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

SYLLABUS
(Effective from the academic year 2019-2020)

BIOMATHEMATICS AND BIOSTATISTICS

CODE: 19BI/PC/BS15 **CREDITS: 5**
L T P: 4 1 0
TOTAL TEACHING HOURS: 65

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
- To understand statistical methods in its several forms is the basis of biological research
- To introduce the various statistical techniques useful for handling quantitative data

COURSE LEARNING OUTCOMES

On Successful completion of the course, the student will be able to

- Understand the importance of mathematics for research based problems
- Apply the different statistical tests for the research
- Learn to solve aptitude based problems in competitive exams
- Gain skills on solving the population genetics equations
- Apply the regression and correlation techniques to interpret Drug activity based on QSAR

Unit 1 **(15 Hours)**

Set Theory and Matrices

1.1 Introduction, Representation of a Set, Set Operations - Types of Sets, Subsets, Complement of Sets, Union and Intersection of Sets, Difference of Sets
1.2 De Morgan's Law, Venn diagram, Cartesian Product of Sets
1.3 Matrix, Basic Operations, Transpose, square matrices, Non Singular Matrices, Inverse of a Matrix, Determinants, Elementary Applications

Unit 2 **(10 Hours)**

Relations and Functions

2.1 Introduction – Product sets, Relations
2.2 Functions – Linear Function
2.3 Related Functions – Polynomials and Differences

Unit 3 **(15 Hours)**

Probability

3.1 Rules of probability, Theorems of probability, Addition and Multiplication Theorem
3.2 Probability distributions: Binomial distribution, Poisson distribution, Normal distribution.

3.3 Binomial Co-efficient, Permutations, Combinations, Identities Applications

Unit 4 **(12 Hours)**

Introduction to Biostatistics

4.1 Scope, collection, classification and tabulation, Graphical representation of data-measures of location and dispersion -Diagrammatic and Graphical Presentation of data, Types of data, Significance and uses of diagrammatic representation-limitations.

4.2 Frequency distribution: Discrete and continuous frequency distribution. Mean-Median- Mode.

4.3 Measures of dispersion- Standard Deviation, Coefficient of variation, Range

Unit 5 **(13 Hours)**

Application and Testing

5.1 Sampling techniques, Sampling Distribution, Standard error, testing of hypotheses, Null Hypothesis

5.2 Correlation - Types of correlation-Simple, Linear and Nonlinear- Pearson's Coefficient Correlation, Regression analysis- Types of Regression, Regression Equation of X on Y

5.3 χ^2 test, t-test, Analysis of Variance (ANOVA), Population Genetics: Hardy–Weinberg principle

BOOKS FOR STUDY

Jae K.Lee, *Statistical Bioinformatics for Biomedical and Life Science Researchers*, John Wiley & Sons Publications, USA, 2010

Rao P. S. S. Sundar, *Introduction To Biostatistics And Research Methods*, Prentice Hall, India, 2009.

Veer Bala Rastogi, *Fundamentals of Biostatistics*, Ane Books Pvt Ltd, New Delhi, 2010.

Basu, A.K., (2003), Introduction to Stochastic Process, Narosa Publishing House, New Delhi, India

Gurumani, N., (2004), *An Introduction to Biostatistics*, M.J. P. Publishers, Chennai,India.

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

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

Negi, K.S., *Biostatistics*, AITBS Publishers and Distributors, New Delhi, India. 2002

BOOKS FOR REFERENCE

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

Papoulis, Athanasios and S. Unnikrishnan Pillai, *Probability, Random Variables and Stochastic Processes*, (4th Ed.) Tata McGraw Hill Pub. Co. India. 2002

J. Richard, Sundar P. S. S. Rao, *An Introduction To Biostatistics: A Manual For Students In Health Sciences*, 3rd Edn, Prentice Hall, India. 2004

Bernard Rosner, *Fundamentals of Biostatistics*, Duxbury Press, USA. 2010

B. Antonisamy, Solomon Christopher, P. Prasanna Samuel. *Biostatistics: principles and practice*, Tata McGraw Hill Pub. Co. India. 2010

JOURNALS

The Journal of Mathematical Behavior
Mathematical Journals
The College Mathematics Journal
International Journal of Mathematics and Statistics Studies

WEBSITES

http://mathworld.wolfram.com/Integral.html
http://www-math.mit.edu/~djk/calculus_beginners/
http://mathworld.wolfram.com/Probability.html
https://www.math.hmc.edu/calculus/tutorials/matrixalgebra/

PATTERN OF ASSESSMENT

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)

Other Components: **Total Marks: 50**
Assignment/Class Test

End Semester Examination: **Total Marks: 100** **Duration: 3 Hours**
Section A – 20 x 1 = 20 Marks (All questions to be answered)
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SYLLABUS
(Effective from the academic year 2019-2020)

BIOPHYSICS

CODE: 19BI/PC/BP15 **CREDITS: 5**
L T P: 4 1 0
TOTAL TEACHING HOURS: 65

OBJECTIVES OF THE COURSE

- To give a basic understanding about the forces that determines the structure of biological macromolecules
- To provide knowledge about the techniques used in studying biological structure and function
- To understand the behaviour and properties of biological macromolecules

COURSE LEARNING OUTCOMES
On Successful completion of the course, the student will be able to

- Understand the importance of structural studies in bioinformatics
- Gain an insight about the forces that determines the structure of biological macromolecules
- Apply the knowledge gained to interpret the properties of biological macromolecules
- Apply the recent advances in Biophysical techniques in Life science Research

Unit 1

Introduction **(10 Hours)**

1.1 Atoms, Molecules and Chemical Bonds
1.2 Bohr Model of the Atom, Atomic Spectra, De Broglie Theory of Matter Waves, Schrödinger Wave Equation, Atomic and Molecular Orbitals, Hybrid Orbitals
1.3 Thermodynamics Systems – Laws of Thermodynamics – Statement and Applications – Concepts of Entropy and Enthalpy

Unit 2

Spectroscopy **(15 Hours)**

2.1 Visible, UV And IR Spectroscopy
2.2 Raman Spectroscopy –'Fingerprinting' Using Raman Spectra – Complementarity of Raman and IR Spectroscopy
2.3 Fluorescence Spectroscopy – Principles and Applications only for all

Unit 3

Nuclear Magnetic Resonance **(15 Hours)**

3.1 The Phenomenon, Spin-Spin Interaction
3.2 Relaxation and Nuclear Overhauser Effect, Chemical Shift, Measuring the Spectrum
3.3 One Dimensional and Two Dimensional NMR, NMR Application to Macromolecules

Unit 4

Mass Spectrometry **(15 Hours)**

4.1 Mass Spectrometry for Protein and Peptide Analysis

4.2 MALDI-TOF Analyzer, Tandem Mass Analyzer, The Ion Trap Mass Analyzer, Q-TOF Instrument

4.3 Protein identification by Peptide Mass Fingerprinting, Peptide Sequence Analysis by TMS

Unit 5

Crystallography and Microscopy **(10 Hours)**

5.1 Elementary Description of Crystallography – Crystal Growth, Data Collection, Structure Solution, Refinement and Interpretation – Concept of Resolution

5.2 AFM: Atomic Force Microscopy Basic Principle and Application

5.3 CFM: Chemical Force Microscopy Basic Principles and Applications

BOOKS FOR STUDY

Igor, Serdyuk, Nathan R. Zaccai and Joseph Zaccai. *Methods in Molecular Physics.*UK: Cambridge University Press, 2007.

Narayanan P. *Introductory Biophysics* Mumbai, India: New Age Publishing Co., 2005

Kensal E.vanHolde, Johnson Curtis W. and Ho Shing P. *Principles of Physical Biochemistry***,** USA: Prentice Hall International Inc., 2005.

BOOKS FOR REFERENCE

Bengt Nolting. *Methods in Modern Biophysics,* Germany: Springer, 2004.

D.Freifelder. *Physical Biochemistry.* New York, USA: W.H.Freeman and Company, 1982.

Banwell C.N. *Fundamentals of Molecular Spectroscopy.* New DelhiIndia: Tata McGraw-Hill Publishing Company Lt., 1994.

D.Sherwood, *Crystals, X-rays and Proteins.* London, UK: Longman Group Lts., 1976.

C.R.Cantor and P.Schimmel. *Biophysical Chemistry, Vol. I, II and III***.** New York, USA: W.H.Freeman and Company, 1985.

Sears F. W, Zemansky M.W and Young H.D. *College Physics*, Massachusetts, USA: Addison Wesley Publishing Company, 1985.

Leach A.R, *Molecular Dynamics Simulation.* New York, USA: John Wiley and Sons, 2001.

A.P. Gunning, A. R. Kirby, V. J. Morris. *Atomic Force Microscopy***.** London: Imperial College Press, 2009.

JOURNALS

Biophysical Journal
European Biophysics Journal
Journal of Biophysics

WEBSITES
http://www.biophysics.org/Education/Careers/CareersinBiophysics/tabid/112/Default.aspx
http://www.rcsb.org/pdb/101/static101.do?p=education_discussion/Looking-at-Structures/methods.html

PATTERN OF ASSESSMENT

Continuous Assessment: **Total Marks: 50** **Duration: 90 minutes**
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)

Other Components: **Total Marks: 50**
Seminars
Assignment
Interpretation of results

End Semester Examination: **Total Marks: 100** **Duration: 3 Hours**
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M.Sc. DEGREE: BIOINFORMATICS

SYLLABUS
(Effective from the academic year 2019 -2020)

CELL BIOLOGY AND GENETICS

CODE: 19BI/PE/CG15 **CREDITS : 5**
L T P : 4 1 0
TOTAL TEACHING HOURS:65

OBJECTIVES OF THE COURSE

- To understand the structure and function of the basic unit of life
- To gain knowledge about the Cell and all its components in both Prokaryotic and Eukaryotic cells
- To familiarize the students with the basic concepts of Genetics

COURSE LEARNING OUTCOMES

On Successful completion of the course, the student will be able to

- Understand the functions of the cell at the molecular level
- Represent and illustrate the structural organization of genes and the control of gene expression
- Explore the prokaryotic and eukaryotic protein synthesis mechanism
- Conceptualize mechanisms of signal transduction, cell cycle and cell death
- Link the concepts of cell and molecular biology to a better understanding of diseases, including cancer

Unit 1 (10 Hours)

Prokaryotic and Eukaryotic cells

1.1 Introduction - Prokaryotic and Eukaryotic cell - Characteristics, **Similarities and differences**

1.2 Bacteria Cells - Structure, organisation and bacterial genetics

1.3 Virus - Structure, Viral Infective cycles, origin and significance, Viroids and Prions

Unit 2 **(15 Hours)**

Organelles

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- Types, Ribosomes – Structure, Assembly of polypeptides on Ribosomes

Unit 3 **(15 Hours)**

Cytoskeleton

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:

R**oles of membranes in eukaryotic cells;** Membrane structure and composition, The Plasma Membrane - Fluid Mosaic Model

Unit 4 **(13 Hours)**

Multiple alleles

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 **(12 Hours)**

Cell Cycle and Karyotyping

5.1 **Chromosomes- Structure and function, Centromers and Telomers, Cell Cycle- Mitosis and Meiosis**

5.2 Karyotyping, Sex determination in Human - Barr body - Importance of Y Chromosome - Klinefelters' and Turners' Syndromes

5.3 Inter –sexuality Linked Inheritance: Colour blindness and Haemophilia Y - linked genes

BOOKS FOR STUDY

Harvey Lodish, Arnold Berk, Chris A. Kaiser, Monty Krieger, Anthony Bretscher, Hidde Ploegh. Molecular Cell Biology. USA: W. H. Freeman, Eighth edition, 2016.

Wolfe, Stephen L. *Molecular and Cellular Biology.* USA: Wadsworth, 2005.

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

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 REFERENCES

Watson, James, D. *Molecular Biology of the Gene.* UK: Pearson, Seventh edition, 2017.

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.

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

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

Journal of Molecular Biology
Journal of Genetics and Genomics
BMC Cell Biology

WEB SOURCES

www.cellbio.com
www.molbiolcell.org
www.sciencedirect.com
http://www.biology.arizona.edu/cell_bio/cell_bio.html

PATTERN OF ASSESSMENT

Continuous Assessment Test: Total Marks: 50 Duration: 90 minutes
Section A – 10 x 1 = 10 Marks (All questions to be answered)
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Section C – 1x 20 = 20 Marks (1 out of 2 to be answered)

Other Components: Total Marks:50
Assignment/Quiz/Case studies/Seminars

End Semester Examination: Total Marks: 100 Duration: 3 Hours
Section A – 20 x 1 = 20 Marks (All questions to be answered)
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M.Sc. DEGREE: BIOINFORMATICS

SYLLABUS
(Effective from the academic year 2019 -2020)

CHEMINFORMATICS

CODE: 19BI/PE/CI15 **CREDITS : 5**
L T P: 4 1 0
TOTAL TEACHING HOURS: 65

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
- To understand the applications of Cheminformatics in drug design

COURSE LEARNING OUTCOMES

On Successful completion of the course, the student will be able to

- Gain skills to analyse the properties of small molecules
- Design the biological targets and properties of the small molecule under investigation
- Better understanding of the drug discovery and development process
- Apply the concepts to create novel leads

Unit 1 **(15 Hours)**

Introduction

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

Unit 2 **(10 Hours)**

Representation of Molecules

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 **(15 Hours)**

Cheminformatics databases

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 (ZINC)

Unit 4 **(10 Hours)**

Searching Chemical Structure

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 and 3D Drawing Tools (ACD Chemsketch) Structure Optimization

Unit 5 (15 Hours)

Applications of Cheminformatics tools

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

BOOKS FOR STUDY

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

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

BOOKS FOR REFERENCE

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

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

Bajorath, Juergen,Totowa, N.J. *Chemoinformatics: 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
Chemoinformatics: Concepts, Methods, and Tools for Drug Discovery
International Journal of Chemoinformatics 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

PATTERN OF ASSESSMENT

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)

Other Components: **Total Marks: 50**
Assignment/Case study/Seminars

End Semester Examination: **Total Marks:100** **Duration: 3 Hours**
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SYLLABUS
(Effective from the academic year 2019-2020)

BASICS OF CLINICAL RESEARCH MANAGEMENT

CODE:19BI/PE/CR15 **CREDITS : 5**
L T P : 4 1 0
TOTAL PRACTICAL HOURS : 65

OBJECTIVES OF THE COURSE

- To give a basic understanding about clinical research
- To understand the various aspects of clinical research management
- To be conversant with the regulations in clinical management

COURSE LEARNING OUTCOMES

On Successful completion of the course, the student will be able to

- Evaluate critical global regulatory and health care issues that challenge and influence biopharmaceutical product development
- Understand the basic statistical principles, concepts, and methods for clinical data analysis and reporting
- Forecast the resources necessary for developing and managing clinical trials
- Demonstrate advanced critical thinking skills necessary to enhance employment opportunities or advance within the biopharmaceutical industry

Unit 1 **(10 Hours)**

Clinical Research

1.1 History of drug development - Pharmaco-epidemiology
1.2 Issues in Clinical Trials. Nuremberg Code, Declaration of Helsinki, International Conference of Harmonization and Good Clinical Practice
1.3 Clinical trials – History of clinical trials. Stages of Clinical trials

Unit 2 **(10 Hours)**

Pharmacology and Drug Development

2.1 Introduction to Drug Discovery and Development, Approaches, Sources of Drugs, Databases for drug search
2.2 Pharmacokinetics and pharmacodynamics, Toxicological requirements
2.3 Emerging technologies in Drug Discovery**,** Preclinical Testing, Clinical Trials

Unit 3 **(15 Hours)**

Regulations in Clinical Research

3.1 Evolution and History of Regulations in Clinical Research, US FDA Regulations, IND, NDA, ANDA, FDA Audits and Inspections
3.2 European Regulatory Affairs, Organization and Functions
3.3 INDIAN Regulatory system, Schedule Y- Rules and Regulations, Post Drug Approval Activities, PMS

Unit 4 **(15 Hours)**

Clinical Trial Management

4.1 Role of Ethics Committees and Institutional Review Boards. Special populations; women elderly and children

4.2 Designing of Protocol, SOP, ICF, Pharmacovigilance

4.3 Project management Documentation, Monitoring, Audits, Inspections, Fraud and Misconduct, Roles and Responsibilities of Clinical Research Professionals

Unit 5 **(15 Hours)**

Clinical Data Management

5.1 Importance of CDM in clinical research, Clinical Data Entry**,** CRF, e-CRF

5.2 Statistical considerations at the design, analysis and reporting stage.

5.3 Data validation, SAE reconciliation, Quality Assurance

BOOKS FOR STUDY

Lori A. Nesbitt. *Clinical Research What It Is and How It Works*. UK: Jones Barlett Publishers, 2006.

Richard K. Rondel, Sheila A. Varley, Colin F. Webb. *Clinical Data Management*. UK: John Wiley, 2013.

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

BOOKS FOR REFERENCE

Russ B. Altman, David Flockhart, David B. *Goldstein Principles of Pharmacogenetics and Pharmacogenomics.* UK: John Wiley, 2012.

Martin M. Zdanowicz. *Concepts in Pharmacogenomics*. UK: Mc Graw Hill, 2010.

JOURNALS

Journal of Clinical Research & Bioethics

Perspectives in Clinical Research

Asian Journal of Pharmaceutical and Clinical Research

WEB RESOURCES

http://hub.ucsf.edu/clinical-study-management
http://icmr.nic.in/ethical_guidelines
http://www.niaaa.nih.gov/research/guidelines-and-resources/clinical-trial-regulations-policies-and-guidance
http://www.fda.gov/ScienceResearch/SpecialTopics/RunningClinicalTrials/ucm155713.html

PATTERN OF ASSESSMENT

Continuous Assessment: Total Marks: 50 **Duration: 90 mins**.

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Other Components: Total Marks: 50

Seminars/Quiz/Group discussion//Assignments/Case studies, etc.

End Semester Examination **Total Marks: 100** **Duration: 3 Hours**

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

CODE: 19BI/PE/DM15 **CREDITS : 5**
L T P : 4 1 0
TOTAL TEACHING HOURS : 65

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

COURSE LEARNING OUTCOMES

On Successful completion of the course, the student will be able to

- Gain insight into the field of Bioinformatics from theoretical models to finished software
- Understand how software design and methods can be integrated with existing tools to create productive information environment for bioinformatics practice
- Understand how open source can be powerful in creating web-based applications in Bioinformatics
- Understand important roles of programming languages and databases in Bioinformatics software development and service

Unit 1 **(10 Hours)**

Data mining

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 **(10 Hours)**

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 **(15 Hours)**

Data Processing

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 and other classification methods

Unit 4 **(15 Hours)**

Clustering

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 **(15 Hours)**

Neural networks and machine learning

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

BOOKS FOR STUDY

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 ASSESSMENT

Continuous Assessment: Total Marks: 50 Duration: 90 minutes.
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Other Components: Total Marks:50
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SYLLABUS
(Effective from the academic year 2019 -2020)

IMMUNOINFORMATICS

CODE: 19BI/PE/IM15 **CREDITS : 5**
L T P: 4 1 0
TOTAL TEACHING HOURS: 65

OBJECTIVES OF THE COURSE

- To understand the immune system, its components and their functions
- To impart knowledge of immune responses to various pathogens by integrating genomics and proteomics with bioinformatics strategies
- To provide information about the methods used in immunological bioinformatics

COURSE LEARNING OUTCOMES

On Successful completion of the course, the student will be able to

- Understand the application of information technology to immunology
- Study informatics-based approaches for prediction of epitopes and immuno-diagnostic tools
- Gain knowledge about computer aided vaccine design

Unit 1

Immune System **(10 Hours)**

1.1 Introduction to Immune System - Adaptive and Innate Immunity
1.2 Cells of the Immune System, Soluble Mediators of Immunity, Cell and Antibody mediated immunity
1.3 Immune Responses - Inflammation, Immunopathology, Auto immune diseases, Vaccines

Unit 2

Antigens and Antibodies **(15 Hours)**

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

Unit 3

Computational Immunology **(10 Hours)**

3.1 Computational Immunology - Databases in Immunology, dbMHC-MHC database at NCBI
3.2 T-cell epitope databases, B-cell epitope databases, SYFPEITHI MHC-presented epitopes
3.3 IMGT Immunoinformatics, IMGT International ImMunoGeneTics Information System. HLA Nomenclature and the IMGT/HLA Sequence Database

Unit 4 **(15 Hours)**

Vaccine Design

4.1 From immunome to Vaccine – Prediction of immunogenicity, Vaccine design tools
4.2 Reverse Vaccinology and Immunoinformatics, Peptides with Antimicrobial Activity or Antibiotic Peptides
4.3 Functional Prospecting of Genes and Transcripts, Future of Computational Modelling and Prediction Systems in Clinical Immunology

Unit 5

Viral Bioinformatics **(15 Hours)**

5.1 Viral Bioinformatics - Computational Views of Hosts and Pathogens using VIDA
5.2 Drug Discovery - Introduction, Conventional Drug Design Approaches, Lipinski rule, Pharmacophore Kinetics and Dynamics, ADME Properties
5.3 Applications of Computer Based Drug Discovery

BOOKS FOR STUDY

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

Abul K. Abbas, Andrew H. H. Lichtman, and Shiv Pillai. *Cellular and Molecular Immunology* USA: Elsevier, 2017.

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

Continuous Assessment: Total Marks: 50 Duration: 90 minutes
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)

Other Components: Total Marks:50
Assignment/Tests/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)