatics and the major database available for usage.

CO-8: To understand the usage of Bioinformatics tools.

CO-9: To be well versed with the databases available especially for plants.

CO-10: To acquire knowledge on accessing the informations on hereditary and inheritance.

Unit I Plant 12

Plant cell architecture, Photosynthesis, Respiration, Plant growth regulator: auxins, gibberellins, cytokinins, ethylene abscisic acid. Primary structure of stem, leaf and root of Dicotyledons and monocotyledons. Economic importanceofplants.

Unit II Plant Kingdom 12

Plant Kingdom- Definition and Classification, of Plant Kingdom – Thallophyta: Algae (Chlorophyceae, Phaeophyceae, Rhodophyceae), Bryophytes: Life cycle, Economic Importance of Bryophytes, Pteridophytes, Phanerogams, Gymnosperms, Angiosperms (Dicot and Monocot). Five Kingdom Classification, Three domains of life, Eight Kingdom model, Cavalier-Smith's systems, Viroids and Viruses.

Unit III 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 IV Bioinformatics Tools for Plants – 1 12

Bioinformatics Tools for Plant Genomics – 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 Gene.

Unit V Bioinformatics Tools for Plants - 2 12

Plant Associated Microbe Geneontology (PAMGO), Gene Index, ArrayExpress, GEO, Plant Expression Database (PlexDB), Plant Promoter Database (PlantProm DB), PlantCARE (Plant Cis-Acting Regulatory Elements), PLACE (Plant Cis-Acting Regulatory DNA Elements), HarvEST EST database.

Total: 60 Hours

Text Book:

1. David Edwards, "Plant Bioinformatics – Methods and Protocols", Springer, 2007.

Reference Books:

1. Gurcharan Singh, "Plant Systematics: An Integrated Approach", Science Publishers, 2004.
2. Susheela M. Das, "A Textbook of Plant Taxonomy: Theory & Objectives", Hardcover - Wisdom Press. 2013.

Bioinformatics in Microbiology, Immunology and Nanotechnology 3 0 0 3

Course Objective: The subject provides an insight into the concepts of microbiology, immunology and nanotechnology. The understanding of basic concepts and mechanism aids the bioinformaticians in developing the right tools and software for the biological problems.

Course outcome:

CO-1: Able to acquire knowledge relevant to microbial infection caused by microorganism.

CO-2: To develop the basic information towards laboratory and hospital control of microbial infection

CO-3: To determine biological importance of cells that are responsible for immune system

CO-4: To acquire the basic information about the organs of immune system which plays a major role in the producing immune cells.

CO-5: To study the effect of destruction of immune cell by the entry of specific antigen into the human body

CO-6: To acquire the detailed information about the production and working of immunoglobins toward the antigenic response

CO-7: To study the systematic production of B cells and T cells during the immune response.

CO-8: To elaborate in detail about the antigen presenting cell in the human body

CO-9: To gain knowledge on immune system, its function and also the response to the foreign bodies

CO-10: To get a clear knowledge on immunoassays to perform anti-doping concepts to include in scientific experiments regarding human growth hormone

Unit I Microbiology- An Introduction 12

Introduction to Microbiology, History of Microbiology, Morphology of bacteria and Physiology of bacteria , Sterilization and Disinfection, Culture Technique, Culture Media, Culture Methods, Identification of Bacteria, Normal Microbial Flora of the Human Body, Bacteriology of Water, Milk & Air, Laboratory Control of Antimicrobial Therapy, Hospital Infection.

Unit II Databases for Microorganisms 12

Saccharomyces Genome Database (SGD),Ensembl genome database - Ensembl bacteria, fungi, Metazoa, plants, protists. Microbial Genome database – Bacteria, Archaea, Eukaryota. MLST (Multi locus sequence Typing) databases, BacDive, ECMDB, Integrated Microbial Genomes (IMG), Streptome DB, SporeWeb

Unit III Immunology 12

Organs of the immune system: PrimaryLymphoid organs - Thymus, Bone Marrow and secondary Lymphoid organs- Lymph nodes,Spleen, MALT, Tonsils. Classification of immune system – innate and adaptive immunity, Immune Cells - T Cells & B Cells, Antigens, Antibodies and their structure – IgM, IgG, IgA, IgD, IgE.

Unit III Antigens and Antibodies 12

AbMiner, AlgPred, Antibodies Online -- Antibodies Database, AntigenDB -- Pathogen Antigens Database, BCIpep, CEP, CytoSVM, Epitome, ExactAntigen, FRED, GPX, HBVRegDB, HIV Molecular Immunology Database, HPtaa database, IDR, IEDB, IIDB**,** IMGT**,** IMGT/3Dstructure DB and IMGT/StructuralQuery, T Cell Receptor and MHC Structural Data, IMGT/GeneInfo-- V(D)J Recombination Database**,** IMGT/PRIMER-DB, INTERFEROME**,** IPD**,** InnateDB**,** MHC-Peptide Interaction Database version T (MPID-T)**,** MHCBN**,** MHCP**,** MHCPred**,** MODPROPEP, MUGEN mouse, NetMHC-3.0**,** PEPVAC, PIGS, PREDBALB/c, PRRDB, Pcleavage, Protegen – PROTEctiveantiGEN database, SVMHC, SuperHapten, VBASE2**,** VIOLIN.

Unit IV Nanoinformatics 12

Introduction to Nanoinformatics, Applications of nanoinformatics- Development and Scientific goals, Scientific content and informatics goals, Integrating data and knowledge, Tools to support professional practice, Methods and tools to support research, Education and training MI and BI professionals. Five significant areas of research where BMI should influence nanoinformatics – Data, Repositories and Standards, Interoperability, Extension of virtual integrative physiological programs, Translational nanoinformatics, Linking nano information to the electronic health record (EHR).

Total: 60 Hours

Text Book:

Reference Books:

1. Dr. PHBS Sharma, “Text Book of Microbiology”, 2015.

2. A. Mani, AM. Selvaraj, LM. Narayanan, N.Arumugam, “Microbiology”

3. Dulsy Fatima, N. Arumugam, “Immunology”

4. N. Arumugam, Dulsy Fatima, A. Mani, LM. Narayanan, AM. Selvaraj, “Immunology and Microbiology”,

5. V. Maojo, AM. Fritts, Martin-Sanchez, “Nanoinformatics: Developing new computing applications for nanomedicine”.

Programming in C++ Practical **0 0 3 1**

Course Objectives: To provide the hands on experience on Programming. To make the students to think and write their own C++ program by understanding the concepts of programming clearly. Make the student to create the program using classes and objects methods of OOPS.

Course Outcome

CO - 1: To apply C++ features to program design and implementation.

CO - 2: Explain object-oriented concepts and describe how they are supported by C++.

CO - 3: To use C++ to demonstrate practical experience in developing object-oriented solutions.

CO - 4: To design and implement programs using C++.

CO - 5: To analyze problem description.

CO - 6: To design and build object-oriented software using good coding practices and techniques.

CO - 7: To implement an achievable practical application.

CO - 8: To analyze issues related to object-oriented techniques in the C++ programming language.

CO - 9: To use common software patterns in object-oriented design for problem solving.

CO -10: To recognize their applicability to other software development contexts.

1. Program to implement classes; create object and member functions. **04**
2. Program to implement the concept of function in Classes. **04**
3. Program to implement the concept of function overloading. **04**
4. Program to implement the concept of Inline function. **04**
5. Program to implement the concept of Static member functions. **04**
6. Program to implement the concept of Operator overloading. **04**
7. Program to implement the concept of Single Inheritance. **04**
8. Program to implement the concept of Multiple Inheritance. **04**
9. Program to implement the concept of Constructors & Destructors. **04**
10. Program to implement Arrays using Functions. **04**
11. Program to implement file handling concepts. **04**

Total: 45 Hours

Text Book:

1. E.Balagurusamy, "Object Oriented Programming with C++", 6th Edition, Tata McGraw Hill, Publishing Company Limited, New Delhi, 2013.

Reference Books:

1. K.R.Venugopal, Rajkumar, T. Ravishankar, "Mastering C++", Tata McGraw Hill, NewDelhi, 1999: 25th Reprint, 2006.
2. D. Ravichandran, "Programming with C++", Third Edition, Tata McGraw Hill, 2010.
3. Horowitz, Sahni& Mehta, "Fundamentals of Data Structures in C++", 2nd Edition,Silicon Press, 2006.

Plant Bioinformatics Practical **0 0 3 1**

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 species.

Course Outcome:

CO-1: To understand the importance and preparation of herbarium, therefore to compile the data shorter and meaningful.

CO-2: To access and store the taxonomy information of a medicinal plant from the databases available.

CO-3: To explore the NCBI database for its various information under different criteria.

CO-4: To understand the retrieval system of Entrez.

CO-5: To acquire knowledge from tremendous literature available in PubMed database and to retrieve the required information from it.

CO-6: To access and query the protein data bases for its sequence and other details

CO-7: To acquire knowledge on the EBI search providing easy and uniform access to the biological data.

CO-8: To understand and explore the sequence retrieval system.

CO-9: To access the data stored from the GenBank databases.

CO-10: To understand the indexing and retrieval system of Entrez.

1. Collecting and Creating Herbarium of 5 different kinds of plants **08**
2. Creating computer data for Herbaria. **08**
3. Biological Data retrieval system using Entrez for plants. **08**
4. Exploring the integrated database system at NCBI server and querying the PUBMED. **08**
5. Exploring and querying the TAIR database. **07**
6. Exploring and accessing the plant genome specific databases,Eg. MaizeGDB **07**
7. Accessing and querying the SSR Locator, Eg. Gramene **07**

8. Explore and access the plant microarray datasets, Eg. GeneIndex, PLEXdb, GEO. **07**

Total: 60 Hours

Text Book:

1. David Edwards. “Plant Bioinformatics – Methods and Protocols”. Springer. 2007.

Reference Books:

1. Gurcharan Singh.” Plant Systematics: An Integrated Approach”. Science Publishers, 2004.
2. Susheela M. Das “A Textbook of Plant Taxonomy: Theory & Objectives” Hardcover – Wisdom Press, 2013.

Cheminformatics **4 0 0 4**

Course Objective: This course will enable the students to understand the fundamentals and complementary aspects of chemo informatics and bioinformatics for design of bioactive molecules. To get hands-on experience in chemical structure representation, storage and analysis of small molecular data.

Course Outcome:

CO-1: To acquire knowledge on the basic representation and file formats of chemical molecules.

CO-2: To understand the applications of chemical information in various fields.

CO-3: To gain knowledge on different descriptor formats available for the molecules.

CO-4: To understand the important properties of small molecules and its application in the similarity and diversity analysis.

CO-5: To observe the infrastructure of chemical databases, information stored and its types.

CO-6: To be clear with the different search techniques and its importance in acquiring required data.

CO-7: To perceive the molecular relationships based on physical and chemical properties with the biological properties.

CO-8: To obtain knowledge on the molecular properties and to develop tools for predicting the specific properties.

CO-9: To observe the features of pharmacophore and to access the combinatorial libraries for pharmacophore designing.

CO-10: To be clear with identification, accession and application of pharmacophores in drug designing process.

Unit I Basics of Chemistry 12

Introduction to Atoms, Ions, Elements, Molecules, Properties of atoms- Protons, neutron and electrons, p-Block and s-Block elements, periodic table, Chemical Bonding and Molecular Structure, Types of bonds, Resonance structure and Hybridization, Stereochemistry, Isomerism, Enantiomers.

Unit II Introduction to Cheminformatics 12

Introduction tocheminformatics: Aim, Scope, History, Applications (Storage and Retrieval, Virtual Libraries, Virtual Screening, Quantitative Structure-Activity Relationship (QSAR)); Role ofcheminformatics in Pharmaceutical/Chemical Research. Chemical Structure Representation- 1D, 2D and3D Structures. Molecular File Formats (SMILES, WLN, SDF, andMOL).

Unit III Molecular Descriptors 12

Molecular Descriptors- An Introduction, Invariance Properties of Molecular Descriptors, Types of Molecular Descriptors, Descriptors calculated from 2D structure- physicochemical properties, molar refractivity, Topological, Electrotoplogical and Shape Indices, Fingerprints and MACCS Keys. Molecular Similarity andMolecular Diversity Analysis.

Unit IV Molecular Database Screening 12

Introduction to Molecular Database, Screening Methods (Ligand-Based and Structure-Based), Lipinski's Rule: Drug/Lead like Molecules (Absorption, Distribution, Metabolism, Excretion and Toxicity).Chemical Structure Based Search Techniques: Exact, Sub-Structure and Similar Structure Searches.

Unit V Combinatorial Chemistry, Library Design and QSAR 12

Combinatorial Chemistry and Library Design- Library Enumeration, Design Strategies- Monomer based and Product based selection. Pharmacophore modeling strategies, Molecular Docking studies, Molecular Matched Pair Analysis (MMPA), Quantitative Structure Activity Relationship.

Total: 60 Hours

Text Books:

1. Gasteiger Johann, Engel Thomas. "Chemoinformatics: A Textbook". Publisher: Wiley VCH; 1st edition. 2003.

Reference Books:

1. Bunin Barry A. Siesel Brian, Morale Guillermo, Bajorath Jürgen. Chemoinformatics: Theory, Practice, & Products Publisher: New York, Springer. 2006.

2. Leach Andrew R., Valerie J. Gillet. An introduction to Chemoinformatics. Publisher: Kluwer academic, 2003.
3. Gasteiger Johann, Handbook of Chemoinformatics: From Data to Knowledge (4 Volumes), Publisher: Wiley-VCH, 2003.
4. Thomas Engel. Chemoinformatics – A Textbook Publisher: Kluwer academic, 2005.

Operating System and Computer Networks 3 0 0 3

Course Objectives: Explain the following terms: computer network, LAN, WAN, MAN, internet, protocol, topology, media, peer-to-peer network, server based network. Aimto give clear view of operating system structure, Processing and its memory. Also to make the student to clear understand on OS memory management system and its implementations on computer programming structures, application of operating systems and its uses etc.

CO - 1: To acquire sound knowledge on operating system and architecture.

CO - 2: To understand the basics of operating system types and uses.

CO - 3: To acquire knowledge on process management and various concepts.

CO - 4: To understand the working nature of communication satellite and telephone.

CO - 5: To understand the steps involve in the data link layer related to vast communication using networks.

CO - 6: To understand the architecture of various protocol in data link layer.

CO - 7: To acquire the knowledge on network layer and its uses.

CO - 8: To understand the transport layer and its importance.

CO - 9: To be well versed with the application layer and use of networks. .

CO - 10: To acquire knowledge on accessing the e-mail and website.

Unit I **Introduction to Operating System** **10**

Introduction, Views, Goals and types of operating systems, Structure, Components, services, Uses and Types of Operating Systems, Process concepts, process scheduling, scheduling criteria, scheduling algorithms. Memory Management, Single and multiple partitioned allocation, paging, segmentation, internal & External Fragmentation.

Unit II **Files and I/O Systems** **09**

File concept, Access methods, Directory structure, file system mounting, Protection. File-System Implementation, Directory implementation, Allocation methods, Free-space management, efficiency and performance, File system in Linux and Windows, I/O Systems, I/O Hardware, I/O interface, Kernel I/O subsystem, streams, performance. Disk management, Swap-space management, RAID, disk attachment, stable storage, tertiary storage.

Unit III **Introduction to Computer Networks** **08**

Introduction: Computer Networks Definition, advantages of computer networks, Client and Server, Network hardware and software, LAN, WAN, MAN. Reference Models: OSI and TCP/IP Models. Example Networks: Internet, ATM, Ethernet and Wireless LANs.

Unit IV **Communication Media** **08**

Communication Media: Definitions, Data communications and Networking, Theoretical basis for data communication, guided transmission media, Wireless transmission, Communication Satellites. Telephones structure: Definition, local loop, trunks and multiplexing, switching.

Unit V **Computer Network Layers** **10**

Data Link Layer: Logical Link Control, Services of DLL, DLL Protocol, Network Layer: Services of network layer, routing, Network layer in the internet, IP protocol, IP address. Transportation Layer: services of transportation layer, addressing, flow control. Application layer: Definition, Application Layer Protocols, DNS, name space, resource. Email, architecture and services.

Total: 45 Hours

Text Books:

1. Andrew S. Tanenbaum, “Computer Networks”, Fourth Edition, Pearson Education, 2003.
2. Andrew S. Tanenbaum, “Modern Operating Systems”, Second Edition, Pearson Education, 2004

Reference Books:

1. Behrouz A Forousan, “Computer Networks: A Top Down Approach”, Tata McGraw Hill, 2012.
2. Larry L. Peterson, “Computer Networks: A System Approach”, Morgan Kaufmann Publications, 2010
3. Davis Rajkumar, “Operating System: A Systematic View”, Pearson Education, 2007.
4. H. M. Deitel, “Operating System”, Second Edition, Pearson Education, 1990

Medical Coding and Transcription **3 0 0 3**

Course Objective: The Human Anatomy course involves the study of the structure of the human body. To provide a sound knowledge of medical coding guidelines and regulations including compliance and reimbursement and to make the student to learn about ICD-10 (Diagnosis code), CPT code and medical terminologies.

Course Outcome

CO-1: Study of the anatomy, physiology of human body function and general health management of diseases and injuries across the lifespan

CO-2: Application of basic coding rules, principles, guidelines and conventions in health care.

CO-3: Introduction to health IT standards, health-related data structures, software applications, and enterprise architecture in health care and public health.

CO-4: Introduction to systems and processes for collecting, maintaining, and disseminating primary and secondary health-related information including content of health record, documentation requirements, registries, indices, licensing, regulatory agencies, forms, and screens

CO-5: Instruction in principles, procedures, and regulations involving legal and ethical relationships among physicians, patients, and medical assistants in ambulatory care settings.

CO-6: Includes current ethical issues and risk management as they relate to the practice of medicine and fiduciary responsibilities.

CO-7: To benefits those who work or want to work in the medical field whether it be as a medical biller, medical coder, medical collector, or medical office administrator.

CO-8: Coding scenarios are provided to help the student continue his/her knowledge in the field of medical coding.

CO-9: Analyze the CPT and ICD-10- CM manuals for medical reimbursement.

CO-10: Interpret the elements and characteristics of the CPT and ICD-10-CM manuals.

Unit I Introduction to Human Anatomy - I 12

Basics of Human Anatomy and Physiology, Cell, Tissues and Membrane, The integumentary system, Skeletal system, Muscular system, Endrocrine system, Nervous system.

Unit II Introduction to Human Anatomy - II 12

Cardiovascular system, Respiratory system, Digestive system, Urinary system and Reproductive system. Coding medical procedures What to code and how to prepare the forms.

Unit III Claim Information and Medical Records 12

Professional claim information How to set up medical claims for Medicare, Medicaid, private insurance companies, HMOs, PPOs, workers' compensation and personal injury cases. Documenting Medical Records: The role medical records play in a coding specialist's job. The importance of documentation in medical records and to recognize the various types of dictation formats and manage medical records. Medical Ethics Concepts of ethics, compliance, fraud and abuse. The importance of confidentiality when dealing with medical records and insurance audits and the legal concepts involved.

Unit IV CPT Codes 12

CPT Coding: CPT Coding from the Integumentary System, from the Reproductive Systems to the Operating Microscope, for Radiology, Pathology, Medicine and Anesthesia, Evaluation and Management Services, Comprehensive CPT Evaluation and Management, Surgery Coding, Digestive System Coding, Urology system coding, Cardiovascular coding.

Unit V Diagnostic Codes 12

Diagnostic Coding - ICD-9-CM Coding Manual Introduction, Diagnosis Coding: Guidelines and Rules, from Infections to Blood Diseases, from Mental Disorders to the Respiratory System ,from the Digestive System to Pregnancy, from the Skin to Conditions of the Perinatal Period, from Symptoms to Complications, V Codes, E Codes and ICD-9-CM Coding Practicum.

Total: 60 Hours

Text Book:

1. Beth A.Rich, "Medical Coding: A Journey", Prentice Hall, 2013. ISBN – 13: 9780132541770
2. Martini and Nath. 2018. Fundamentals of Anatomy and Physiology 11th ed.+ Modified Mastering A&P Access Code. Pearson, San Francisco, CA.

Reference Books:

1. Karen Smiley, "Medical Coding And Billing for Dummies", Second Edition, 2012.
2. Perez. 2008. Anatomy (Flash Cards). Bar Charts Publishing, Boca Raton, FL.

Cheminformatics Practical **0 0 4 2**

Course Objective: This course will enable the students to understand the fundamentals and complementary aspects of chemo informatics and bioinformatics for design of bioactive molecules. To get hands-on experience in chemical structure representation, storage and analysis of small molecular data.

Course Outcome:

CO - 1: To differentiate and understand the features different molecular representation of a molecule.

CO - 2: To be capable in interpreting the chemical molecular structure from different molecular representation.

CO - 3: To observe the different molecular file formats, its variation and application.

CO - 4: To acquire structural knowledge from the given molecular file formats.

CO - 5: To observe the molecular patterns of various molecules.

CO - 6: To workout tools available for describing molecular pattern of a chemical substance.

CO - 7: To acquire knowledge in accessing the database and the screening techniques for a molecule.

CO - 8: To predict the drug-likeness and other properties of a molecule using tools and software.

CO - 9: To observe the molecular descriptors for different molecule representation.

CO -10: To explore molecular descriptors to understand and develop tools in design and discovery of new compounds.

1. Chemical Structure representation for the following categories, **06**
    - 1 Dimension Structures,
    - 2 Dimension Structures
    - 3 Dimension Structures
2. Accessing and retrieving information about drugs **04**
3. Exploring and accessing the chemical structure databases **10**
    - Pubchemdatabase
    - Chemical Structure Database (CSD)
4. Analyzing Molecular file formats for the following, **12**
    - SMILES,
    - WLN
    - SDF
    - MOL
5. Prediction and analysis of Molecular Properties and descriptors **08**
6. Exploring Molecule structure drawing tool **10**
7. Perform and analyze exact, substructure search using Pubchem through NCBI portal **05**
8. Exploring the Quantitative Structure Activity Relationship **05**

Total: 60 Hours

Text Book:

Gasteiger Johann, Engel Thomas. Chemoinformatics: A Textbook. Publisher: WileyVCH; 1st edition. 2003.

Reference Books:

Bunin Barry A. Siesel Brian, Morales Guillermo, Bajorath Jürgen. Chemoinformatics: Theory, Practice, & Products Publisher: New York, Springer. 2006.

Environmental Studies **2 0 0 2**

Course Objective: To inculcate the importance of environmental pollution, preservation of nature and environmental management for human welfare.

Course Outcome

CO-1: To develop the knowledge towards environmental pollution, control, management and protection

CO-2: To understand the Definition, scope and importance of environmental studies

CO-3: To acquire knowledge on the different types of resources

CO-4: To make them clear about the importance of natural resources and the required conservation steps to be carried out in order to protect it from non-existence as well as contamination for future generations.

CO-5: To understand clearly about the pollution types, cause of pollution and its dangerous effect.

CO-6: To acquire the basic knowledge to manage and control the pollution caused by different measures.

CO-7: To bring an awareness for the students regarding the social issues and incorporate methods for environment development.

CO-8: To make the students recognize the importance of water and its conservation measures to solve the problems arise in urban areas.

CO-9: To bring an alertness among the students about the climatic changes due to global warming, ozone layer depletion, etc.

CO-10: To attain the knowledge regarding the awareness program and environment protection act for forest, wildlife conservation, etc.

Unit I **Environmental Awareness** **06**

Definition, scope and importance of environmental studies. Public awareness regarding environment.

Unit II **Energy Resources** **06**

Renewable and non-renewable energy sources. Forest resources, water resources, mineral resources, food resources, energy and land resources. Conservation of natural resources.

Unit III **Pollution and Control** **06**

Environmental pollution-Definition, causes, effects and control measures of air, water, soil, marine, noise and nuclear pollution. Solid waste management and disaster management.

Unit IV **Environmental Management** **06**

Social issues and the environment-unsustainable and sustainable development. Urban problems related to energy. Water conservation, rain water, and harvesting and watershed management.

Unit V **Environmental Protection** **06**

Climate change-Global warming, acid rains, ozone layer depletion, nuclear accidents, waste land reclamation and maintenance. Environment protection act, wildlife, forest conservation act.

Total: 30 Hours

Text Book:

1. Subramaniam.V. Text Book in environmental Science, Narosa. 2002.

Reference Books:

1. Subramaniam.V.. Text Book in environmental Science, Narosa. 2002
2. Balu.V, Environmental Studies, Srivenkateshwara.2004
3. Moo Young. M. et al. Environmental biotechnology, Principles and application, Springer. 1996
4. Bharucha, E. Text Book of environmental Studies for undergraduates, University Press (India) Pvt. Ltd. 2005.
5. Sinha and Saradha , Text Book of Environmental Studies, AITBS Publication. 2005
6. Vijaya Ramesh K. Environmental Microbiology. MJP Publication.2004
7. Demain, A.L. Manual of Industrial Microbiology, ASM. 2004
8. RajanMisra, A Text Book on environmental Studies. University Science Press. New Delhi. 2009
9. Mohapatra P.K. Text Book of Environmental biotechnology. I.K. International Publishing House Pvt.Ltd. 2006

DISCIPLINE SPECIFIC ELECTIVES

Programming in JAVA **4 0 0 4**

Course Objective: 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.

Course Outcome

CO - 1: To understand the object oriented programming concepts.

CO - 2: To learn basics of Java such as tokens, data types and expressions.

CO - 3: To able to solve computational problems using basic constructs like if-else, and control structures.

CO - 4: To be well versed in array, and strings.

CO - 5: To understand how to define class and create objects.

CO - 6: To able to implement multiple inheritance through interfaces and develop packages.

CO - 7: To understand the exception handling mechanism and will be able to handle exceptions while programming.

CO - 8: To overcome all the errors while executing programs.

CO - 9: To able to demonstrate programs on multithreading.

CO - 10: To able to demonstrate programs using applets.

Unit I Fundamentals of JAVA 15

Fundamentals of Object – Oriented Programming:- Introduction, Object-Oriented Paradigm, Basic Concepts of Object-Oriented Programming, Benefits of OOP, Applications of OOP, Java Evolution:- Java History, Java Features, Java and C/C++, Java and Internet, Java and WWW, Java Environment, Overview of Java Language:- Simple java Program, java Program Structure, Java Tokens, Java Statements, Java Virtual Machine, command Line Arguments, Constants, variables and Data Types in Java.

Unit II Operators and Decision Making 20

Operators and Expressions:- Arithmetic, Relational, Logical, Assignment, Increment, Decrement, Conditional, Bitwise and Special operators, Arithmetic Expressions, Evaluation of Expressions, Arithmetic operator Precedence, Mathematical Functions. Decision Making and Branching:- if, if…Else, nesting of if…else, else if ladder and Switch statement, the ?: operator, Decision Making and Looping:- while, Do While and For statements, Jumps in Loops and Labeled Loops, Classes, Objects and Methods:- Defining a Class, fields declaration, methods declaration, creating objects, accessing class members, Constructors, methods overloading, Extending a Class (Inheritance), Overriding Methods, final variables and methods, final classes.

Unit III Arrays and Packages 20

Arrays, Strings and Vectors:- Introduction, One-dimensional Arrays, Creating an Array, Two-Dimensional Arrays, Strings, Vectors, Wrapper Classes, Enumerated Types, Strings and Regular Expressions:- Java's Regular Expression API, Introduction to Regular Expressions, Sorting Array of Strings, Ignore Case Difference When Sorting, Replacing Substrings with case difference ignorance, Splitting a String using split(), Multiple Inheritance:- Defining Interfaces, extending interfaces, implementing interfaces, Accessing interface Variables, Packages:- Java API packages, using system packages, Naming conventions, creating packages, accessing a package, using a package, hiding classes.

Unit IV Errors and Multithread Programming 12

Errors and Exceptions:- Types of errors, Exceptions, Syntax of Exception Handling code, Multiple Catch Statements, Using Finally Statement, Throwing Exceptions, Exceptions for Debugging, File Handling:- Overview of File Handling, Reading characters from a file, Writing characters to a file, Read and write Random-Access files, Obtaining File Attributes, Formatting Data:- Overview of Formatter, Number Format and Date Format – Four Simple Numeric Formatting Techniques using formatter, Format Time and Date Using formatter, Multithreaded Programming:- Introduction, Creating Threads, Extending the thread class, Stopping and

Blocking a Thread, Life Cycle of a thread.

Unit V Applet Programming 08

Applet Programming:- Introduction, preparing to Write Applets, Building Applet Code, Applet Life Cycle, Creating an Executable Applet, Designing a Web Page, Applet Tag, Applet to HTML, running the Applet, Graphics Programming:- Graphics class, Lines and Rectangles, Circles and Ellipses, Drawing Arcs, Drawing Polygons, Drawing Graphs, Using Control Loops in Applets.

Total: 75 Hours

Text Book:

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

Reference 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.

Programming in JAVA Practical **0 0 4 2**

Course Objective: 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. Have the ability to write a computer program to solve specified problems.

Course Outcome

CO - 1: To gain basic knowledge on programming skills in Java and Biojava.

CO - 2: To know how to implement operators and expressions in Java programming.

CO - 3: To use various packages in java.

CO - 4: To know the basics of formatting data, looping and branching in java.

CO - 5: To implement java programming in sort an array of strings in reverse order.

CO - 6: To split DNA sequence into pieces by using split.

CO - 7: To use java applets in the programming.

CO - 8: To compare two sequences using java.

CO - 9: To use biojava to parse PDB file.

CO - 10: To create web page using JSP.

1.	Operators and Expressions	**03**
2.	Branching and Looping	**03**
3.	Classes and Objects	**03**
4.	Packages	**03**
5.	Formatting Data	**03**
6.	Sort an Array of Strings in Reverse Order	**04**
7.	Implementing Case Differences Ignorance	**04**
8.	Applet Example	**05**
9.	Drawing Circle, rectangle using Java Graphics.	**04**
10.	Reading or writing Fasta files using Biojava?	**05**
11.	Comparing two Sequences.	**04**
12.	Translating DNA sequence into Protein sequence in Java	**04**

Total: 45Hours

Text Book:

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

Reference 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.

Programming in PERL and BIOPERL **4 0 0 4**

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.

Course Outcome

CO - 1: To acquire sound knowledge on basics in perl and more on usage of scalar, arrays and hashes.

CO - 2: To understand the concepts of subroutines in perl.

CO - 3: To acquire knowledge on file handling and file management in perl.

CO - 4: To understand the role of regular expressions concepts in perl and its major role in bioinformatics.

CO - 5: To understand the basics of control structures in perl.

CO - 6: To understand the importance of perl modules in the advance programming skills.

CO - 7: To acquire the knowledge on BioPerl and its modules.

CO - 8: To understand the usage of BioPerl in Bioinformatics research.

CO - 9: To gain knowledge on common gateway interface (CGI) and methods.

CO - 10: To acquire knowledge on CGI connecting HTML and webpages.

Unit I Introduction to PERL 08

Introduction:- PERL, Features, IDE, Syntax, Output with print, Identifiers, Data typers, Scalar, Array, Hashes, Getting User Input, The chomp operator, undef Value, List Literals, List Assignment, Subroutines:- Defining a subroutine, Invoking a subroutine, Perl References.

Unit II Expressions and Files 08

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,.

Unit III Operators 10

Operators, types, Precedence, 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 IV Control Structures 09

Control Structures: Conditional statement, If, If- Else, if-elsif-else, unless, unless-els, switch, Conditional operator. Autoincrement and Autodecrement, The for Control Structure, Loop Controls, Logical Operators, File Tests:- File Test Operators, The local time function, Bitwise Operators, Using the Special Underscore

Unit V Packages, Modules and BIOPERL 10

Perl packages, Begin and End block, Modules, Require function, Use function, Finding Modules, Installing Modules, Using Simple Modules. CPAN, Introduction, Bioperl, Installing Bioperl, Classes, Sequences (Bio::Seq Class, Sequence Manipulation), Extracting sequences, Accessing databases.

Total: 45 Hours

Text Book:

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

Reference 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.

PERL and BIOPERL Practical **0 0 4 2**

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.

Course Outcome

CO - 1: To gain basic knowledge on programming skills in PERL.

CO - 2: To know how to calculate the length of the sequence using perl program.

CO - 3: To perform the reverse of the given sequence using Rev List.

CO - 4: To perform concatenation of the given sequence by using dot operator.

CO - 5: To find the complement and reverse complement of the given sequence by using Tr operator.

CO - 6: To know the GC content of the given DNA sequence in order to evaluate the stability of DNA. .

CO - 7: To convert DNA to protein sequence by using perl program and be used in the translation process.

CO - 8: To know the basics and implement bioperl modules in the perl program.

CO - 9: To retrieve DNA sequence from the database and translate it using bioperl modules.

CO - 10: To parse PDB and FASTA file using bioperl.

1. Calculating the true length of a Sequence? **05**
2. Program to find the length of the given sequence? **05**
3. Program to reverse and concatenation of the given sequence? **05**
4. Program to complement and reverse complement of DNA sequence? **05**
5. Program to calculate GC content in the given DNA sequence? **05**
6. Program to translate DNA into Protein Sequence? **04**
7. Program to Implement BioPerl **04**
8. Retrieving DNA Sequence from the Database and Translating it into Protein Sequence using Perl and BioPerl. **08**
9. Parsing PDB and FASTA file using BioPerl? **04**

Total: 45 Hours

Text Book:

1. Martin C Brown, "Perl The Complete Reference", Second Edition, Tata McGraw Hill, 2001.

Reference 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.

Genomics and Proteomics **4 0 0 4**

Course Objectives: This course will enable the students to appreciate the importance and understanding of full genome and to explore the genomics databases & various algorithms used for comparisons of full genome and gene order. It also useful for understanding the concepts of SNPs and their significance with increase in value of proteomics concepts and technology.

Course Outcome

C.O-1: To learn about the overview of genome, composition and evolution.

C.O-2: To gain knowledge in gene predictions.

C.O-3: To understand the location of genes in the chromosomes using mapping techniques.

C.O-4: To learn the markers and types of maps in locating the genes in the chromosome.

C.O-5: To know about the fundamentals of proteomics.

C.O-6: To enlighten about gene expression, codon bias and protein levels.

C.O-7: To learn the analytical techniques and instrumentations for protein identification, separation.

C.O-8: To know about the algorithms for mining specific features of tandem MS data.

C.O-9: To enrich the knowledge on Proteomic tools.

C.O-10: To learn about the mining proteomes with its applications.

Unit I **Introduction to Genomics** **12**

Definition of Genome, Genome sequencing, genome composition & genome evolution Genome map: Types of Genome maps and their uses, High and low-resolution map, Map elements, Polymorphic markers Line, sine, Restriction Fragment Length Polymorphism, (RFLP), single nucleotide polymorphism (SNP), Finding Specific Genes. Gene prediction in prokaryotes, Gene prediction in eukaryotes.

Unit II **Types of Mapping** **12**

Types of maps: Cytogenetic, Linkage map, Transcript map, Physical map, Comparative map, Integrated map, STS content maps, Map repositories: NCBI – Entrez Human genome map viewer, OMIM – Online Mendelian Inheritance in Man. Linkage map resources: CEPH reference pedigree, CHLC – Cooperative human linkage center.

Unit III **Protein Classification and Structure Prediction** **12**

Structural elements and terminology: Helix, Sheet, Strand, Loop and coil, Active site, Architecture, Blocks, Class and Domains, Fold, Motif, PSSM. Principles of classification: Based on structural features, Phylogenetic relationship. Use of sequence pattern, leucine zipper, coiled coil, transmembrane, signal peptide, cleavage site. Secondary structure prediction: GOR 4, SOPMA, tertiary structure prediction-threading, modeling.

Unit IV **Proteomics Tools** **12**

Analytical protein and peptide separation - .Extracting Proteins from Biological Samples, Protein Separations Before Digestion, After Digestion, One-Dimensional & Two-Dimensional SDS-PAGE, Protein digestion techniques, Mass spectrometers for protein and peptide analysis-MALDI-TOF MS Instruments, ESI Tandem MS instrument.

Unit V **Applications of Proteomics** **12**

Post-Translational Modifications: Protein-Protein Interactions: Protein Expression Profiling: Molecular Medicine: Discovery of protein biomarkers, Tumor Metastasis, Technology to the Field of Neurotrauma, renal disease diagnosis, Neurology, fetal and maternal medicine, Urological Cancer Research, autoantibody profiling for the study and treatment of autoimmune disease, Cardiovascular research, diabetes research.

Total: 60 Hours

Text Book:

1. David W. Mount, “Bioinformatics Sequence and Genome Analysis”, Cold Spring Harbor Laboratory Press. 2001.

Reference Books:

1. Ann Gibbons, “Comparative genetics”, Science. 281: 1432 – 1434, 1998.
2. Baxevanis A.D., “The Molecular Biology Database Collection: updated compilations of Biological database resources”, Nucleic Acids Research.29 p 1-10, 2001.
3. Jeremy D. Peterson et.al.. The Comprehensive Microbial Resource. Nucleic Acids Research. 29: 123 – 125, 2001.
4. S.R.Pennigton and M.J.Dunn, “Proteomics”, Viva Books Private Limited. New Delhi, 2002.

Programming in Visual Basics and RDBMS 3 0 0 3

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.

Course Outcome

CO-1: To demonstrate fundamental skills in utilizing the tools of a visual environment in terms of the set of available command menus and toolbars.

CO-2: To explain and use of delegates and events for producing event-driven application.

CO-3: To apply visual programming to software development by designing projects with menus and submenus.

CO-4: To use visual programming environment to create simple visual applications.

CO-5: To describe basic concepts of database system.

CO-6: To design a data model and schemas in RDBMS.

CO-7: To use RDBMS‟s for developing industry applications.

CO-8: To be competent in use of Structured Query Language SQL.

CO-9: To analyze functional dependencies for designing a robust database.

CO-10: To implement transactions, concurrency control, and be able to do Database recovery and Query optimization.

Unit I Introduction to Visual Basic 10

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 08

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 08

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 10

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 09

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: 45 Hours

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.

Reference 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.

Programming in Python **3 0 0 3**

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.

Course outcome:

CO1: To understand script and the contributions of scripting languages.

CO2: To understand Python especially toward object-oriented concepts

CO3: To understanding of the built-in objects of Python,

CO4: To implement a given biological algorithm as a computer program using Python

CO5: To adapt and combine standard python algorithms to solve a given biological problem (incudes numerical as well as non-numerical algorithms)

CO6: To use standard python programming for biological constructs of algorithm using repetition, selection, functions, composition, modules, aggregated data (arrays, lists, etc.)

CO7: To identify and to repair coding errors in a biological program

CO8: To understand and use object based software concepts to solve the gene coding problem

CO9: To use library software for building a graphical user interface, web application, mathematical software

CO 10: To build new Python software tools for life science research.

Unit I Introduction to Python 06

Introduction to Python, History of Python, Python Features, Python Development Tools, Writing Python Program, Values and Variables:- Numeric Values, Variables and Assignment, Keywords, Identifiers, print function, Statements, Indentation and Comments, Namespace.

Unit II Expression 06

Expressions and Arithmetic: Operator Precedence and Associativity, Errors (Syntax, Run-time errors, Logic Errors), Arithmetic Examples, Variables, Constants and Literals, Data types, Type Conversion and Type Casting, Input, Output and Import, File I/O, File Methods, Directory and Files Management.

Unit III Conditional Execution 06

Conditional Execution: Conditional statement in Python, Simple if Statement, if/else statement, else – if ladder, While Statement, For Statement, Nested Loops, the break statement, the continue statement, Pass. Infinite Loops,

Unit IV Functions 06

Function: Introduction, Docstring, return statement, Scope and Lifetime of variables, Types of Functions, Built-in functions, User-defined functions, Arguments, Recursion, Global, Local and Nonlocal variables, Global Keyword.

Unit V Modules and Packages 06

Modules: Definition, import modules, import statement, Module Search Path, Reloading a module, dir () built-in function, Packages, Importing module from a package.

Total: 30 Hours

Text Book:

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

Reference 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.

Programming In Visual Basics and Python Practical 0 0 4 2

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.Read and understand the Python syntax. Be familiar with Python's fundamentals and develop simple applications. Use sophisticated techniques and Python modules that are particularly useful for bioinformatics programming. Apply different strategies for error handling of applications. Write applications in one of the most simplistic languages available.

Course outcome

CO-1: To determine complement and reverse complement for DNA Sequence using python

CO-2: To write the python program to evaluate the composition of amino acids for the given protein sequence

CO-3: To develop the python algorithm for translating the DNA sequence into protein sequence

CO-4: To compute the script for finding the similarities between the two known sequences.

CO-5: To develop the coding to extract the protein information from the genbank databases.

CO-6: To compute the bio python program to read specific sequence from the given multiple sequences.

CO-7: To script the bio python program to find the exact location of genes in the cells.

CO-8: To develop the program to retrieve the two protein structure from protein databank, compare it structures.

CO-9: To read a script for the extracting the nucleotide information from the NCBI databases.

CO-10: To compute the bio python program to read the biological information in Genbank file file

1. Creating Simple application forms in Visual Basic. **01**
    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

a) Creation of student information records containing Roll number, Name, Subject Code Marks etc., **01**

b) Finding the total and average marks, result for each student table. **01**

c) Record Manipulations such as Deletion, Modification, Addition and Counting the Record. **01**

d) Creating table that demonstrates simple biological applications. **02**

e) Creating table to demonstrate applications with biological sequences. **02**

PROGRAMMING IN PYTHON

1. Program to convert DNA to RNA using python. **01**
2. Program to calculate the frequency of aminoacid. **01**
3. Program to frequency of DNA. **01**
4. Program to reverse of DNA sequence. **01**
5. Program to complement of DNA sequence. **01**

6. Program to reverse complement of DNA sequence. **01**
7. Program to open a FASTA file. **01**
8. Program to find the GC content given sequence in the existing sequence. **01**
9. Program to sum two matrices. **02**
10. Program to transpose the matrix. **02**
11. Program to find the sequence matcher. **02**

Total: 30 Hours

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

Reference 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.
4. Richard L., Halterman, "Learning to Program With Python", 2011
5. Kent D. Lee, "Python Programming Fundamentals: Second Edition", Springer, 2010
6. Cody Jackson, "Learning to Program Using Python", Second Edition, 2013.

Enzymes and Metabolism **3 0 0 3**

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.

CO-1: To acquire sound knowledge on fundamentals and regulation of enzymes with its activities, chemical kinetics, and inhibition of enzyme reactions.

CO-2: To understand the basics of regulatory enzymes and immobilized enzymes.

CO-3: To know the introduction to metabolism with overview of anabolic and catabolic pathways of carbohydrates, proteins and lipids.

CO-4: To understand the Clinical correlation of purine and pyrimidine metabolism.

CO-5: To understand the steps involve in the Digestion and absorption of carbohydrates.

CO-6: To acquire knowledge about the biochemical pathways involved in metabolism function.

CO-7: To acquire the knowledge in introduction to lipid metabolism, β-Oxidation of fatty acids, Ketogenesis. Biosynthesis of fatty acids, Triacylglycerols and prostaglandins. Metabolism of phospholipids, glycolipids and cholesterol its uses.

CO-8: To understand the transport channel and its importance in addition about Triacylglycerols and prostaglandins.

CO-9: To be well metabolism of lipids and its uses.

CO-10: To acquire sound knowledge on basic protein metabolism, clinical correlation of proteins and integration of metabolisms.

Unit I Introduction to Enzymes 10

Introduction to enzymes, nomenclature, classification, ribo-enzyme, 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, multi-enzyme system and bi-substrate reactions, catalytic mechanisms, regulatory enzymes and immobilized enzyme.

Unit II Introduction to Metabolism 10

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 08

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 08

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 09

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: 45 Hours

Text Book:

1. Lehninger, A. L. 1984. Principles of Biochemistry. CBS publishers and distributors, New Delhi, India

Reference books:

1. C. K. Mathews, K. E. Van Holde, & K.G. Ahern, "Biochemistry", Third Edition, Prentice Hall, 1999.
2. Shanmughavel P, "Principles of Bioinformatics", Pointer Publishers, Jaipur, India. 2005.

Mathematics for Bioinformatics **4 0 0 4**

Course Objective: Accordingly, the objective of this course isn't to increase your knowledge but rather to expand your ignorance. After all, the process of science occurs at the boundary of what is known, which, as it grows, generates a greater interface with what is not known. The prime objective of this course is to help you develop skills to play the game of science - to greet confusion with joy, to withstand it, organize it, and chart a path through it.

Course Outcome:

CO-1: To acquire knowledge on basics of mathematics and to implement it in biological concepts.

CO-2: To be clear in converting the biological data to knowledge and to utilize matrices in analyzing genetic codes.

CO-3: To understand symmetry concepts and apply in analyzing biological sequences and genetics.

CO-4: To acquire knowledge to establish the theoretical concepts in analyzing biological information.

CO-5: To understand the geometric perspective in revealing the regularities in protein construction.

CO-6: To explore the geometrics and to develop in higher-level symmetries in understanding protein structure.

CO-7: To understand the inheritance properties using algebra concepts of mathematics.

CO-8: To develop tools and software to predict the genotype distribution of a particular trait in a population or in number of generations.

CO-9: To understand the basics of denotational mathematics and cognitive informatics.

CO-10: To get clear knowledge on natural intelligence and the brain through theoretical and computational approach.

Unit I **Genetic Code and Mathematics** **12**

Introduction, Genetic Code and Mathematics, Mathematical Background, Converting Data to Knowledge, The Big Picture: Informatics, Challenges and Perspectives, Genetic Codes and Matrices.

Unit II **Mathematical Sequences** **12**

Symmetrical Patterns, Molecular Genetics, and Bioinformatics, Mathematical Sequences, Sequence Alignment, Structures of DNA and Knot Theory – Introduction, Knot Theory Preliminaries, DNA Knots and Links, Challenges and Perspectives.

Unit III **Protein Structures, Geometry and Topology** **12**

Protein Structures, Geometry, and Topology: Introduction, Computational Geometry and Topology Preliminaries, Protein Structures and Prediction, Statistical Approach and Discussion, Biological Networks and Graph Theory – Introduction, Graph Theory Preliminaries and Network Topology, Models of Biological Networks.

Unit IV **Genetic Matrices** **12**

Matrix Genetics, Hadamard Matrices, and Algebraic Biology: Introduction, Genetic Matrices and the Degeneracy of the Genetic Code, The Genetic Code and Hadamard Matrices, Genetic Matrices and Matrix Algebras of Hypercomplex Numbers, Some Rules of Evolution of Variants of the Genetic Code, Challenges and Perspectives

Unit V **Denotational Mathematics and Cognitive Informatics** **12**

Bioinformatics, Denotational Mathematics, and Cognitive Informatics: Introduction, Emerging Pattern, Dissipative Structure, and Evolving Cognition, Denotational Mathematics and Cognitive Computing, Challenges and Perspectives.

Total: 60 Hours

Text Book:

1. Matthew He, Sergey Petoukhov, “Mathematics of Bioinformatics: Theory, Practice, And Applications”, Wiley Series of Bioinformatics, 2010.

Reference Books:

1. Ahmed N and Rao K, “Orthogonal Transforms for Digital Signal Processing”. New York, Springer – Verlag, 1975.
2. B.S.Vatssa- WishwaPrakashan, “Discrete Maths”, A Division of Wiley Eastern Ltd. Chennai, 1993.
3. P.R.Vittal, “Mathematical Foundations” – Margham Publication, Chennai, 2012

Virology **4 0 0 4**

Course Objective: This course will enable the students to describe at the molecular level the replication strategies of representative DNA and RNA viruses and the effects of virus infection on cell growth control and survival. To elucidate individual steps in virus life cycles and their interactions with host cells and their vaccine.

Course Outcome:

CO-1: To understand the basics structures, morphology and taxonomy of virus.

CO-2: To acquire knowledge on bio-safety measures to maintain and handle virus in the laboratorial conditions.

CO-3: To obtain a clear knowledge on basic cellular functions and the cell receptors involve in interactions.

CO-4: To get a clear understanding in the cell organelles and its role in regular cellular functions.

CO-5: To acquire knowledge on viral cell morphogenesis and transport of proteins, replications.

CO-6: To attain clear knowledge on signaling pathways and cytoskeletal interactions as well as the host-parasite relations.

CO-7: To figure out the strategies of replication in both RNA and DNA molecules.

CO-8: To be aware of mechanism involve in host viral infection in order to develop effective antiviral medicines.

CO-9: To perceive knowledge on antiviral and viral vaccines combating viral infections in the host.

CO-10: To implement modern approaches and computational techniques to get rid of viral infections.

Unit I Introduction of Virus 15

Introduction of virus, History and principles of virology, virus taxonomy, introduction to replication strategies. Virus structure and morphology, viruses of veterinary importance and plant viruses.Principles of bio-safety, containment facilities, maintenance and handling of laboratory animals and requirements of virological laboratory.

Unit II Cellular Receptors 10

Cellular receptors and virus entry – Definition, structure and methods of discovery of viral receptors (polio, herpes, VSV, HIV). Kinetics of receptor binding. Cellular interactions - clathrin coated pits, lipid rafts, caveolae, endocytosis and virus uncoating mechanisms Nuclear localization signals and nuclear pore transit, virus –cytoskeletal interactions, chaperons.

Unit III Virus Morphogenesis 10

Virus morphogenesis Replication sites and their characterization, IRES, replicones, transport of viral proteins.Mechanism of host cell damage- Host cell 'shut off', apoptosis, necrosis, stress response, alteration of signaling pathways, cellular basis of transformation, types of cenotaphic effects, ultrastructural cytopathology.

Unit IV Virus Replication 15

Virus Replication: RNA viruses: General strategies, replication of plus stranded RNA virus (polio), negative strand. RNA viruses (VSV and influenza). Other RNA viruses. Replication of double stranded RNA virus (rota), ambisense RNA (LCM) and retroviruses (HIV and HTLV). DNA viruses Replication of double stranded DNA viruses (SV40, pox), ssDNA virus (AAV). Miscellaneous(Prion proteins, replication of plant virus (Poty))

Unit V Antivirals and Viral Vaccines 10

Antivirals and Viral Vaccines:Viral Vaccines – Conventional vaccines –killed and attenuated, modern vaccines—recombinant proteins, subunits, DNA vaccines, peptides, immune modulators (cytokines), vaccine delivery and adjuvants. Antivirals- Interferons, designing and screening for antivirals, mechanisms of action, anti-viral libraries, anti-retrovirals—mechanism of action and drug resistance.Modern approaches of virus control anti-sense RNA, siRNA, ribozymes, *in silico* approaches for drug designing.

Total: 60 Hours

Text Book:

1. P.Saravanan, "Virology", Neha Publishers & Distributors, 2009.

Reference Books:

1. Antiviral Agents, Vaccines, and Immunotherapies. Stephen K. Tyring. Latest edition / Pub. Date: October 2004. Publisher: Marcel Dekker.
2. Antiviral Drug Discovery for Emerging Diseases and Bioterrorism Threats. Paul F. Torrence (Editor). Latest edition / Pub. Date: July 2005. Publisher: Wiley, John & Sons, Incorporated
3. Principles of Virology: Molecular Biology, Pathogenesis, and Control of Animal Viruses. S. J. Flint, V. R. Racaniello, L. W. Enquist, V. R. Rancaniello, A. M. Skalka Latest edition / Pub. Date: December 2003 Publisher: American Society Microbiology.
4. DNA Virus Replication. Alan J. Cann. Latest edition / Pub. Date: March 2000. Publisher: Oxford University Press.

Biophysical Chemistry **4 0 0 4**

Course Objective: This course will enable the students to be familiar with the Physics,chemistry of different classes of biomolecules and their interactions in an aqueous environment and also understand the structure-function relationships of macromolecules, the principles of enzyme catalysis and regulation.

Course Outcome

CO - 1: To know the nature of quantum particles and its mechanics.

CO - 2: To understand the molecular basics of quantum particles.

CO - 3: To acquire knowledge on thermodynamics of particles and the importance of various laws in computing energies.

CO - 4: To understand the concepts of energy contributions in biological systems.

CO - 5: To understand the theoretical basics of atoms and biological systems.

CO - 6: To gain knowledge on various bond interactions and its dynamic behavior in biology.

CO - 7: To acquire the knowledge on basics of physical concepts of X-ray and crystallization.

CO - 8: To understand the usage of X-ray crystallography and macromolecular structure.

CO - 9: To be well versed with the spectroscopy techniques and its uses.

CO - 10: To acquire knowledge on NMR technique and its uses in macromolecular structure.

Unit I Classical and Quantum Mechanics 15

Classical mechanics: History, Description of the theory, Limits of validity. Quantum mechanics-History, Interactions with other scientific theories, Philosophical implications, Applications, Examples. Elementary introduction to Lagrangian and Hamiltonian formulation of mechanics — Planck theory of blackbody radiation – photoelectric effect – Bohr model of the atom – atomic spectra – De Broglie theory of matter waves – Schrodinger wave equation – interpretation of wave function .

Unit II Thermodynamics 10

Thermodynamics And Energetics: Thermodynamics Systems – Laws Of Thermodynamics First Law Of Thermodynamics, SecondLaw Of Thermodynamics, ThirdLaw Of Thermodynamics – Statement And Applications – Concepts Of Entropy And Enthalpy – Chemical Potentials – Free Energy – Gibbs And Helmholtz Free Energy – ATP (Adenosine triphosphate)As Energy Currency In Biological Systems.

Unit III MolecularMechanics and Dynamics 15

Molecular Mechanics – Functional form, Areas of application, Environment and alvation, Software packages Molecular Dynamics:History, Areas of application and limitations, Basic Principles – Molecular Representations – Force Fields – Atom-Atom Pair Potentials – Bond Length, Bond Angle, Torsion Angle Potential – Van Der Waals And Electrostatic Potential – Hydrogen Bonding Terms.

Unit IV X-ray Crystallography 10

X-ray crystallography – History, Contributions to chemistry and material science, Relationship to other scattering techniques, Methods – Procedure, Limitations, Crystallization, Data collection, Data analysis, Diffraction theory, Advantages of a crystal, Elementary description of crystallography- Unit cell – Miller indices – Crystal growth, X-ray diffraction- Refinement and interpretation- Concept of resolution.

Unit V Spectroscopy Techniques 10

IR spectroscopy – Theory, Practical IR spectroscopy, Absorption bands, Uses and applications UV-Visible spectroscopy – Principle of ultraviolet-visible absorption, Applications, Beer–Lambert law, Ultraviolet-visible spectrophotometer, Microspectrophotometry, Additional applications Raman spectroscopy – Theoretical basis, History, Raman shift, Applications, Microspectroscopy, Polarized analysis, Variations. NMR(Nuclear magnetic resonance) spectroscopy.History, Basic NMR techniques, Correlation spectroscopy, Biomolecular NMR spectroscopy.

Total: 60 Hours

Text Books:

1. VasanthaPattabhi and N. Gautham, 'Biophysics', Narosa Publishing Company, New Delhi. (2001).
2. P.Narayanan. 'Introductory Biophysics' New Age Publishing Co., Mumbai, India (1999).

Reference Books:

1. C.R. Cantor and P. Schimmel, 'Biophysical Chemistry, (Vol I, II and III), W.H. Freeman and Company, New York, USA. (1985).
2. D. Freifelder, 'Physical Biochemistry', W.H.Freeman and Company, New York, USA. (1982).
3. E.Ackerman, L.B.M.Ellis and L.E.Williams, 'Biophysical Science' Prentice Hall Inc., New Jersey, USA. (1979).

Cloud Computing Basics **3 0 0 3**

Course Objective: Aims to Provide World-leading IT technology with high international standard of service. Implementation service with a quality control from project imitation to production. A commitment of quality of work delivered to the public 5. Continuously strengthen our business rapport among IT vendors, manufacturers, resellers, and distributors, is also our main focusing area in running the business.

Course Outcome

CO-1: To acquire sound knowledge on cloud and its architecture in computing.

CO-2: To understand the business values of cloud computing.

CO-3: To know the concepts of cloud computing applied in various field.

CO-4: To understand the basis of service administration of cloud computing.

CO-5: To know the steps involve in cloud computing technology.

CO-6: To understand the usage of cloud computing in web applications.

CO-7: To acquire the knowledge on cloud computing data management, security and protection.

CO-8: To understand the concepts of data storage in cloud computing.

CO-9: To be well versed with the private cloud computing concepts.

CO-10: To acquire knowledge on accessing the novel hybrid clouds.

Unit I Introduction to Cloud Computing 10

Introduction to cloud computing: Collaborative to Cloud – A Short History, Functioning of Cloud computing, Cloud Architecture, Cloud Storage and Cloud Services, Industrial Applications, Business Values :– Introduction, Service Modeling, Infrastructure as a Service, Platform as a Service.

Unit II Service Administration 09

Inside Cloud Computing: Introduction, Sensational Feeling about Organization, Deciding on Strategy, Governance Issues, Monitoring Business Process, IT Cost Management, Cloud Service Administration:- Introduction, Service Level Agreements and Monitoring, Support Services, Resource Management, Service Management.

Unit III Computing Technology 10

Cloud Computing Technology: Introduction, Clients – Hardware clients, software clients, cloud clients, Security, Network – Basic public internet, The accelerated internet, Site-to-Site VPN, cloud providers, Cloud consumers, Pipe size, Redundancy, Services – Identity, Integration, Mapping, Payments, Search, Accessing the Cloud:- Introduction, Platforms – Web application frame work, web hosting service, propriety methods, Web applications, API in cloud computing, browsers for cloud computing.

Unit IV Data Management 08

Cloud Data Management: Data Security, Data Location, Data Control, Securing data for Transport, Scalability and cloud services – Large scale data processing, Databases and data stores and data archival, Storage as a Service, Information Storage in Cloud computing – Storage Providers, Storage Security, Merits and Demerits of Cloud Storage.

Unit V Private and Hybrid Clouds 08

Discovery of Private and Hybrid clouds: Need for privacy, comparing public, private and hybrid, examining the economics of the private cloud, The Up Key Vendors, Cloud Computing Standards – Best Practices and Standards, Practical Issues, Standards Organizations and Groups.

Total: 45 Hours

Text Book:

1. Dr. Kumar Saurabh, "Cloud Computing", 2nd Edition, Wiley India Private Ltd., 2012.

Reference Book:

1. Anthony T. Velte, Toby J. Velte, Robert Elsenpeter, "Cloud Computing: A Practical Approach", Tata McGrah Hill, 2014.

Recombinant DNA Technology 3 0 0 3

Course Objective: This course will enable the students to understand the knowledge in genetic engineering, vectors in gene cloning, transformation in higher organisms and the applications of rDNA technology and to introduce the Bioinformatician to application of rDNA technology.

Course Outcome

CO-1: To learn about the fundamentals and role of biomolecules in Recombinant DNA technology.

CO-2: To gain knowledge about strategies in gene cloning.

CO-3: To understand the basic techniques and applications in Genetic engineering

CO-4: To enrich the quest on applications including cloning vectors and expression vectors.

CO-5: To know about the concepts of cell transformation due to the changes in genetic material, and cell cloning.

CO-6: To bring into the light about the creation of gene libraries.

CO-7: To learn about the beginning of transformation and transfection methods.

CO-8: To bring abundant knowledge in cloning methodologies, sequencing and human genome project.

CO-9: To learn about the advent of Polymerase Chain Reaction and tremendous impact on molecular biology.

CO-10: To understand the Polymerase Chain Reaction based mutagenesis and gene silencing techniques.

Unit I Cloning and RDNA Technology 09

Introduction to cloning and rDNA technology, Recombinant DNA, Cloning DNA, Cloning vectors: Plasmids (pUC 18 and Ti plasmids), Bacteriophages, Plasmids, Cosmids, SV40, retrovirus and Artificial Chromosomes (BAC, YAC), Amplification of Recombinant DNA.

Unit II Gene Cloning 09

Strategies in gene cloning: restriction, ligase, insertion into vector, cloning, transformation into host cell, Enzymology of Recombinant DNA. Screening for recombinant (Insertional inactivation, Colony/in situ hybridization, radioactive antibody test, Xgal, complementation and physical methods).

Unit III Genome Sequencing 09

Methods of gene transfer and genome sequencing:CaPO4 mediated gene transfer, liposomes, electroporation, electro fusion, micro-injection, particle bombardment. DNA sequencing (Sanger and Coulson method; Maxam and Gilbert method and Automated method) – Chromosomal walking, transposons, construction of genomic and cDNA libraries; molecular markers- RAPD, RFLP.

Unit IV Transgenic Plants 09

Transgenic plants: Definitions, types of Transgenic plants, benefits, public concern and future, high yielding, salt, draught, herbicide, disease resistant. Genetically modified crops, Transgenic animals –for improved livestock production.

Unit V RDNA in Medicine 09

rDNA in medicine: Recombinant DNA Therapy in Medicine, Vaccines, enzymes, blood factors, interferon, gene therapy, DNA fingerprinting and its applications in forensic sciences, Application of Recombinant Technology – Gene mapping, Diagnosis of Molecular disease, Application in forensic medicine.

Total: 45 Hours

Text Book:

1. Primrose. Principles of genetic manipulation; 6thEd., Blackwell Science publication.

Reference Books:

1. Keya Chaudhuri Recombinant DNA Technology, Paperback, July 19, 2013 b.

2. T. A. Brown. A Introduction to Gene Cloning, Chapman and Hall publications, 3rd Ed., 1995.
3. Sardul Singh Sandhu. Recombinant DNA Technology, Hardcover – Import. Oct 2010.
4. Monika Jain. Recombinant DNA Techniques: A Textbook, 1st Ed. Paperback.2011.

Data Warehousing and Data Mining **3 0 0 2**

Course Objective: Students will be enabled to understand and implement classical models and algorithms in data warehousing and data mining. They will learn how to analyze the data, identify the problems, and choose the relevant models and algorithms to apply. They will further be able to assess the strengths and weaknesses of various methods and algorithms and to analyze their behavior.

Course Outcome

CO-1: To learn about the components in data ware housing.

CO-2: To gain knowledge in identify the subject area for which a data warehouse is to be built.

CO-3: To enlighten about query tools and Applications.

CO-4: To learn the Dimensional model for data warehouse.

CO-5: To know about introduction and types of data mining.

CO-6: Analyze the market needs by applying suitable OLAP operations.

CO-7: Identify the patterns that can be extracted on application of data mining techniques in various domains.

CO-8: To Understand several different data mining techniques such as market basket analysis, Clustering, classification.

CO-9: To develop an application by using various data mining techniques to identify patterns that evolves in various business domains.

CO-10: To know about clustering and applications and trends in data mining.

Unit I Introduction to Data Warehousing 09

Data Warehousing:- Data warehousing Components –Building a Data warehouse – Mapping the Data Warehouse to a Multiprocessor Architecture – DBMS Schemas for Decision Support – Data Extraction, Cleanup, and Transformation Tools –Metadata.

Unit II Business Analysis 09

Business Analysis:- Reporting and Query tools and Applications – Tool Categories – The Need for Applications – Online Analytical Processing (OLAP) – Need –Multidimensional Data Model – OLAP Guidelines – Multidimensional versus Multi relational OLAP – Categories of Tools – OLAP Tools and the Internet.

Unit III Data Mining 09

Data Mining:- Introduction – Data – Types of Data – Data Mining Functionalities – Interestingness of patterns – Classification of Data Mining Systems – Data Mining Task Primitives –Integration of a Data Mining System with a Data Warehouse – Issues –Data Preprocessing.

Unit IV Association Rule Mining and Classification 09

Association Rule Mining and Classification:- Mining Frequent Patterns, Associations and Correlations – Mining Methods – Mining Various Kinds of Association Rules – Correlation Analysis – Constraint Based Association Mining – Classification and Prediction – Basic Concepts.

Unit V Clustering, Applications and Trends in Data Mining 09

Clustering and Applications and Trends in Data Mining:- Cluster Analysis – Types of Data – Categorization of Major Clustering Methods – K means – Partitioning Methods – Hierarchical Methods – Density-Based Methods – Grid Based Methods – Model-Based Clustering Methods- Clustering High Dimensional Data – Constraint – Based Cluster Analysis.

Total: 45 Hours

Text Book:

1. Alex Berson and Stephen J. Smith, “Data Warehousing, Data Mining & OLAP”, Tata McGraw – Hill Edition, Tenth Reprint 2007.

Reference Books:

1. Jiawei Han and MichelineKamber, “Data Mining Concepts and Techniques”, Second Edition, Elsevier, 2007.

2. Pang-Ning Tan, Michael Steinbach and Vipin Kumar, “Introduction to Data Mining”, Person Education, 2007.
3. G. K. Gupta, “Introduction to Data Mining with Case Studies”, Easter Economy Edition, Prentice Hall of India, 2006.
4. Data Mining Data Warehousing and Olap, S K Kataria, Paperback 2010.

GENERIC ELECTIVE COURSES

Introduction to Bioinformatics **3 0 0 3**

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.

Course Outcome

CO-1: To acquire the skill of constructing algorithms and there by determining the computational complexity of algorithms by knowing the basic biological information.

CO-2: To provide the necessary biological (Gene and protein) background which are required solve the problem that arise during the designing of algorithm.

CO-3: To map an unknown segment of DNA by breaking it into pieces and then by identifying the locations of the breakpoints in the gene.

CO-4: To follow the problem solving heuristic of making the locally optimal choice at each stages with the hope of finding a global optimum.

CO-5: To solve many different types of complex problem by breaking down into a collection of simpler sub biological problems and by solving each of those biological problems one by one until expected solutions arrived.

CO-6: To analyze the previously solved sub problems and combine their solutions along with the achieved result to give the best solution for the given biological problem.

CO-7: To divide the given problem, at least into 2 sub-problems and the combination of the results arrived by sub problem is much easier than finding the solution of the initial problem directly.

CO-8: To prove an algorithm for the given biological problem is often necessary to replace the original problem with a more complicated problem in order to initialize the recursion.

CO-9: Mathematical approach to solving certain types of biological problem like sequence alignment, gene detection, structure prediction, data-mining literature.

CO-10: The problem is not directly noticeable, but the output of the problem dependent on the result predicted by the probability distribution.

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 20

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 Biological Databases 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 15

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 15

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: 75 Hours

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: BoS April 26, 2010 Dr. Urmila Kulkarni-Kale 15

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. Baxevanis Andreas D. Bioinformatics: A Practical Guide to the Analysis of Genes and Proteins, 3rd Edition. Publisher: New York, John Wiley & Sons, Inc. 2002, ISBN: 9814126756
3. Lesk, A.M. (2002) "Introduction to Bioinformatics:, 1st Edition, Oxford University Press, Oxford, UK , , ISBN: 9042112221
4. Teresa Attwood, Parry-Smith David J. Introduction to Bioinformatics. Publisher: Pearson Education (Singapore) Pte.Ltd., 2001. ISBN:8178085070
5. Mount David W. Bioinformatics: Sequence and Genome Analysis. Publisher: Cold Spring Harbor Laboratory Press; 1st edition 2001. ISBN: 0879695978
6. Gibas Cynthia, Jambeck Per. Developing Bioinformatics Computer Skills. Publisher: Shroff Publishers and distributors O'Reilly Media, Inc., 2001. ISBN: 8173662428.

Cheminformatics **3 0 0 3**

Course Objective: This course will enable the students to understand the fundamentals and complementary aspects of chemo informatics and bioinformatics for design of bioactive molecules. To get hands-on experience in chemical structure representation, storage and analysis of small molecular data.

Course Outcome

CO-1: To acquire knowledge on the basic representation and file formats of chemical molecules.

CO-2: To understand the applications of chemical information in various fields.

CO-3: To gain knowledge on different descriptor formats available for the molecules.

CO-4: To understand the important properties of small molecules and its application in the similarity and diversity analysis.

CO-5: To observe the infrastructure of chemical databases, information stored and its types.

CO-6: To be clear with the different search techniques and its importance in acquiring required data.

CO-7: To perceive the molecular relationships based on physical and chemical properties with the biological properties.

CO-8: To obtain knowledge on the molecular properties and to develop tools for predicting the specific properties.

CO-9: To observe the features of pharmacophore and to access the combinatorial libraries for pharmacophore designing.

CO-10: To be clear with identification, accession and application of pharmacophores in drug designing process.

Unit I Basics of Chemistry 12

Introduction to Atoms, Ions, Elements, Molecules, Properties of atoms- Protons, neutron and electrons, p-Block and s-Block elements, periodic table, Chemical Bonding and Molecular Structure, Types of bonds, Resonance structure and Hybridization, Stereochemistry, Isomerism, Enantiomers.

Unit II Introduction to Cheminformatics 12

Introduction tocheminformatics: Aim, Scope, History, Applications (Storage and Retrieval, Virtual Libraries, Virtual Screening, Quantitative Structure-Activity Relationship (QSAR)); Role ofcheminformatics in Pharmaceutical/Chemical Research. Chemical Structure Representation-1D, 2D and3D Structures. Molecular File Formats (SMILES, WLN, SDF, andMOL).

Unit III Molecular Descriptors 12

Molecular Descriptors- An Introduction, Invariance Properties of Molecular Descriptors, Types of Molecular Descriptors, Descriptors calculated from 2D structure- physicochemical properties, molar refractivity, Topological, Electrotoplogical and Shape Indices, Fingerprints and MACCS Keys. Molecular Similarity andMolecular Diversity Analysis.

Unit IV Molecular Database Screening 12

Introduction to Molecular Database, Screening Methods (Ligand-Based and Structure-Based), Lipinski's Rule: Drug/Lead like Molecules (Absorption, Distribution, Metabolism, Excretion and Toxicity).Chemical Structure Based Search Techniques: Exact, Sub-Structure and Similar Structure Searches.

Unit V Combinatorial Chemistry, Library Design and QSAR 12

Combinatorial Chemistry and Library Design- Library Enumeration, Design Strategies-Monomer based and Product based selection. Pharmacophore modeling strategies, Molecular Docking studies, Molecular Matched Pair Analysis (MMPA), Quantitative Structure Activity Relationship.

Total: 60 Hours

Text Books:

1. Gasteiger Johann, Engel Thomas. "Chemoinformatics: A Textbook". Publisher: Wiley VCH; 1st edition. 2003.

Reference Books:

1. Bunin Barry A. Siesel Brian, Morale Guillermo, Bajorath Jürgen. Chemoinformatics: Theory, Practice, & Products Publisher: New York, Springer. 2006.

2. Leach Andrew R., Valerie J. Gillet. An introduction to Chemoinformatics. Publisher: Kluwer academic, 2003.
3. Gasteiger Johann, Handbook of Chemoinformatics: From Data to Knowledge (4 Volumes), Publisher: Wiley-VCH, 2003.
4. Thomas Engel. Chemoinformatics – A Textbook Publisher: Kluwer academic, 2005.

Molecular Modeling and Drug Designing **3 0 0 3**

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.

Course Outcome

CO-1: To understand the molecular geometry information, basic concepts of a molecule.

CO-2: To explore the molecular geometry information to determine the stability of small molecule interactions with the proteins.

CO-3: To perceive the knowledge on the activities of a molecule inside the biological system through simulation studies.

CO-4: To understand the algorithms used to develop software to predict the molecular activities through computational approach.

CO-5: To get knowledge on pharmacophore, its features, applications and to get access to the sources exist at present

CO-6: To determine a significant pharmacophore model in order to identify the most promising candidates.

CO-7: To understand the algorithms used in the molecular docking concepts and its types.

CO-8: To get an exposure to the existing docking software and to observe the result.

CO-9: To be aware of molecular databases available at present to explore the biological molecules.

CO-10: To understand the basic steps in querying database and to interpret information from the datas available.

Unit I Molecular Modeling and Mechanics 15

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, HatreeFock 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 20

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 15

Pharmacophore – Historical Perspective andFeatures, 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 15

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: 75 Hours

Text Book:

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

Reference 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, 291995. 9780198557401

Structural Bioinformatics **3 0 0 3**

Course Objective: This course will enable the students to explore primary and derived databases in the field of computational structural biology and to visualize macromolecular structures using various visualization tools. Finally acquire skills to use different approaches for prediction of protein structure.

Course Outcome

CO-1: To learn about the introduction to bioinformatics, structural bioinformatics, molecular structure and internal energy.

CO-2: To gain knowledge in energy minimization of small molecules.

CO-3: To enlighten about bioinformatics databases applied in protein structure prediction.

CO-4: To learn the protein structural terminology, protein classification and modelling.

CO-5: To know about the protein structures.

CO-6: To enrich the knowledge on Proteomic tools.

CO-7: To learn about the protein stability and fold, protein function prediction methods and approaches to protein structural genomics.

CO-8: To understand protein function predictions- sequence based and network based methods.

CO-9: To learn secondary structure predictions homology modelling, fold recognition and *ab initio* 3D structure predictions.

CO-10: To know about protein sequence and structure analysis tools.

Unit I Introduction to Proteins 12

Fundamentals of X-ray diffraction, NMR spectroscopy of macromolecules Protein Structure: Primary, Secondary, Super Secondary, Domains, Tertiary, Quaternary, Ramachandran plot.

Unit II Protein secondary databases 12

Protein secondary structure classification databases: HSSP, FSSP, CATH, SCOP. Protein secondary structure prediction methods: GOR, Chou-Fasman, PHD, PSI- PRED, J-Pred.

Unit III Protein Tertiary databases 12

Protein Tertiary structure prediction methods: Homology Modeling, Fold Recognition, Abintio Method. Protein folding, Molecular Dynamics of Protein, Molecular Docking of Protein, Small molecule and Nucleotide, Concepts of Force Field

Unit IV Introduction to HMM 12

Motif and Domain: Motif databases and analysis tools. Domain databases (CDD, SMART, ProDom) and Analysis tools. HMM (Hidden Markov Model): Introduction to HMM, its application in Sequence alignment and Structure prediction, HMM based Softwares (HMMER and HMMSTR)

Unit V Structural features of RNA 12

Structural features of RNA: Primary, Secondary, Tertiary. Introduction to RNA Secondary structure prediction, Methods for RNA Secondary structure prediction, Limitation of RNA Secondary structure prediction

Total: 60 Hours

Text Book:

1. Webster David (Editor). Protein Structure Prediction: Methods and Protocols (Methods in Molecular Biology) Volume 143. Publisher: New Jersey Humana Press. 2000. ISBN: 0896036375.

References:

1. Cesareni Giovanni, Gimona Mario, Sudol Marius, Yaffe Michael (Editors). Modular Protein Domains. Publisher: Weinheim Wiley-VCH. 2005. ISBN: 352730813X.
2. Höltje Hans-Dieter, Sippl Wolfgang, Rognan Didier, FolkersGerd. Molecular Modeling: Basic Principles and Applications. Publisher: New York, Wiley-VCH. 2003. ISBN: 3527305890.

Programming in PERL and BIOPERL 3 0 0 3

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.

Course Outcome

CO-1: To acquire sound knowledge on basics in perl and more on usage of scalar, arrays and hashes.

CO-2: To understand the concepts of subroutines in perl.

CO-3: To acquire knowledge on file handling and file management in perl.

CO-4: To understand the role of regular expressions concepts in perl and its major role in bioinformatics.

CO-5: To understand the basics of control structures in perl.

CO-6: To understand the importance of perl modules in the advance programming skills.

CO-7: To acquire the knowledge on BioPerl and its modules.

CO-8: To understand the usage of BioPerl in Bioinformatics research.

CO-9: To gain knowledge on common gateway interface (CGI) and methods.

CO-10: To acquire knowledge on CGI connecting HTML and webpages.

Unit I Introduction to PERL 08

Introduction:- PERL, Features, IDE, Syantx, Output with print, Identifiers, Data typers, Scalar, Array, Hashes, Getting User Input, The chomp operator, undef Value, List Literals, List Assignment, Subroutines:- Defining a subroutine, Invoking a subroutine, Perl References.

Unit II Expressions and Files 08

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,.

Unit III Operators 10

Operators, types, Precedence, 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 IV Control Structures 09

Control Structures: Conditional statement, If, If- Else, if-elsif-else, unless, unless-els, switch, Conditional operator. Autoincrement and Autodecrement, The for Control Structure, Loop Controls, Logical Operators, File Tests:- File Test Operators, The local time function, Bitwise Operators, Using the Special Underscore

Unit V Packages, Modules and BIOPERL 10

Perl packages, Begin and End block, Modules, Require function, Use function, Finding Modules, Installing Modules, Using Simple Modules. CPAN, Introduction, Bioperl, Installing Bioperl, Classes, Sequences (Bio::Seq Class, Sequence Manipulation), Extracting sequences, Accessing databases.

Total: 45 Hours

Text Book:

2. Martin C Brown, “Perl The Complete Reference”, Second Edition, Tata McGraw Hill, 2001

Reference Books:

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

Python For Bioinformatics **3 0 0 3**

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.

Course outcome

CO-1: To understand script and the contributions of scripting languages.

CO-2: To understand Python especially toward object-oriented concepts

CO-3: To understanding of the built-in objects of Python,

CO-4: To implement a given biological algorithm as a computer program using Python

CO-5: To adapt and combine standard python algorithms to solve a given biological problem (incudes numerical as well as non-numerical algorithms)

CO-6: To use standard python programming for biological constructs of algorithm using repetition, selection, functions, composition, modules, aggregated data (arrays, lists, etc.)

CO--7: To identify and to repair coding errors in a biological program

CO-8: To understand and use object based software concepts to solve the gene coding problem

CO-9: To use library software for building a graphical user interface, web application, mathematical software

CO-10: To build new Python software tools for life science research.

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

Text Book:

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

Reference 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

Consumer Affairs **3 0 0 3**

Course Objective: This paper seeks to familiarize the students with their rights and responsibilities as a consumer, the social framework of consumer rights and legal framework of protecting consumer rights. It also provides an understanding of the procedure of redress of consumer complaints, and the role of different agencies in establishing product and service standards. The student should be able to comprehend the business firms' interface with consumers and the consumer related regulatory and business environment.

Unit I Conceptual Framework **13**

Consumer and Markets: Concept of Consumer, Nature of markets: Liberalization and Globalization of markets with special reference to Indian Consumer Markets, E-Commerce with reference to Indian Market, Concept of Price in Retail and Wholesale, Maximum Retail Price (MRP), Fair Price, GST, labeling and packaging along with relevant laws, Legal Metrology.

Experiencing and Voicing Dissatisfaction: Consumer buying process, Consumer Satisfaction/dissatisfaction-Grievances-complaint, Consumer Complaining Behaviour: Alternatives available to Dissatisfied Consumers; Complaint Handling Process: ISO 10000 suite

Unit II The Consumer Protection Law in India **13**

Objectives and Basic Concepts: Consumer rights and UN Guidelines on consumer protection, Consumer goods, defect in goods, spurious goods and services, service, deficiency in service, unfair trade practice, restrictive trade practice.

Organizational set-up under the Consumer Protection Act: Advisory Bodies: Consumer Protection Councils at the Central, State and District Levels; Adjudicatory Bodies: District Forums, State Commissions, National Commission: Their Composition, Powers, and Jurisdiction (Pecuniary and Territorial), Role of Supreme Court under the CPA with important case law.

Unit IIIGrievance Redressal Mechanism under the Indian Consumer Protection Law **13**

Who can file a complaint? Grounds of filing a complaint; Limitation period; Procedure for filing and hearing of a complaint; Disposal of cases, Relief/Remedy available; Temporary Injunction, Enforcement of order, Appeal, frivolous and vexatious complaints; Offences and penalties.

Leading Cases decided under Consumer Protection law by Supreme Court/National Commission: Medical Negligence; Banking; Insurance; Housing & Real Estate; Electricity and Telecom Services; Education; Defective Products; Unfair Trade Practices.

Unit IV Role of Industry Regulators in Consumer Protection **13**

i. Banking: RBI and Banking Ombudsman
ii. Insurance: IRDA and Insurance Ombudsman
iii. Telecommunication: TRAI
iv. Food Products: FSSAI
v. Electricity Supply: Electricity Regulatory Commission
vi. Real Estate Regulatory Authority

Unit V Contemporary Issues in Consumer Affairs 13

Consumer Movement in India: Evolution of Consumer Movement in India, Formation of consumer organizations and their role in consumer protection, Misleading Advertisements and sustainable consumption, National Consumer Helpline, Comparative Product testing, Sustainable consumption and energy ratings.

Quality and Standardization: Voluntary and Mandatory standards; Role of BIS, Indian Standards Mark (ISI), Ag-mark, Hallmarking, Licensing and Surveillance; Role of International Standards: ISO an Overview

Total: 65 Hours

Text Books:

1. Khanna, Sri Ram, Savita Hanspal, Sheetal Kapoor, and H.K. Awasthi. (2007) Consumer Affairs, Universities Press.
2. Choudhary, Ram Naresh Prasad (2005). Consumer Protection Law Provisions and Procedure, Deep and Deep Publications Pvt Ltd.
3. G. Ganesan and M. Sumathy. (2012). Globalisation and Consumerism: Issues and Challenges, Regal Publications

Reference Books:

1. Suresh Misra and SapnaChadah (2012). Consumer Protection in India: Issues and Concerns, IIPA, New Delhi
2. Rajyalaxmi Rao (2012), Consumer is King, Universal Law Publishing Company
3. Girimaji, Pushpa (2002). Consumer Right for Everyone Penguin Books.
4. E-books :- www.consumereducation.in
5. Empowering Consumers e-book,
6. ebook, www.consumeraffairs.nic.in
7. The Consumer Protection Act, 1986 and its later versions.

Disaster Management **3 0 0 3**

Course Objective: To provide students an exposure to disasters, their significance and types. To ensure that students begin to understand the relationship between vulnerability, disasters, disaster prevention and risk reduction. To gain a preliminary understanding of approaches of disaster risk reduction. To gain a preliminary understanding of approaches of disaster risk reduction (DRR). To enhance awareness of institutional processes in the country and To develop rudimentary ability to respond to their surroundings with potential disaster response in areas where they live, with due sensitivity.

Unit I **Introduction to Disasters** **06**

Introduction to Disasters: Concepts and Definitions (Disaster, Hazard, Vulnerability, Resilience, Risks)

Unit II **Disasters: Classification, Causes, Impacts** **12**

Disasters: Classification, Causes, Impacts: (Including social, economic, political, environmental, health, psychosocial, etc.). Differential impacts- in terms of caste, class, gender, age, location, disabilityGlobal trends in disasteis, urban disasters, pandemics, complex emergencies,Climate change.

Unit III **Approaches to Disaster Risk Reduction** **10**

Approaches to Disaster Risk Reduction: Disaster Cycle – its analysis, Phases, Culture of safety, prevention, mitigation and preparednesscommunity based DRR, Structural- nonstructural measures,roles and responsibilities of- community, Panchayati Raj Institutions/UrbanLocal Bodies (PRIs/ULBs), states, Centre, and other stake-holders.

Unit IV **Inter-relationship between Disasters and Development** **06**

Inter-relationship between Disasters and Development: Factors affecting vulnerabilities, differential impacts, impact ofDevelopment projects such as dams, embankments, changes inLand-use etc. Climate Change Adaptation. Relevance of indigenousknowledge, appropriate technology and local resources.

Unit V **Disaster Risk Management in India** **08**

Disaster Risk Management in India: Hazard and Vulnerability profile of IndiaComponents of Disaster Relief: Water, Food, Sanitation, Shelter,Health, Waste ManagementInstitutional arrangements (Mitigation, Response and Preparedness,DM Act and Policy, Other related policies, plans, programmesand legislation).

Unit VI **Project Work: (Field Work, Case Studies)** **08**

The project /fieldwork is meant for students to understand vulnerabilities andto work on reducing disaster risks and to build a culture of safety. Projectsmust be conceived creatively based on the geographic location and hazardprofile of the region where the college is located.A few ideas or suggestions are discussed below.

Several governmental initiatives require Urban Local Bodies (ULBs) andPanchayati Raj Institutions (PRIs) to be proactive in preparing DM Plans andcommunity based disaster preparedness plans. Information on these would beavailable with the district Collector or Municipal Corporations. The scope forstudents to collaborate on these initiatives is immense. Teachers may explorepossibilities.

Teachers could ask students to explore and map Disaster prone areas,vulnerable sites, vulnerability of people (specific groups) and resources. Thestudents along with teachers could work on ways of addressing thesevulnerabilities, preparing plans in consultation with local administration orNGOs.

Students could conduct mock drills in schools, colleges or hospitals. Theycould also work on school safety, safety of college buildings)training in firstaid.

Other examples could be- identifying how a large dam, road/ highway or anembankment or the location of an industry affects local environment andresources or how displacement of large sections of people creates severevulnerabilities may be mapped by student project work.

Text Books:

1. Alexander David, Introduction in 'Confronting Catastrophe', OxfordUniversity Press, 2000
2. Andharia J. Vulnerability in Disaster Discourse, JTCDM, Tata Institute ofSocial Sciences Working Paper no. 8, 2008
3. Blaikie, P, Cannon T, Davis I, Wisner B 1997. At Risk Natural Hazards,Peoples' Vulnerability and Disasters, Routledge.
4. Coppola P Damon, 2007. Introduction to International Disaster Management,
5. Carter, Nick 1991. Disaster Management: A Disaster Manager's Handbook.Asian Development Bank, Manila Philippines.
6. Cuny, F. 1983. Development and Disasters, Oxford University Press.

Reference Books:

1. Document on World Summit on Sustainable Development 2002.
2. Govt. of India: Disaster Management Act 2005, Government of India, NewDelhi.
3. Government of India, 2009. National Disaster Management Policy,

4. Gupta Anil K, Sreeja S. Nair. 2011 Environmental Knowledge for DisasterRisk Management, NIDM, New Delhi
5. Indian Journal of Social Work 2002. Special Issue on Psychosocial Aspects ofDisasters, Volume 63, Issue 2, April.
6. Kapur, Anu& others, 2005: Disasters in India Studies of grim reality, RawatPublishers, Jaipur
7. KapurAnu 2010: Vulnerable India: A Geographical Study of Disasters, IIASand Sage Publishers, New Delhi.
8. Parasuraman S, Acharya Niru 2000. Analysing forms of vulnerability in adisaster, The Indian Journal of Social Work, vol 61, issue 4, October.
9. Pelting Mark, 2003 The Vulnerability of Cities: Natural Disaster and SocialResilienceEarthscah publishers, London
10. Reducing risk of disasters in our communities, Disaster theory, Tearfund,2006.
11. UNISDR, Natural Disasters and Sustainable Development: Understanding thelinks between Development, Environment and Natural Disasters, BackgroundPaper No. 5. 2002.
12. IFRC, 2005. World Disaster Report: Focus on Information in Disaster, pp.182-225.