

**STELLA MARIS COLLEGE (AUTONOMOUS), CHENNAI - 600 086**  
**M.Sc. DEGREE: BIOINFORMATICS**

**SYLLABUS**

(Effective from the academic year 2015 -2016)

**DATA MINING**

**CODE: 15BI/PE/DM14**

**CREDITS : 4**

**L T P : 4 0 0**

**TOTAL TEACHING HOURS : 5 2**

**OBJECTIVES OF THE COURSE:**

- To provide an insight to Data mining
- To introduce the techniques used in data mining
- To understand these techniques in collecting and sorting of data

**Unit 1**

**Data Mining (8 hrs.)**

- 1.1 Introduction: Classification of Data, Relational Databases. Data Warehouses  
Transactional Databases .Advanced Database Systems and Advanced  
Database Applications
- 1.2 Data Mining Functionalities. Concept /Class Description
- 1.3 Characterization and Discrimination. Association Analysis

**Unit 2**

**Classification and Prediction (10 hrs.)**

- 2.1 Classification and Prediction -Clustering Analysis. Evolution and Deviation  
Analysis
- 2.2 Classification of Data Mining Systems. Major Issues in Data Mining
- 2.3 Multimedia Data Mining. Spatial Data Mining. Text Mining

**Unit 3**

**Data Processing (10 hrs.)**

- 3.1 Data Preprocessing. Data Integration and Transformation, Data Reduction.  
Association Rule Mining
- 3.2 The Apriori Algorithm: Finding Frequent Item Sets From Association Mining  
to Correlation Analysis
- 3.3 Classification and Prediction Classification by Back Propagation Association-  
Based Classification Other Classification Methods

**Unit 4**

**Clustering (12 hrs.)**

- 4.1 Clustering – Cluster Analysis – Types of Clustering Methods- Types of Data  
in Clustering Analysis
- 4.2 A categorization of Major Clustering Methods. Hierarchical Methods. Density  
Based Clustering Methods. Grid Based Methods. Outlier Analysis
- 4.3 Data Mining Applications and Trends in Data Mining – Data mining  
Applications in Biotechnology and Bioinformatics

**Unit 5****Neural Networks and Machine Learning****(12 hrs.)**

5.1 Introduction to Neural networks, Learning Rules

5.2 Classification Analysis, Learning Algorithm and Model Evaluation

5.3 SOM and SVM Techniques in Data Mining

**TEXT BOOK**

Jiawei Han and Micheline Kamber. *Data Mining: Concepts and Techniques*, USA: Morgan Kaufmann Publishers, 2011.

**BOOKS FOR REFERENCE**

Oliviero carugo and Frank Eisenhaber. *Data Ming techniques for life sciences*. Singapore: Humana Press, 2009.

**JOURNALS**

Data Mining in Bioinformatics

International Journal of Data Mining and Bioinformatics

**WEB RESOURCES**

<http://www.bioinformaticszen.com/post/an-introduction-to-data-mining-in-bioinformatics/>

<http://biit.cs.ut.ee/>

**PATTERN OF EVALUATION****Continuous Assessment:**

Total Marks: 50

Duration: 90 mins.

Section A – 10 x 1 = 10 Marks (All questions to be answered)

Section B – 2 x 10 = 20 Marks (2 out of 4 to be answered)

Section C – 1x 20 = 20 Marks (1 out of 2 to be answered)

**Third Component:****List of Evaluation modes**

Assignment

Case study

Seminars

**End Semester Examination:**

Total Marks: 100

Duration: 3 hours

Section A – 20 x 1 = 20 Marks (All questions to be answered)

Section B – 4 x 10 = 40 Marks (4 out of 7 to be answered)

Section C – 2 x 20 = 40 Marks (2 out of 4 to be answered)

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**M.Sc. DEGREE: BIOINFORMATICS**

**SYLLABUS**

(Effective from the academic year 2015 -2016)

**RESEARCH METHODOLOGY AND SCIENTIFIC COMMUNICATION**

**CODE:15BI/PE/RM14**

**CREDITS : 4**

**L T P : 4 0 0**

**TOTAL TEACHING HOURS : 52**

**OBJECTIVES OF THE COURSE**

- To describe and express the role and importance of research in basic and applied sciences
- To facilitate writing of research proposals / projects and apply for grants in the field of bioinformatics

**Unit 1**

**Introduction (12 hrs.)**

- 1.1 Definition of Research and Research Methodology. Principles and Practice of Research. Exploring the Broad Area – Using the Library and Online Resources. Narrowing the Subject. Identifying The Research Problem
- 1.2 Literature Review - Its Relevance and Importance in Directing Research. Citations – Types Of Citations
- 1.3 Action Plan, Design and Pilot Study Undertaking a Research Project

**Unit 2**

**Types of Data (10 hrs.)**

- 2.1 Data Collection, Sampling. Sources of Data Primary, Secondary and Tertiary Sources Classification and Presentation of Data
- 2.2 Documents, Types of Documents, Archives, Chronologies
- 2.3 Electronic Sources of Data: Internet, Websites

**Unit 3**

**Scientific Communication (10 hrs.)**

- 3.1 Writing a Research Proposal: The Components of the Proposal, Structure of the Proposal. Writing Grant Proposals.
- 3.2 Format of Thesis. Presentation of the Results, Tabulations and Figures.
- 3.3 Guidelines for Writing Papers and Making Posters for Presentation

**Unit 4**

**Bioethics (10 hrs.)**

- 4.1 Bioethics- Introduction. Intellectual Property Rights (IPR) and Patents, TRIPS
- 4.2 Case studies on Patents (Basmati, Turmeric and Neem).
- 4.3 Plagiarism –Viper Software

## **Unit 5**

### **Critiquing a Research Paper**

**(10 hrs.)**

- 5.1 Paper critiquing- the Purpose and the Methodology of Paper Critiquing
- 5.2 Bibliography and End Matters, Editing and Proof Reading a Thesis.
- 5.3 Common Errors in Scientific Writing.

### **TEXT BOOKS**

Beauchamp, T.L., and Childress, J.F. *Principles of Biomedical Ethics*. India: Oxford University Press, 1994.

Gopalan, R. *Thesis Writing*. India: Vijay Nicole Imprints Private Limited, 2005.

Gurumani, N. *Research Methodology for Biological Sciences*. India MJ Publishers, 2010.

Raman, A. *A Handbook on Research Processes*. India: S. Viswanathan Pvt. Ltd., Chennai, 2003.

### **REFERENCE BOOKS**

Kothari C R. *Research Methodology, Methods and Techniques*. India: Wishwa Prakashan, 2009.

Pence, G.E. *Classic Cases in Medical Ethics*. India: McGraw-Hill, 2004.

### **JOURNALS**

The Journal of Communication  
International Association for Media And Communication Research  
Indian Journal of Science Communication

### **WEB RESOURCES**

<http://www.palgrave.com/studentstudyskills/page/choosing-appropriate-research-methodologies/>  
<https://explorable.com/research-methodology>

### **PATTERN OF EVALUATION**

Total Marks: 50

Duration: 90 mins.

### **Continuous Assessment:**

Section A – 10 x 1 = 10 Marks (All questions to be answered)

Section B – 2 x 10 = 20 Marks (2 out of 4 to be answered)

Section C – 1x 20 = 20 Marks (1 out of 2 to be answered)

**Third Component:**  
**List of Evaluation modes**

Assignment  
Open book test  
Case study

**End Semester Examination:**

Total Marks: 100

Duration: 3 Hours

Section A – 20 x 1 = 20 Marks (All questions to be answered)  
Section B – 4 x 10 = 40 Marks (4 out of 7 to be answered)  
Section C – 2 x 20 = 40 Marks (2 out of 4 to be answered)

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**M.Sc. DEGREE: BIOINFORMATICS**

**SYLLABUS**  
(Effective from the academic year 2015 -2016)  
**CHEMINFORMATICS**

**CODE: 15BI/PE/CI14**

**CREDITS : 4**

**L T P: 4 0 0**

**TOTAL TEACHING HOURS: 52**

**OBJECTIVES OF THE COURSE**

- To introduce the basic concepts of using chemical structure databases
- To apply the concepts and learn the use of cheminformatics tools

**Unit 1**

**Introduction (10 hrs.)**

- 1.1 Introduction to Cheminformatics, History and Evolution of Cheminformatics, Use of Cheminformatics, Prospects of Cheminformatics
- 1.2 Databases: Chemical Structure Databases (PubChem, Binding database, Drug bank)
- 1.3 Modelling of small molecules and Structure Elucidation

**Unit 2**

**Representation of Molecules (10 hrs.)**

- 2.1 Representation of Molecules and Chemical Reactions
- 2.2 Different Types of Notations, SMILES Coding, Structure of Mol files and Sdf files (Molecular converter, SMILES Translator)
- 2.3 Similarity Search of the Molecule

**Unit 3**

**Cheminformatics Databases (16 hrs.)**

- 3.1 Structure databases; Reaction Databases; Literature Databases; Medline; GenBank
- 3.2 PIR; CAS Registry; National Cancer Institute (NCI) Database
- 3.3 Databases of Small Molecules (PubChem, ZINC)

**Unit 4**

**Searching Chemical Structure (8 hrs.)**

- 4.1 Searching Chemical Structure: Full Structure Search; Sub Structure Search; Similarity Search
- 4.2 Three dimensional Search Methods. Structure Visualization
- 4.3 Drawing the Chemical Structure: 2D & 3D Drawing Tools (ACD Chems sketch). Structure Optimization

## Unit 5

### Applications of Cheminformatics Tools

(8 hrs.)

- 5.1 Definition of drugs, Structure-Based Drug Design, QSAR
- 5.2 Pharmacophore Design, Ligand-Based Design, De Novo Drug Design Virtual Screening / Docking of Ligands
- 5.3 Protein structure. Fragment-Based Drug Design, ADMET Prediction

### TEXT BOOK:

Johann Gasteiger and Thomas Engel. *Cheminformatics-A Textbook*. Germany: Wiley-VCH, 2003.

Johann Gasteiger. *Handbook of Cheminformatics-From Data to Knowledge*, Germany: Wiley-VCH, 2003.

### REFERENCE BOOK:

Andrew R. Leach, Valerie J. Gillet. *An Introduction to Cheminformatics*.UK: Springer, 2007.

Bunin, Barry A. Dordrecht. *Cheminformatics: Theory, Practice, and Products*.UK: Springer, 2010.

Bajorath, Juergen, Totowa, N.J. *Cheminformatics: Concepts, Methods, and Tools for Drug Discovery*. USA: Humana Press, 2004.

Ekins, Sean, Hoboken, N.J. *Computer Applications in Pharmaceutical Research and Development*. Germany: Wiley, 2006.

### JOURNALS

Journal of Cheminformatics

Cheminformatics: Concepts, Methods, and Tools for Drug Discovery

International Journal of Cheminformatics and Chemical Engineering

BMR Bioinformatics & Cheminformatics

The Journal of Chemical Information and Modeling

### WEB RESOURCES

<http://cheminformatics.org/>

<http://www.emolecules.com/info/molecular-informatics>

<http://accelrys.com/products/informatics/cheminformatics/>

[http://www.rasalsi.com/services\\_drugdis.html](http://www.rasalsi.com/services_drugdis.html)

## **PATTERN OF EVALUATION**

### **Continuous Assessment:**

Total Marks: 50

Duration: 90 mins.

Section A –  $10 \times 1 = 10$  Marks (All questions to be answered)

Section B –  $2 \times 10 = 20$  Marks (2 out of 4 to be answered)

Section C –  $1 \times 20 = 20$  Marks (1 out of 2 to be answered)

### **Third Component:**

#### **List of Evaluation modes**

Assignment

Case study

Seminars

### **End Semester Examination:**

Total Marks: 100

Duration: 3 Hours

Section A –  $20 \times 1 = 20$  Marks (All questions to be answered)

Section B –  $4 \times 10 = 40$  Marks (4 out of 7 to be answered)

Section C –  $2 \times 20 = 40$  Marks (2 out of 4 to be answered)



**STELLA MARIS COLLEGE (AUTONOMOUS), CHENNAI - 600 086**  
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**SYLLABUS**

(Effective from the academic year 2015 -2016)

**IMMUNOINFORMATICS**

**CODE: 15BI/PE/IM14**

**CREDITS : 4**

**L T P: 4 0 0**

**TOTAL TEACHING HOURS: 5 2**

**OBJECTIVES OF THE COURSE**

- To understand the application of information technology to immunology
- To apply the immunological data and to the sophisticated computational solutions available for immunological research

**Unit 1**

**Immune System**

**(8 hrs.)**

- 1.1 Introduction to Immune System. Adaptive and Innate Immunity
- 1.2 Cells of the Immune System, Soluble Mediators of Immunity, Antigens, Immune Responses
- 1.3 Inflammation, Immunopathology

**Unit 2**

**Major Histocompatibility Complex**

**(10 hrs.)**

- 2.1 The Major Histocompatibility Complex (MHC) its Polymorphism, Causes Polymorphism, Supertypes
- 2.2 Epitope. Affinity Maturation. Epitope mapping
- 2.3 Principles of B-cell and T-cell Epitope Prediction. Recognition of Antigen by B cells. Neutralizing Antibody

**Unit 3**

**Computational Immunology**

**(10 hrs.)**

- 3.1 Computational Immunology. Databases in Immunology. From immunome to Vaccine. Vaccine design tools. IMGT immunoinformatics
- 3.2 Reverse Vaccinology and immunoinformatics. Peptides with Antimicrobial Activity or Antibiotic Peptides
- 3.2 The Future of Computational Modelling and Prediction Systems in Clinical Immunology

## Unit 4

### Immunogenetics

(12 hrs.)

- 4.1 From Immunogenetics to Immunomics
- 4.2 Functional Prospecting of Genes and Transcripts
- 4.3 IMGT International ImmunoGeneTics Information System.HLA Nomenclature and the IMGT/HLA Sequence Database

## Unit 5

### Viral Bioinformatics

(12 hrs.)

- 5.1 Viral Bioinformatics. Computational Views of Hosts and Pathogens using VIDA
- 5.2 Drug Discovery: Introduction. Conventional Drug Design Approaches, Irrational vs. Rational, Lipinski rule-pharmacophore Kinetics And Dynamics-ADME Properties
- 5.3 Applications of Computer Based Drug Discovery.

## TEXT BOOKS

Christian Schönbach, ShobaRanganathan, and Vladimir Brusic. *Immunoinformatics (Immunomics Reviews)* USA: Humana Press, 2010.

Darren R. Flower. *Bioinformatics for Immunomics (Immunomics Reviews)*. New York: Springer-Verlag, 2010.

## BOOKS FOR REFERENCE

Kenneth Murphy. *Janeway's Immunobiology*, UK: Garland Science, 2014.

Robert A. Meyer. *Immunology - from cell biology to disease*. Germany: Wiley VCH, 2007.

Richard A. Goldsby, Thomas J. Kindt, Barbara A. Osborne & Janis Kuby. *Immunology*. USA: WH Freeman Company, 2013.

## JOURNALS

Immunology  
Immunoinformatics  
BMC Genomics  
Journal of Computational Biology

## WEB RESOURCES

<http://www.imgt.org/Immunoinformatics.html>  
<http://rsob.royalsocietypublishing.org/content/3/1/120139>  
<http://journals.plos.org/ploscompbiol/article?id=10.1371/journal.pcbi.0020071>

<http://omicsonline.com/immunoinformatics.php>

## **PATTERN OF EVALUATION**

### **Continuous Assessment:**

Total Marks: 50

Duration: 90 mins.

Section A – 10 x 1 = 10 Marks (All questions to be answered)

Section B – 2 x 10 = 20 Marks (2 out of 4 to be answered)

Section C – 1 x 20 = 20 Marks (1 out of 2 to be answered)

### **Third Component:**

#### **List of Evaluation modes**

Assignment

Tests

Seminars

### **End Semester Examination:**

Total Marks: 100

Duration: 3 hrs.

Section A – 20 x 1 = 20 Marks (All questions to be answered)

Section B – 4 x 10 = 40 Marks (4 out of 7 to be answered)

Section C – 2 x 20 = 40 Marks (2 out of 4 to be answered)

**STELLA MARIS COLLEGE (AUTONOMOUS), CHENNAI - 600 086**  
**M.Sc. DEGREE: BIOINFORMATICS**

**SYLLABUS**

(Effective from the academic year 2015 - 2016)

**CELL BIOLOGY AND GENETICS**

**CODE: 15BI/PE/CG14**

**CREDITS : 4**

**L T P : 4 0 0**

**TOTAL TEACHING HOURS : 52**

**OBJECTIVES OF THE COURSE**

- To understand the structure and function of the Cell and all its components in both Prokaryotic and Eukaryotic cells.
- To understand the Basic Concepts of Genetics.

**Unit 1**

**Prokaryotic and Eukaryotic cells (10 hrs.)**

- 1.1 Characteristics, Similarities and Differences
- 1.2 Bacteria Cells - Structure, Organisation, Transport, Virus - Structure, Viral Infective Cycles, Origin and Significance, Viroids and Prions
- 1.3 Chromosomes - Structure and Function of Chromosomes, Centromeres and Telomeres, Mitosis and Meiosis

**Unit 2**

**Organelles (12 hrs.)**

- 2.1 Structure and Function of Mitochondria, Plastids (i.e. Chloroplasts), Endoplasmic Reticulum Golgi bodies, Lysosomes and Peroxisomes
- 2.2 DNA -Structure – Conformations, Histones and Non-Histones, Nuclear Matrix and Lamins; Nuclear Envelope, Pore Complexes, Transport Through the Envelope
- 2.3 RNA- Ribosomes – Structure, Assembly of Polypeptides on Ribosomes, Post-Translational Modifications.

**Unit 3**

**Cytoskeleton (12 hrs.)**

- 3.1 Structure of the Cell Wall
- 3.2 Structure and Role of Microtubules and Microfilaments in cells -cell-cell Interactions- Cell Adhesion, Tight Junctions and Plasmodesmata
- 3.3 Introduction to Membranes - Structure, Function, and Communication: Roles of Membranes in Eukaryotic Cells; Membrane Structure and Composition, Plasma Membrane - Fluid Mosaic Model; Organization of Membranes in the Cells

**Unit 4**  
**Multiple Alleles** (10 hrs.)

- 4.1 Human blood groups (A, B, AB, O, M, N and H) and Rh factor - Inheritance and significance
- 4.2 Gene Linkage and Recombination: Coupling and Repulsion Hypothesis Linkage in *Drosophila* Cytological Proof of Crossing Over - Example – *Drosophila*
- 4.3 Mapping: Locating Genes along a Chromosome: Two - Point and Three - Point Crosses

**Unit 5**  
**Karyotyping** (8 hrs.)

- 5.1 Sex Determination and Sex Chromosomes
- 5.2 Chromosomal Mechanisms of Sex Determination and Karyotyping
- 5.3 Sex determination in Human - Barr body - Importance of Y Chromosome - Klinefelters' and Turners' Syndromes Inter –Sexuality Linked Inheritance: Colour Blindness and Haemophilia Y - Linked Genes

**TEXT BOOKS**

Klug, William, S. and Michael R. Cummings. *Concepts of Genetics*. USA: Prentice Hall, 2008.

Purvis, William K, David Sadava, Craig Heller and Gordan H. Orians. *Life: The Science of Biology*. USA : Sinauer, 2004.

**BOOKS FOR REFERENCE**

Burns, George W., and Botto, Paul J. *The Science of Genetics*. USA: Macmillan Publishing Company, 1989.

Darnell, James, Harvey Lodish and David Baltimore. *Molecular and Cell Biology*, Scientific American Books, USA : W.H. Freeman, 2000.

Karp and Gerald. *Cell and Molecular Biology- Concepts and Experiments*, USA : John Wiley, 2013.

Karp, Gerald and Nancy L. Puritt, *Cell and Molecular Biology- Concepts and Experiments*, USA: John Wiley, 2004.

Lodish Harvey, Arnold Berk, Paul Matsudaira, Chris A. Kaiser, Monte Krieger, Mathew P. Scott, S. Lawrence Zipursky and James Darnell. *Molecular Cell Biology*. USA: W.H. Freeman, 2004.

Lewin and Benjamin. *Genes IX*, UK :Oxford University Press, 2009.

Roitte, Ivan M., Brostoff, Jonathan and Male, David K. *Immunology*. Philadelphia: J.B. Lippincott, 1990.

Watson, James, D. *Molecular Biology of the Gene*. USA : The Benjamin Cummings Publishing Company, 2007.

## **JOURNALS**

The Journal of Molecular Cell Biology

The Journal of Cell Biology

Journal of Genetics and Genomics

BMC Cell Biology

## **WEB RESOURCES**

<http://www.nature.com/scitable/topic/cell-biology-13906536>

[http://www.biology.arizona.edu/cell\\_bio/cell\\_bio.html](http://www.biology.arizona.edu/cell_bio/cell_bio.html)

<http://learn.genetics.utah.edu/content/science/>

<http://ghr.nlm.nih.gov/>

## **PATTERN OF EVALUATION**

Total Marks: 50

Duration: 90 mins.

### **Continuous Assessment:**

Section A – 10 x 1 = 10 Marks (All questions to be answered)

Section B – 2 x 10 = 20 Marks (2 out of 4 to be answered)

Section C – 1 x 20 = 20 Marks (1 out of 2 to be answered)

### **Third Component:**

#### **List of Evaluation modes**

Assignment

Open book test

Seminar

Study on genetic disorders

### **End Semester Examination:**

Total Marks: 100

Duration: 3 Hours

Section A – 20 x 1 = 20 Marks (All questions to be answered)

Section B – 4 x 10 = 40 Marks (4 out of 7 to be answered)

Section C – 2 x 20 = 40 Marks (2 out of 4 to be answered)

**STELLA MARIS COLLEGE (AUTONOMOUS), CHENNAI - 600 086**  
**M.Sc. DEGREE: BIOINFORMATICS**

**SYLLABUS**

(Effective from the academic year 2015 -2016)

**BASIC MATHEMATICS**

**CODE: 15BI/PE/BM14**

**CREDITS: 4**

**L T P: 4 0 0**

**TOTAL TEACHING HOURS: 52**

**OBJECTIVES OF THE COURSE**

- To enhance the skills in mathematics those are essential for learning Bioinformatics
- To understand and implement various mathematical techniques being applied in analyzing information of biological data

**Unit 1**

**Set Theory (8 hrs.)**

- 1.1 Introduction, Examples of Sets, Representation of a Set, Notation
- 1.2 Set Operations - Types of Sets, Subsets, Complement of Sets, Union and Intersection of Sets, Difference of Sets
- 1.3 De Morgan's Law, Complement of a Set, Set Difference, Venn Diagram, Cartesian Product of Sets

**Unit 2**

**Algebra (10 hrs.)**

- 2.1 Algebra: Functions, Matrix, Basic Operations, Transpose, square matrices, Non Singular Matrices, Inverse of a Matrix, Determinants, Elementary Applications
- 2.2 Progressions, Arithmetic Progression, Geometric Progressions, Expansions
- 2.3 Exponential Series, Logarithmic Series (without proof) – Simple Problems

**Unit 3**

**Differential Calculus (12 hrs.)**

- 3.1 Differentiation of Standard Functions, Basic Rules of Differentiation, Successive Differentiation
- 3.2 Applications (Concepts and Simple Problems only), Meaning of the Derivative, Tangent and Normal, Maxima and Minima
- 3.3 Partial Differentiation

**Unit 4**

**Integral Calculus (12 hrs.)**

- 4.1 Methods of Integration, Simple Problems
- 4.2 First Order Ordinary Differential Equations, Second Order Ordinary Differential Equations with Constant Co-Efficient
- 4.3 Fourier Series and Fourier Transforms – Simple Problems

## **Unit 5**

### **Probability**

**(10 hrs.)**

5.1 Introduction Probability Distribution: Basics of Binomial, Poisson and Normal Distributions, Baye's Theorem and their Application in Biology

5.2 Random Variable; Discrete and Continuous Probability Distribution, Probability Mass Function, Probability Density Function, Mathematical Expectation

5.3 Binomial Co-efficient, Permutations, Combinations, Identities Applications, Sampling with Replacement

### **TEXT BOOKS**

Bogart, Kenneth, P. *Introductory Combinatorics*. USA :Pitman Publishing, Inc., 1983.

Lipschutz S. and Lipson, M.L. *Discrete Mathematics*, New York: McGraw Hill Book Company, 2001.

Massachusetts and Cohen. *Basic Techniques of Combinatorial Theory*. USA: John Wiley, 1979.

Narayanan S. and Manicavachagam Pillay, T. K., *Calculus*. India: S. Viswanathan Printers and Publishers,2000.

Narayanan S. and Manicavachagam Pillay, T. K., *Ancillary Mathematics- Book II*, India: S. Viswanathan Printers and Publishers, 2002.

### **BOOKS FOR REFERENCE**

Natarajan, T., Govindaraju T., Rajagopalan K. R. and Muthuswami K., *Matrices*, India: Rochouse, 1970.

Raisinghania, M.D. *Integral Transforms*. India : S. Chand, 1998.

Singaravelu A. *Differential Equations, Fourier Series And Laplace Transforms*, India:Meenakshi Publishers, 2002.

Vittal, P.R. *Allied Mathematics*, India: Margham Publishers, 2001.

### **JOURNALS**

The Journal of Mathematical Behavior

Mathematical Journals

The College Mathematics Journal

International Journal of Mathematics and Statistics Studies



## **WEB RESOURCES**

<http://mathworld.wolfram.com/Integral.html>

[http://www-math.mit.edu/~djk/calculus\\_beginners/](http://www-math.mit.edu/~djk/calculus_beginners/)

<http://mathworld.wolfram.com/Probability.html>

<https://www.math.hmc.edu/calculus/tutorials/matrixalgebra/>

## **PATTERN OF EVALUATION**

### **Continuous Assessment:**

Total Marks: 50

Duration: 90 mins.

### **Theory:**

Section A:  $4 \times 5 = 20$  (Six questions to be set)

Section B:  $2 \times 15 = 30$  (Four questions to be set)

### **Third Component:**

#### **List of Evaluation modes**

Assignments

Problem solving

Tests

### **End Semester Examination:**

Total Marks: 100

Duration: 3 Hours

Section A :  $5 \times 8 = 40$  (Seven questions to be set).

Section B :  $3 \times 20 = 60$  (Five questions to be set).

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**M.Sc. DEGREE: BIOINFORMATICS**

**SYLLABUS**

(Effective from the academic year 2015 -2016)

**PHARMACOGENOMICS**

**CODE: 15BI/PE/PG24**

**CREDITS : 4**

**L T P: 4 0 0**

**TOTAL TEACHING HOURS: 5 2**

**OBJECTIVES OF THE COURSE**

- To understand the basics of pharmacogenomics in the context of variability in drug response
- To examine factors that affect drug response and the application of pharmacogenetics to drug development and drug treatment

**Unit 1**

**Pharmacogenomics (8 hrs.)**

- 1.1 Introduction to Basic Concept of Pharmacogenomics. Importance, Clinical Application and Challenges in Pharmacogenomics
- 1.2 Personalized Medicine- Introduction and Importance. The Genetics of Therapeutic Targets and Gene-Based Targets
- 1.3 Pharmacogenomics Necessity in Drug Designing

**Unit 2**

**Genetic Variation (10 hrs.)**

- 2.1 Introduction to Genetic Variation, Types of Variants, SNPs, Coding and Cis/Trans Regulatory Variants, Insertion/Deletions
- 2.2 Databases, National Pharmacogenetics Resources/Efforts (PGRN), Pharmacogenomics Knowledge Base (PharmGKB)
- 2.3 Prediction of Structural Changes among Sequences by the Influence of Polymorphisms. Genetic Analysis of Human Variation, Microsatellite for Studying Genetic Variation

**Unit 3**

**Pharmacokinetics & Metabolism (12 hrs.)**

- 3.1 Pharmacokinetics (PK), Pharmacodynamics (PD)
- 3.2 Safety Metabolisms Pharmacology, ADME
- 3.3 Definition of Toxicogenomics, Detoxification and Poisoning. Preclinical Toxicology

**Unit 4****Pharmacogenomics in Drug Discovery and Development (12 hrs.)**

- 4.1 An Introduction to Drug Discovery and Development
- 4.2 Process in Structural Pharmacogenomics- Target Structure optimization, Validation, Lead Identification, ADME Prediction, Synthesis, Assays and Clinical Trials
- 4.3 Drug response to patients, Structural influence in the Drug response. Efficacy and Metabolism of Drugs. Drug Metabolism Pathways and Adverse Drug Reactions

**Unit 5****Microarray Analysis (10 hrs.)**

- 5.1 DNA Microarray: Importance and Definition, Designing a Microarray Experiment: The Basic Steps
- 5.2 Types of Microarray, NCBI and Microarray Data Management, GEO (Gene Expression Omnibus), MAML
- 5.3 The Promise of Microarray Technology in Treating Disease. Microarray Data, Expression Pattern, Visualizing Microarray Data

**TEXT BOOKS:**

Rapley R and Harbron S. *Molecular analysis and Genome discovery*. John Willey, 2004.

Russ B. Altman, David Flockhart, David B. Goldstein. *Principles of Pharmacogenetics and Pharmacogenomic*. UK: Cambridge University Press, 2012.

**BOOKS FOR REFERENCE**

Lori A. Nesbitt. *Clinical Research What It Is and How It Works*. UK: Jones Barlett Publishers, 2004.

Martin M. Zdanowicz. *Concepts in Pharmacogenomics*. New York: McGraw Hill, 2010.

Steven Piantadosi. *Clinical Trials A Methodologic Perspective*. UK: John Wiley, 2005.

**JOURNALS**

The Pharmacogenomics Journal  
American Journal of Pharmacogenomics  
Pharmacogenomics and Personalized Medicine  
Pharmacogenetics and Genomics

**WEB RESOURCES**

<http://ghr.nlm.nih.gov/handbook/genomicresearch/pharmacogenomics>  
<https://www.pharmgkb.org/>

[http://www.fda.gov/drugs/scienceresearch/researchareas/pharmacogenetics/ucm083378.h  
tm](http://www.fda.gov/drugs/scienceresearch/researchareas/pharmacogenetics/ucm083378.htm)

## **PATTERN OF EVALUATION**

### **Continuous Assessment:**

Total Marks: 50

Duration: 90 mins.

Section A – 10 x 1 = 10 Marks (All questions to be answered)

Section B – 2 x 10 = 20 Marks (2 out of 4 to be answered)

Section C – 1 x 20 = 20 Marks (1 out of 2 to be answered)

### **Third Component:**

#### **List of Evaluation modes**

Assignment

Case study

Seminars

### **End Semester Examination:**

Total Marks: 100

Duration: 3 hrs.

Section A – 20 x 1 = 20 Marks (All questions to be answered)

Section B – 4 x 10 = 40 Marks (4 out of 7 to be answered)

Section C – 2 x 20 = 40 Marks (2 out of 4 to be answered)

**STELLA MARIS COLLEGE (AUTONOMOUS), CHENNAI - 600 086**  
**M.Sc. DEGREE: BIOINFORMATICS**

**SYLLABUS**  
(Effective from the academic year 2015 -2016)  
**FUNDAMENTALS OF BIOINFORMATICS**

**CODE: 15BI/PE/FB34**

**CREDITS : 4**

**L T P : 4 0 0**

**TOTAL TEACHING HOURS : 5 2**

**OBJECTIVES OF THE COURSE**

- To familiarize the students with bioinformatics and its role in changing complex biological research
- To enable textual mining of biological literature and bioinformatics tools that are required to query biological data and analyze genomic data

**Unit 1**

**Introduction to Bioinformatics (10 hrs.)**

- 1.1 Introduction to Bioinformatics, Classification of biological databases, Biological Data Formats, Application of Bioinformatics in Various Fields
- 1.2 Introduction to Single Letter Code of Amino acids, Symbols Used in Nucleotides
- 1.3 Data Retrieval Systems- Entrez and SRS

**Unit 2**

**Sequence Alignment (12 hrs.)**

- 2.1 Introduction to Sequence Alignment. Substitution Matrices, Scoring Matrices – PAM and BLOSUM
- 2.2 Local and Global Alignment Concepts, Dot Plot. Dynamic Programming Methodology: Needleman and Wunsch Algorithm. Smith–Waterman Algorithm.
- 2.3 Multiple sequence Alignment. Progressive Alignment. Database Search for Similar Sequences Using FASTA and BLAST Programs

**Unit 3**

**Phylogenetic analysis (10 hrs.)**

- 3.1 Evolutionary Analysis: Distances, Cladistic and Phenetic Methods
- 3.2 Clustering Methods. Rooted and Unrooted Tree Representation
- 3.3 Bootstrapping Strategies, Use of Clustal and PHYLIP

**Unit 4**

**Genome analysis (10 hrs.)**

- 4.1 Gene Finding Methods. Gene Prediction: Analysis and Prediction of Regulatory Regions
- 4.2 Fragment Assembly, Genome Sequence Assembly

4.3 Restriction Mapping, Repeat Sequence finder

**Unit 5**

**Microarrays**

**(10 hrs.)**

- 5.1 Concept of Gene Expression, Types of Microarrays; Making Microarrays; Spotted Microarrays
- 5.2 Using Microarrays, Sample Preparation and Labeling, Hybridization, Washing, Image Acquisition
- 5.3 GEO Database. Application of Microarrays

**TEXTBOOKS**

Baxevanis, Andreas D. and Francis B.F. Ouellette. *Bioinformatics- A Practical Guide to the Analysis of Genes and Proteins*. USA: John Wiley, 2001.

David W. Mount. *Bioinformatics Sequence and Genome Analysis*. INDIA: CBS Publishers, 2003.

Pevsner and Jonathan. *Bioinformatics and Genomics Functional*. USA: John Wiley, 2003.

**BOOKS FOR REFERENCE:**

Baldi P. and Brunak S. *Bioinformatics: Machine Learning Approach*. USA: MIT Press, 2003.

Chen, Yi-Ping Phoebe. *Bioinformatics Technologies*. Germany: Springer, 2005.

Durbin R, S. Eddy, A. Krogh and G. Mitchison. *Biological Sequence Analysis: Probabilistic Proteins and Nucleic Acids*. USA: Cambridge University Press, 2005.

Higgins, Des and Willie Taylor. *Bioinformatics –Sequence, Structure and Databanks – Practical Approach*. UK: Oxford University Press, 2001.

Lesk Arthur M. *Introduction to Bioinformatics*. UK: Oxford University Press, 2005.

**JOURNALS**

BMC Bioinformatics

Bioinformatics

Journal of Bioinformatics and Computational Biology

Journal of Biomedical Informatics

Journal of Integrative Bioinformatics

PLoS Computational Biology

## **WEB RESOURCES**

<http://bioinformaticsweb.net/tools.html>

<https://www.bits.vib.be/index.php/training/122-basic-bioinformatics>

<http://bioinformaticssoftwareandtools.co.in/>

<http://www.genscript.com/tools.html>

## **PATTERN OF EVALUATION**

### **Continuous Assessment:**

Total Marks: 50

Duration: 90 mins.

Section A – 10 x 1 = 10 Marks (All questions to be answered)

Section B – 2 x 10 = 20 Marks (2 out of 4 to be answered)

Section C – 1 x 20 = 20 Marks (1 out of 2 to be answered)

### **Third Component:**

#### **List of Evaluation modes**

Assignment

Open book test

Seminars

Quiz

### **End Semester Examination:**

Total Marks: 100

Duration: 3 hrs.

Section A – 20 x 1 = 20 Marks (All questions to be answered)

Section B – 4 x 10 = 40 Marks (4 out of 7 to be answered)

Section C – 2 x 20 = 40 Marks (2 out of 4 to be answered)

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**SYLLABUS**

(Effective from the academic year 2015 -2016)

**PYTHON**

**CODE: 15BI/PI/PT24**

**CREDITS: 4**

**OBJECTIVES OF THE COURSE**

- To gain knowledge of Python and its use as a programming language
- To enable practical application of Python program

**Unit 1**

**Introduction**

- 1.1 Introduction to Python Language, Use of Third-Party Software, Object-Oriented Programming
- 1.2 The Python Environment Variables
- 1.3 Biopython

**Unit 2**

**NumPy and SciPy**

- 2.1 Introduction to NumPy and SciPy, Basic Array Manipulations
- 2.2 Basic Math: Equal or copy, Comparisons, Slicing, Sorting and Shaping, Statistical Methods, Array Conversion
- 2.3 Introduction to SciPy

**Unit 3**

**Parsing DNA Data Files**

- 3.1 FASTA Files, Genbank Files: File Overview, Parsing the DNA, Gene and Protein Information
- 3.2 Gene Locations Splices, Extracting all Gene Locations
- 3.3 Coding DNA, Proteins, Extracting Translations

**Unit 4**

**Sequence Alignment**

- 4.1 Matching Sequences: Perfect Matches, Insertions and deletions
- 4.2 Rearrangements, Global Versus Local Alignments, Sequence Length
- 4.3 Clustering: K-Means Clustering

**Unit 5**

**Text Mining**

- 5.1 An introduction to Text Mining, Collecting Bioinformatics Textual Data, Creating Dictionaries
- 5.2 Document Analysis: Text Mining of Documents, Word Frequency
- 5.3 Indicative Words, Document Classification



## **TEXT BOOKS**

Jason Kinser. *Python for Bioinformatics*. Massachusetts: Jones and Barlett Publishers, 2009.

Mitchell L Model. *Bioinformatics Programming Using Python*. USA: O'Reilly Media Publication, 2009.

## **BOOKS FOR REFERENCE**

Mark Lutz. *Learning Python*. USA: O'Reilly Media Publication, 2009.

Martin C Brown. *Python: The Complete Reference*. Osborne: McGraw-Hill Media, 2001

## **JOURNALS**

The Python Papers Source Codes

The Python Papers Anthology

Python Journal

## **WEB RESOURCES**

[www.sthurlow.com/python/](http://www.sthurlow.com/python/)

[www.learnpython.org](http://www.learnpython.org)

[www.codecademy.com/en/tracks/python](http://www.codecademy.com/en/tracks/python)

<https://docs.python.org/2/tutorial/>

[www.pyschools.com/](http://www.pyschools.com/)

## **PATTERN OF EVALUATION**

### **End Semester Examination – (3 hrs.)**

The duration of the examination will be 3 hrs. – 1 hr theory and 2 hrs practical.

#### **Theory:**

Section A – 30 x 1 = 30 Marks (All questions to be answered)

Section B – 10 x 2 = 20 Marks (2 out of 4 to be answered)

#### **Practical:**

Section C – 2 x 25 = 50 Marks

Question comprising the following:

Complete a programme,

Write a Python program related to Bioinformatics (transcription, finding motifs/repeats/restriction enzyme etc.)

Output of the given program.

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**SYLLABUS**

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**SYSTEMS BIOLOGY**

**CODE: 15BI/PI/SB34**

**CREDITS : 4**

**OBJECTIVE OF THE COURSE**

- To introduce the basic concepts of Systems biology
- To train the students in designing a new organism through modelling network concept and manipulating them for biological applications

**Unit 1**

**Introduction**

- 1.1 Introduction – Systems Biology is a Living Science
- 1.2 Properties of Models-Model Behaviour- Model Development
- 1.3 Systems Biology is Data Integration

**Unit 2**

**Standard Models and Approaches in Systems Biology**

- 2.1 Standard Models and Approaches in Systems Biology
- 2.2 Enzyme Kinetics and Thermodynamics-Metabolic Networks
- 2.3 Structure of Intra- and Intercellular Communication-Receptor-Ligand Interactions

**Unit 3**

**Modeling of Gene Expression**

- 3.1 Modeling of Gene Expression-Modules of Gene Expression – Promoter
- 3.2 Identification - General Promoter Structure- Sequence-Based Prediction of Promoter. Representation of Gene Network as Directed and Undirected Graphs.
- 3.3 Bayesian Networks-Boolean Networks- Gene Expression Modeling With Stochastic Equations

**Unit 4**

**Analysis of Gene Expression Data**

- 4.1 Analysis of Gene Expression Data- Introduction-DataCapture-DNA Array Platforms
- 4.2 Image Analysis and Data Quality Control-Grid Finding- Quantification of Signal Intensities- Signal Validity- Pre-processing-Global Measures.
- 4.3 Linear Model Approaches- Nonlinear. Fold-change Analysis

## **Unit 5**

### **Clustering Algorithms**

- 5.1 Clustering Algorithms-Hierarchical Clustering- Self-organizing Maps (SOMs).K-means- Validation of Gene Expression
- 5.2 Publication in the Era of Systems Biology- Systems Biology and Text Mining. Systems Biology in Medicine and Drug Development
- 5.3 Guiding the Design of New Organisms -Computational Limitations- Potential Dangers.

### **TEXT BOOKS**

Andres Kriete And Roland Eils. *Computational Systems Biology*. Uk: Elsevier, 2005.

E. Klipp, R. Herwig, A. Kowald C. Wierling, H. Lehrach. *Systems Biology In Practice- Concepts, Implementation And Application*. Germany: Wiley-Vch Verlag Gmbh & Co.Kgaa, 2005.

### **BOOKS FOR REFERENCE**

Choi And Sangdun. *Introduction To Systems Biology*. Usa: Humana Press, 2007.

Edda Klipp, Wolfram Liebermeister, Christoph Wierling, Axel Kowald, Hans Lehrach, Ralf Herwig. *Systems Biology: A Textbook*. Uk: Wiley- Vch.Edinburgh, 2009.

Uri Alon. *An Introduction To Systems Biology: Design Principles Of Biological Circuits*. London: Chapman & Hall/Crc, Taylor And Francis Group, 2006.

Zoltan Szallasi, Joerg Stelling, Vipul Periwal. *Systems Modeling In Cellular Biology*. Usa: Mit Press, 2006.

### **JOURNALS**

Current Synthetic and Systems Biology  
Journal of Computer Science & Systems Biology  
Eurasip Journal on Bioinformatics And Systems Biology  
Bmc Systems Biology

### **WEB RESOURCES**

<http://Sysbio.Med.Harvard.Edu/>  
[www.Systemsbiology.Org](http://www.Systemsbiology.Org)  
[www.Systemsbiology.Ucsd.Edu/](http://www.Systemsbiology.Ucsd.Edu/)  
[www.Sysbio.Org/](http://www.Sysbio.Org/)

**PATTERN OF EVALUATION**

**End Semester Examination**

Total Marks: 100

Duration: 3 Hrs.

Section A – 20 X 1 = 20 Marks (All Questions To Be Answered)

Section B – 4 X 10 = 40 Marks (4 Out Of 7 To Be Answered)

Section C – 2 X 20 = 40 Marks (2 Out Of 4 To Be Answered)

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**M.Sc. DEGREE: BIOINFORMATICS**

**SYLLABUS**

(Effective from the academic year 2015 -2016)

**SOFT SKILLS**

**CODE:15BI/PK/SS22**

**CREDITS : 2**

**L T P : 2 0 0**

**TOTAL TEACHING HOURS : 26**

**OBJECTIVES OF THE COURSE**

- To empower and create opportunities for self development
- To instill confidence and face challenges.

**Unit 1**

**Behavioural Traits (6 hrs.)**

- 1.1 Self Awareness
- 1.2 Communication Skills – Verbal and Non Verbal
- 1.3 Leadership Qualities
- 1.4 Etiquette and Mannerisms
- 1.5 Experiential Learning – Based on Activities

**Unit 2**

**Team Work (5 hrs.)**

- 2.1 Interpersonal Skills
- 2.2 People Management
- 2.3 Creative Thinking
- 2.4 Critical Thinking
- 2.5 Experiential Learning – Based on Activities

**Unit 3**

**Time Management (5 hrs.)**

- 3.1 Importance of Time Management
- 3.2 Planning and Prioritizing
- 3.3 Organizing skills
- 3.4 Action Plan
- 3.5 Experiential Learning – Based on Activities

#### **Unit 4**

##### **Conflict Resolution**

**(5 hrs.)**

- 4.1 Reasons for Conflict
- 4.2 Consequences of Conflict
- 4.3 Managing Emotions
- 4.4 Methods of Resolving Conflicts
- 4.5 Experiential Learning – Based on Activities

#### **Unit 5**

##### **Career Mapping**

**(5 hrs.)**

- 5.1 Goal Setting
- 5.2 Career Planning
- 5.3 Resume Writing
- 5.4 Handling Interviews
- 5.5 Experiential Learning – Based on Activities

#### **BOOKS FOR REFERENCE**

Khera, Shiv. *You Can Win*. India: Macmillan India Ltd, 2002.

Mishra, Rajiv K. *Personality Development: Transform Yourself*. India: Rupa and Co, 2004.

Newstrom, John W. and Scannell, Edward E. *Games Trainers Play: Experiential Learning*.  
India: Tata McGraw Hill, 1980.