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

SYLLABUS
(Effective from the academic year 2019 -2020)

DATABASE MANAGEMENT SYSTEMS

CODE : 19BI/PC/DB14 **CREDITS : 4**
L T P : 3 0 2
TOTAL TEACHING HOURS : 65

OBJECTIVES OF THE COURSE

- To introduce the basic concepts of Relational Database Management System and Client / Server Environment
- To be trained in designing databases and manipulating them for biological applications
- To understand the working knowledge of Linux environment

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

- Understand data models and schemas in DBMS
- Skills to Create, update, retrieve and Manage data
- Handle files and databases
- Gain efficient skills on Atomicity, Consistency, Isolation, and Durability
- Clear understanding and usage of SQLanguage

Unit 1 **(12 Hours)**

Introduction to Database Systems and Linux

1.1 Introduction to File and Database systems- Database System Structure, Data Models Introduction to Network Models – ER Model. Relational Model

1.2 Introduction to Linux Operating System, Properties of Linux, Desktop Environment, Linux basics commands

1.3 Working With Files, Text Editors, I/O Redirections, Pipes, Filters, and Wildcards. Changing Access Rights

Unit 2 **(13 Hours)**

SQL definition and Normalization

2.1 SQL – Data Definition- Queries in SQL- Updates- Views – Integrity and Security

2.2 Relational Database design – Functional dependences and Normalization for Relational Databases (up to BCNF)

2.3 Query Forms

Unit 3 **(15 Hours)**

Files and RDBMS

3.1 Record Storage And Primary File Organization- Secondary Storage Devices- Operations on Files- Heap File- Sorted Files- Hashing Techniques – Index Structure For Files –Different Types Of Indexes- B-Tree - B+Tree – Query Processing

3.2 Multimedia Databases - Basic Concepts and Applications. Indexing and Hashing. Text Databases
3.3 Overview of RDBMs, Advantages of RDBMs Over DBMs - Data Mining

Unit 4 (13 Hours)

Data Definition and Manipulation Language

4.1 Data Definition Language, Data Manipulation Language, Transaction Control and Data Control Language Grant and Revoke Privilege Command
4.2 Set Operators, Joins-Kinds of Joins, Table Aliases, Sub queries, Multiple and Correlated Sub Queries
4.3 Functions-Single Row, Date, Character, Numeric, Conversion, Group Functions

Unit 5 (12 Hours)

Constraints and MySQL

5.1 Constraints-Domain, Equity, Referential Integrity Constraints
5.2 Locks -Types of Locks, Table Partitions, Synonym
5.3 Introduction to PL/SQL, Introduction, MySQL as an RDBMS Tool, Data types and Commands

BOOKS FOR STUDY

Ramakrishnan Raghu and Gehrke Johannes. *Database Management Systems***,** USA: McGraw–Hill, 2003.

BOOKS FOR REFERENCE

George Koch and Kevin Loney. *Oracle 8 - The Complete Reference***,** USA: Tata McGraw – Hill, 2000.

Kyte, Thomas. *Expert Oracle Database Architecture- 9i and 10g Programming Techniques and Solutions*. USA: Berkeley press, 2006.

Michael Abbey and Michael J. Correy.*Oracle 8i - A Beginners Guide.* USA :McGraw-Hill, 1999.

JOURNALS

International Journal of Database Management Systems
Journal of Database Management
Journal of Advanced Database Management & Systems
International Journal of Intelligent Information and Database Systems
International Journal of Computer Science and Information

WEB RESOURCES

www.oracle.com/technetwork/oem/db-mgmt/db-mgmt-093445.html
http://education-portal.com/academy/lesson/what-is-a-database-management-system-purpose-and-function.html
www.odbms.org/
http://www.comptechdoc.org/os/linux/usersguide/linux_ugbasics.html
http://www.dummies.com/how-to/content/common-linux-commands.html

PATTERN OF ASSESSMENT

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

Theory:
Section A – 15 x 1 = 15 Marks (All questions to be answered)
Section B – 5 x 2 = 10 Marks (2 out of 4 to be answered)

Practical:
Section C – 2 x 12.5 = 25 Marks

Other Components: **Total Marks: 50**
Seminars/Group discussion/Assignments/Problem solving

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

The question paper pattern: theory and 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 (2 out of 3 to be answered)

Question comprising the following:

Display the output for the given query,
Error finding,
Output of the given programme,
Find the missing statements in a given programme.

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SYLLABUS
(Effective from the academic year 2019 -2020)

PROGRAMMING IN C++ AND PERL

CODE: 19BI/PC/CP14 **CREDITS : 4**

L T P : 3 0 2
TOTAL TEACHING HOURS: 65

OBJECTIVES OF THE COURSE

- To facilitate the students in gaining programming skills.

- To enable the students to design and execute C++ and Perl scripts
- To interpolate biological demands through programming

COURSE LEARNING OUTCOMES

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

- Learn the basics of programing
- Relate the necessity for programming in biology
- Handling biological concepts with C++ and Perl scripts
- Apply programing to analyze genomic sequences
- Understand Bio-Perl and their application in bioinformatics to handle the complex data

Unit 1 (12 Hours)

Introduction to Programming language

1.1 Introduction to Programming, Machine/Assembly Language, Higher Level Languages, Simple and Compound Data, Code: Syntax and Semantics

1.2 Introduction to Programming in C++: C++ Characteristics, Tokens, Keywords, Identifiers and Constants, Basic Data Types, User Defined Data Types, Derived Data Types, Expressions and Control Structures

1.3 Functions and Variables: Scope, Declaration and Definition, Arrays and Strings in C++

Unit 2 (13 Hours)

Object Oriented Programming – C++

2.1 Object Oriented Programming – Using Objects, Classes, Encapsulation, Inheritance, Abstraction and Polymorphism. Using Constructors, Destructors, Friend functions

2.2 String manipulation – creating string objects, Standard Streams, String operators Manipulating String, String characteristics, Comparing and Swapping

2.3 Working with files – File streams, Open, close, EOF, updating files and error Handling.

Unit 3 (15 Hours)

Introduction to Perl Programming

3.1 Introduction, Statements and Declarations, Default Variable, Expressions, Statements, Operators in Perl, Control Structures

3.2 Variable Types and Data types– Scalar, Arrays, Hashes. Functions- split, join, length, lcfirst, ucfirst, index and exists

3.3 Creating Regular Expressions-Characters, Character Classes, Alternative Match Patterns, Quantifiers, Assertions, Back References, Modifiers and Translator

Unit 4 (13 Hours)

Subroutines and File Handling

4.1 Subroutines- Defining Subroutines, Returning Values, Using Arguments

4.2 Files- Overview and working with File handles, Various Ways of Opening a Perl File Handlers- Normal Scalar variable, Use Perl IO, Open the Standard

Input and Standard Output, Use Sysopen (). Closing the files, printing, renaming files

4.3 Reading and writing perl – arrays and hash files

Unit 5 (12 Hours)

Bioperl

5.1 Introduction to Bioperl: Installation Procedures, Architecture, Uses of Bioperl

5.2 Modules of bioperl- seq, seqio, alignio, db

5.3 Modules of Bioperl – Annotation, location, tools

BOOKS FOR STUDY

E. Balagurusamy. *Object Oriented Programming with C++*. New Delhi: Tata McGraw- Hill, 2017.

Tisdall James D. *Beginning Perl for Bioinformatics.* USA: O'Reilly and Associates, 2014.

BOOKS FOR REFERENCE

Conrod Bessant, Ian Shadforth and Darren Oakley. *Building Bioinformatics Solutions with Perl, R and MySQL***.** New York: Oxford University Press, 2014.

Bjarne, Stroustrup. *The C++ Programming Language*. India: Addison Wesley, 2013.

Holzner and Steven. *Perl Black Book.* India: Dream Tech Press, 2006.

Hubbard, John. *Programming with C++, Schaum's Outline Series*. New Delhi: Tata McGraw Hill, 2003.

Tisdall James D. *Beginning Perl for Bioinformatics.* USA: O'Reilly and Associates, 2003.

Ellen Siever, Weber, Stephen Figgins, Robert, Arnold Robbins*Linux in a Nutshell-ADesktop Quick Reference.* USA: O'Reilly and Associates, 2006

Sanjeev Sofat. *Object Oriented Programming Using C++*, India : Cyber Tech. Publication, 2009.

JOURNALS

C/C++ Users Journal
International Journal of Computer Applications
Computer Methods and Programs in Biomedicine
Perl in communities

WEB RESOURCES

http://www.cplusplus.com/doc/tutorial/
http://www.cprogramming.com/
http://www.stroustrup.com/4th.html

PATTERN OF ASSESSMENT

Continuous Assessment Test: **Total Marks: 50** **Duration: 90 minutes**
Theory:
Section A – 15 x 1 = 15 Marks (All questions to be answered)
Section B – 2 x 5 = 10 Marks (2 out of 4 to be answered)
Practical:
Section C – 2 x 12.5 = 25 Marks

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

End Semester Examination: **Total Marks: 100** **Duration: 3 hours**
Theory:
Section A – 20 x 1 = 20 Marks (All questions to be answered)
Section B – 2 x 15 = 30 Marks (2 out of 4 to be answered)
Practical:
Section C – 4 x 10 = 40 Marks
Record and Viva – 10 Marks

Questions comprising the following:
Find the area and circumference of a circle
Armstrong Number
Prime Number
Convert DNA to RNA (transcription)
Calculate the frequency of bases
Find the reverse complement of the DNA sequence
Using Bioperl retrieve a sequence from database
Using Bioperl Convert DNA to Protein (Translation)
Using Bioperl retrieve last 30 amino acids from the given protein sequence
Using Bioperl run BLAST locally

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SYLLABUS
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ESSENTIALS OF BIOINFORMATICS

CODE: 19BI/PC/EB14 **CREDITS: 4**
L T P: 4 0 2
TOTAL TEACHING HOURS: 78

OBJECTIVES OF THE COURSE

- To provide an integrative approach to the understanding of both theory and practice of bioinformatics
- To apply biological concepts at different levels to study gene / protein analysis, and the proteins implicated in diseases
- To understand the evolution of the life

COURSE LEARNING OUTCOMES

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

- Better understanding of the bioinformatics concepts
- Applications of the gene and protein sequence analysis
- Apprehending the different databases in bioinformatics
- Perform a complete analysis of the genes and protein
- Compare and identify the differences in sequences

Unit 1 **(16 Hours)**

Introduction to Biological Databases

1.1 Type of Databases, Public Biological Databases – NCBI, EBI, CMBI, OMIM. Primary Nucleotide Sequence Databases: EMBL, GenBank, DDBJ

1.2 Secondary Nucleotide Sequence Databases: UniGene, SGD. Sequence Submission Methods and Tools (Sequin, Sakura, Bankit)

1.3 Sequence Retrieval Systems (Entrez & SRS); Sequence File Formats and Conversion Tools. Finding Scientific Articles, Using Pubmed

Unit 2 **(16 Hours)**

Introduction to Sequence Alignment

2.1 Protein Alignment, Homology, Similarity, Identity, Gaps

2.2 Pairwise alignments: Dot Plots, Scoring Matrix-PAM, BLOSUM, Gap Penalty

2.3 Dynamics programming - Alignment Algorithms: Global Sequence Alignment: Needleman-Wunsch Algorithm. Local Sequence Alignment: Smith –Waterman Algorithm. Rapid, Heuristic Versions of Smith Waterman: FASTA

Unit 3 **(16 Hours)**

Basic Local Alignment Search Tool

3.1 BLAST Search Steps, Search Strategy, General concepts

3.2 BLAST Algorithm: Local Alignment Search Statistics and E Value. Raw Scores and Bit Scores, Relation between E and P Values. Gapped Alignments in BLAST, Evaluation of Results

3.3 Advanced BLAST Searching-Specialised BLAST sites: - Organism Specific BLAST Sites, Ensemble BLAST, TIGR BLAST, PSI-BLAST

Unit 4 **(15 Hours)**

Multiple Sequence Alignment

4.1 Definition of Multiple Sequence Alignment

4.2 Databases of Multiple Sequence Alignment Programs- BLOCKS, PRINTS

4.3 Integrated Multiple Sequence Alignment Resources: InterPro, iProClass

Unit 5 **(15 Hours)**

Evolutionary Analysis

5.1 Introduction to Evolutionary Analysis, Bootstrap, Tree Construction Methods

5.2 Neighbor-Joining Method, Unweighted Pair Group Method with Arithmetic Mean (UPGMA)

5.3 Maximum Parsimony Method and Maximum-Likelihood Method

BOOKS FOR STUDY

Pevsner, Jonathan. *Bioinformatics and Functional,Genomics.* USA: John Wiley,2009.

Baxevanis, Andreas, D. and Francis B.F. Ouellette, *Bioinformatics- A Practical Guide to the Analysis of Genes and Proteins.* NewYork: John Wiley, 2004.

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

BOOKS FOR REFERENCE:

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

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

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

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

Lesk, Arthur M. *Introduction to Bioinformatics.* UK: Oxford University Press, 2014.

JOURNALS

BMC Bioinformatics
Bioinformatics
Journal of Bioinformatics and Computational Biology
Journal of Biomedical Informatics
Journal of Integrative Bioinformatics

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 ASSESSMENT

Continuous Assessment Test: Total Marks: 50 Duration: 90 minutes
Theory:
Section A – 15 x 1 = 15 Marks (All questions to be answered)
Section B – 2 x 5 = 10 Marks (2 out of 4 to be answered)

Practical:
Section C – 2 x 10 = 20 Marks
1 x 5 = 5 Marks

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

End Semester Examination: **Total Marks: 100** **Duration: 3 hours**
Theory:
Section A – 20 x 1 = 20 Marks (All questions to be answered)
Section B – 2 x 15 = 30 Marks (2 out of 4 to be answered)

Practical:
Section C – 5 x 10 = 50 Marks

Questions comprising the following:
Primary Nucleotide Sequence Databases: NCBI, EMBL, DDBJ
Basic Local Alignment Search Tool (BLAST)
Protein Sequence Databases – PIR, RefSeq, Swiss-Prot
Protein Structure Databases – PDB
Protein Family Databases –Pfam, TIGRFAM
Protein Visualization Tools- Rasmol, Swiss PDB Viewer
Specialized Database -IMGT
Multiple Sequence Alignment Tools: Clustal W
Phylogenetic Tree Construction Tool: MEGA

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SYLLABUS
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BIOMOLECULES AND BIOCHEMISTRY

CODE: 19BI/PC/BM14 **CREDITS: 4**
L T P: 4 1 0
TOTAL TEACHING HOURS: 65

OBJECTIVES OF THE COURSE
- To understand the concepts of the structure of biomolecules
- To understand the basics of metabolism and enzyme kinetics
- 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

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

- Understand the importance of structural studies in bioinformatics and
- 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 Biochemistry and Biophysical techniques in Clinical Chemistry and Life science Research

Unit 1 **(15 Hours)**

Biomolecules

1.1 Basics of Biomolecules - Structure and functions of Atoms, Molecules and Chemical bonds.

1.2 Biomolecule structures – Carbohydrates, Lipids, and Nucleic acids

1.3 Water - Properties and its importance in Biosystems

Unit 2 **(10 Hours)**

Metabolic Biochemistry

2.1 Carbohydrate metabolism – Glycolysis, Glycogen metabolism, TCA cycle, HMP shunt

2.2 Protein metabolism – Oxidative Deamination, Transamination and Urea Cycle

2.3 Fatty acid metabolism- β- oxidation and Biosynthesis of fatty acids. Xenobiotics and general detoxification methods in the body

Unit 3 **(15 Hours)**

Proteins

3.1 Proteins - Levels of organisation, Amino acid properties, peptide bonds, disulphide bridges and other conformations.

3.2 Four levels of protein structure, The Ramachandran Plot, Structure prediction by crystallography

3.3 Folding pathways. Domains, Motifs and their importance

Unit 4 **(10 Hours)**

Enzyme Kinetics and Bioenergetics

4.1 Enzyme action Mechanisms, Enzyme Kinetics, Michaelis-Menten Equation, significance of V max and Km, Line weaver-Burk plot

4.2 Competitive and non-competitive Inhibition, Feedback inhibition. Enzyme regulation. Allosteric modulation

4.3 Thermodynamics systems - laws of thermodynamics, statement and applications – concepts of entropy and enthalpy

Unit 5 **(15 Hours)**

Analytical Techniques

5.1 Principles and applications of Visible, UV, IR spectroscopy, Raman spectroscopy and Fluorescence spectroscopy

5.2 Nuclear Magnetic Resonance -The phenomenon, One dimensional and Two dimensional, NMR application to Macromolecules

5.3 Mass Spectrometry for protein and peptide analysis, MALDI-TOF Analyser, Tandem Mass Analyser, The Ion Trap Mass Analyser, Q-TOF Instrument

BOOKS FOR STUDY

Albert, L. Lehninger**,** *Biochemistry*, Worth Publishing, UK. 2012.

Thomas. E. Creighton, *Protein*s**,** W. H. Freeman, New York.2012.

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

Champe, Pamela C, Richard A. Harvey and Denise R. Ferrier. *Lippincott's Illustrated Reviews: Biochemistry*, India: J.P. Brothers Medical Publishers, 2013.

Garrett, H. Reginald and Grisham, M. Charles. *Biochemistry.* USA: Thomson–BroCole, 2012.

Jeremy, M. Berg. *Biochemistry***,** New York: W.H. Freeman, 2010.

Lubert and Stryer. *Biochemistry***,** New York: W.H. Freeman, 2012.

Voet, D. and Voet, G. *Biochemistry,* New York: John Wiley and Sons Inc, 2012.

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.

JOURNALS

Journal of Biochemistry
Indian Journal of Clinical Biochemistry
Biochemistry
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
http://www2.chemistry.msu.edu/faculty/reusch/VirtTxtJml/Spectrpy/MassSpec/masspec1.htm
www.themedicalbiochemistrypage.org
www.biochemistry.org

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/Open book test/Case study/Clinical implications of metabolic pathways/ Diagnostic applications of biochemicals/Role of Biomarkers

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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SYLLABUS
(Effective from the academic year 2019 -2020)

GENOMICS AND PROTEOMICS

CODE: 19BI/PC/GP24 **CREDITS : 4**
L T P : 3 0 2
TOTAL CONTACT HOURS: 65

OBJECTIVES OF THE COURSE

- To provide an insight into the complete genome sequences of a few organisms as well as the Human genome through Comparative and Functional genomics
- To acquaint knowledge on functional genomics techniques such as microarrays, EST, SAGE and interpret data obtained through high throughput expression studies
- To develop an understanding of the entire protein complement of a cell through analytical approaches, Data mining and other software tools

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

- Gain an insight of the basic and advanced concepts and applications of sequencing technologies
- Understand the mechanisms of genomics and proteomics and exploit the same in the growing field of omics
- Apply functional genomics techniques to analyse data for biological system
- Implement techniques and database search to analyze complex protein samples
- Analyze the proteomic interactions in complex diseases

Unit 1 **(13 Hours)**

Genomics

1.1 Understanding a Genome sequence, Locating the genes in a Genome Sequence, Gene location by Sequence Inspection, Experimental Techniques for Gene Location, Determining the Functions of Individual Genes

1.2 Genome Sequencing technologies - Conventional Sequencing techniques (Maxam Gilbert and Sanger Sequencing), Whole Genome Shotgun Sequencing, Genome assembly, Genome annotation and Genome databases

1.3 Rates and patterns of Nucleotide substitution, Molecular Clocks, Local Clocks**,** Computer Analysis of a Gene Function, Assigning Gene Function by Experimental Analysis

Unit 2 **(12 Hours)**

Comparative Genomics

2.1 Comparative Genomics - Genome Sequencing Projects, Variations at the Level of individual Nucleotides, Duplications, Comparisons at the Chromosome Level: Synteny, Genomes of Chimpanzees and Humans

2.2 Phylogenetic Analysis - Relationship of Phylogenetic Analysis to Sequence Alignment, Genome Complexity and Phylogenetic Analysis, Maximum Parsimony Method, Distance Methods, Gene Prediction by ORF analysis

2.3 Gene mapping - pedigree analysis, Application of DNA markers - RFLPs, SNPs, Physical mapping - Restriction mapping, Fluorescent *in situ* hybridization, Assessing genomic variations

Unit 3 **(15 Hours)**

Functional Genomics

3.1 Transcriptomes and analysis - Micro Array technology, SAGE, Applications of Microarrays In Medicine, Databases – GEO, MAML

3.2 ESTs Generation, EST Clustering and Assembly, EST databases (DB-EST, UNIGene)

3.3 KEGG and Metabolic Pathways, Regulatory Networks, Sequence based and structure-based approaches to assign gene functions, Role of databases in function assignment, Structural changes in sequences by the influence of polymorphisms (dbSNPs)

Unit 4 **(13 Hours)**

Proteomics

4.1 Introduction to Proteomics - Proteins structure, Organization of protein structure, structural conformation of proteins, three dimensional structures of proteins

4.2 Analytical tools in Proteomics - 1D and 2D-gel electrophoresis, Mass Spectrometry - ESI, MALDI etc., Software for Matching MS Data with Specific Protein Sequences, Peptide sequencing by tandem mass spectrometry

4.3 Preparative IEF, HPLC, Tandem LC/ MS-MS, Protein Digestion Techniques

Unit 5 **(12 Hours)**

Application of Proteomics

5.1 Proteomic interactions - Yeast Two-Hybrid, Mammalian Screen Methods and Co-Immuno Precipitation techniques

5.2 Protein-Protein Interactions and Protein Complexes, Databases and proteomic tools

5.3 Protein Interaction Networks and Protein Pathways, Mapping Protein modifications

BOOKS FOR STUDY

Arthur Lesk M. *Introduction to Genomics***.** New York: Oxford university press, Third edition, 2017.

Brown, T. A. *Genomes -3*. USA: John Wiley and Sons inc., 2006.

Leland Hartwell, Michael L. Goldberg and Janice Fischer. *Genetics: From Genes to Genomes*. USA:McGraw-Hill Publishing Company. 2018

Daniel C. Leibler. *Introduction to Proteomics: Tools for New Biology***.** USA: Humana Press, 2002**.**

Srivastava Sudhir. *Informatics in Proteomics*. USA: Taylor & Francis Group, 2005.

BOOKS FOR REFERENCE

Brown P. O and Botstein D. *Exploring the new world of the genome with DNA microarrays*. USA: Nat. Genet, 1999.

Collado Vides Julio and Ralf Hofstadter. *Gene Regulation and Metabolism – Post Genomic Computational Approaches*. India: Ane Books, 2004.

Dale, Jeremy W and Malcolm von Schantz. *From Genes to Genomes – Concepts and Applications of DNA Technology*. USA: John Wiley and Sons, 2012.

Arthur Lesk M. *Introduction to Genomics***.** New York: Oxford university press, 2008.

Griffiths, A.J.F, Miller, J.H, Suzuki, D.T. Lewontin, R. C. and Gelbart, W.M. *An Introduction to Genetic Analysis*. USA: W.H. Freeman, 1996.

Hunt Stephen P and Livesey Fredrick J. *Functional Genomics -A Practical Approach*. Great Britain: Oxford University Press, 2000.

Golemis and Erica. *Protein-Protein Interaction*. USA: CSHL, 2005.

Lesk Arthur M. *Introduction to Protein Science: Architecture, Function and Genomics*. New York: Oxford university press, 2016.

Mount David W. *Bioinformatics: Sequence and Genome Analysis*, USA: Cold Spring Harbor Lab., 2005.

Pennington S and M. J. Dunn. *Proteomics: From Proteins Sequence to Function*. Germany: Springer Publications, 2001.

Palzkill and Timothy. *Proteomics***.** USA: Kluwer Academic Publishers, 2013.

JOURNALS

Genomics, Proteomics & Bioinformatics
Journal of Data Mining in Genomics & Proteomics
Human Genomics and Proteomics
Journal of Proteomics and Genomics

WEB RESOURCES

http://www.oncolink.org/resources/article.cfm?id=326
http://www.nature.com/nature/journal/v422/n6928/full/nature01510.html
http://proteomics.cancer.gov/whatisproteomics
http://www.isaaa.org/resources/publications/pocketk/15/default.asp

PATTERN OF ASSESSMENT

Continuous Assessment Test: Total Marks: 50 Duration: 90 minutes
Theory:
Section A – 15 x 1 = 15 Marks (All questions to be answered)
Section B – 2 x 5 = 10 Marks (2 out of 4 to be answered)

Practical:
Section C – 5 x 5 = 25 Marks

Other Components: Total Marks: 50
Assignment/Test/Seminars

End Semester Examination: Total Marks: 100 Duration: 3 hours
Theory:
Section A – 20 x 1 = 20 Marks (All questions to be answered)
Section B – 2 x 15 = 30 Marks (2 out of 4 to be answered)

Practical:
Section C – 5 x 10 = 50 Marks

Questions comprising the following:
Genome databases of plants, animals and pathogens
Clusters of Orthologous Groups (COGs)
Gene Prediction by ORF analysis, Gen scan, UCSC Genome Browser
DNA markers - dbSNP, Restriction mapping
Transcriptomes analysis - Micro Array data analysis, GEO
EST Clustering databases - DBEST, UNIGene
Metabolic pathway database – KEGG, PharmGKB
Protein classification and structure analysis - CATH, SCOP
Protein Motif and Domain search - PROSITE, PDBeMotif

Protein - protein interaction analysis - DIP, STRING, BIND

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SYLLABUS
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MOLECULAR BIOLOGY

CODE: 19BI/PC/MB24 **CREDITS : 4**

L T P : 4 1 0
TOTAL TEACHING HOURS: 65

OBJECTIVES OF THE COURSE

- To understand the general principles of gene organization and expression
- To explore the various levels of gene regulation and protein function
- To analyse the various genetic and molecular changes occur in a normal cell

COURSE LEARNING OUTCOMES

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

- 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 **(15 Hours)**

Structure and Organisation of Genes and Chromosomes

1.1 DNA-Structure and Conformations, Histones and Non-Histones, **Chromosomes - Structure and Function of Chromosomes**

1.2 Cell division - Mitosis and meiosis, Cell cycle regulation, Check points

1.3 Organisation of Genomes –Coding Sequences, Repetitive Sequences, transposons

Unit 2 **(15 Hours)**

Replication and Transcription

2.1 DNA replication, repair and recombination, DNA damage and repair mechanisms in prokaryotes and eukaryotes, Mutations

2.2 Transcription: Eukaryotes and Prokaryotes, Genetic code, Transcriptional Control by Regulatory Proteins, Steroid Hormone Receptors - Heat Shock Genes- Homeotic Genes

2.3 Mechanisms Modifying Transcriptional Control – DNA Methylation, Histone Modification, Post Transcriptional Regulation

Unit 3 (12 Hours)

Translation

3.1 **RNA- Types, structure and functions,** Ribosomes – Structure and Assembly

3.2 Translational Regulation - Regulation of gene expression in Prokaryotes (Operon) and Eukaryotes, Gene Silencing

3.3 Genetic Control of Vertebrate Immune System

Unit 4 (10 Hours)

Organelle Genome

4.1 Mitochondrion genome – Organisation and Function

4.2 Chloroplast genome – Organisation and Function

4.3 Transcription and Translation in Mitochondria

Unit 5 (13 Hours)

Cell Signalling and Cancer

5.1 Cell signalling – Signalling molecules, Receptors - Hormones receptors, cell surface receptor, signal transduction pathways, regulation of signalling pathways

5.2 Cancer Biology- Characteristics of Cancer, Genetic basis of cancers, Proto-oncogene, Oncogenes, Tumor Suppressor Genes, Tumor Metastasis

5.3 Oncogenesis - Cancer Immunotherapy, Regulation of Cell Death, Apoptosis

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.

BOOKS FOR REFERENCE

Cooper, Geoffrey M. and Robert E. Hausman. *The Cell, A Molecular Approach.* USA: Sinauer Associates, 2004.

Harvey Lodish, Arnold Berk, Chris A. Kaiser, Monty Krieger, Matthew P. Scott, Anthony Bretscher, Hidde Ploegh and Paul Matsudaira. *Molecular Cell Biology.* USA: W.H.freeman, 2008.

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, 2004.

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

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.

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

JOURNALS

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

WEB SOURCES

www.cellbio.com
www.molbiolcell.org
www.sciencedirect.com
http://www.nature.com/scitable/topic/cell-biology-13906536
http://www.biology.arizona.edu/cell_bio/cell_bio.html
http://ghr.nlm.nih.gov/

PATTERN OF ASSESSMENT

Continuous Assessment Test: 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/Test/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)

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

SYLLABUS
(Effective from the academic year 2019 -2020)

MOLECULAR BIOLOGY PRACTICAL

CODE: 19BI/PC/P122 **CREDITS : 2**
L T P : 0 0 3
TOTAL HOURS : 39

OBJECTIVE OF THE COURSE:

- To identify subcellular structures, organelles and understand their functions
- To provide practical experience of the various techniques involved in Molecular Biology and Biochemistry
- To perform a range of molecular techniques used for the isolation, estimation, purification of biomolecules

COURSE LEARNING OUTCOMES

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

- Utilize laboratory skills to enhance understanding of cell structure and function while participating in a group environment
- Develop responsible conduct of laboratory skills appropriate to the field of cell and molecular biology
- Apply the molecular biology techniques to biotechnological approaches

Unit 1 **(8 Hours)**

1.1 Cell Fraction and Extraction of cell organelles

1.2 Isolation of Sub-Cellular Organelles and Particles –Mitochondria and Chloroplast

Unit 2 **(10 Hours)**

2.1 Extraction of DNA from Onion, Extraction of RNA from Yeast

2.2 Estimation of DNA and RNA

2.3 Estimation of Proteins by Lowry's Method

Unit 3 **(7 Hours)**

3.1 Estimation of Mitochondria by Assessing The Marker Enzyme

3.2 Denaturing Proteins and Identification of Amino Acids by Thin Layer Chromatography

Unit 4 **(7 Hours)**

4.1 Isolation of Plasmid DNA (Demo)

4.2 Amplification of DNA by PCR

Unit 5 **(7 Hours)**

5.1 Electrophoretic Techniques: Agarose Gel Electrophoresis, SDS PAGE (Demo)

5.2 Southern Blotting (Demo)

BOOKS FOR REFERENCE:

Wilson, K; Walker, J. *Principles and techniques of Biochemistry and Molecular Biology.* USA: Cold Spring Harbor Laboratory Press, 2010.

Sambrook, J; Russel, DW. *Molecular Cloning*. USA: Cold Spring Harbor Laboratory Press, 2001.

Sadasivam, S. and Manickam, A. *Biochemical Methods***.** India: New Age International, 2009.

Wilson, K; Walker, J. *Principles and techniques of Biochemistry and Molecular Biology*. USA: Cold Spring Harbor Laboratory Press, Eighth edition, 2010.

Swati Agarwal, Suphiya Khan. Advanced Lab Practices in Biochemistry & Molecular Biology. India: I K International Publishing House, 2018.

PATTERN OF ASSESSMENT

End Semester Examination Total Marks: 100 Duration: 3 hours

Spotters 4 in number each carrying 5 marks totalling 20 marks

Any two experiments each carrying 30 marks each—10 marks for procedure, 10 marks for the result and 10 marks for the conduct of the experiment

Viva - 10 marks

Record - 10 marks

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

SYLLABUS
(Effective from the academic year 2019 -2024)

RESEARCH METHODOLOGY

CODE: 19BI/PC/RM24 CREDITS : 4

L T P : 4 1 0
TOTAL TEACHING HOURS : 65

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
- To understand the analytical tests to be applied for research

COURSE LEARNING OUTCOMES

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

- Better understanding of the research methods
- Design an action plan of research
- Acquire skills of writing a research manuscript
- Application of statistical study in research
- Understand the ethics in writing research work

Unit 1 (15 Hours)

Types of Data and research problem identification

1.1 Data Collection, Sampling. Sources of Data Primary, Secondary and Tertiary Sources Classification and Presentation of Data

1.2 Documents, Types of Documents, Archives, Chronologies

1.3 Definition of Research and Research Methodology. Principles and Practice of Research. Exploring the Broad Area – Using the Library and Online Resources. Identifying The Research Problem

Unit 2 (15 Hours)

Scientific Communication

2.1 Literature Review - Its Relevance and Importance in Directing Research. Citations – Types Of Citations, Bibliography and End Matters, Editing and Proof Reading

2.2 Action Plan, Design and Pilot Study Undertaking a Research Project, Writing a Research grant Proposal, writing papers and posters, Format of thesis

2.3 Paper critiquing- the Purpose and the Methodology of Paper Critiquing

Unit 3 (10 Hours)

Writing well

3.1 Writing for non- native audiences, usage of simple sentences, untangle long noun phrases, make complete sentences.

3.2 Use of punctuations- comma, colon, semicolon, dash and periods.

3.3 Creating non-textual information- acquiring, processing and printing illustrations. Concepts of mind maps.

Unit 4 (12 Hours)

Bioethics

4.1 Introduction. Intellectual Property Rights (IPR) and Patents, TRIPS

4.2 Case studies on Patents (Basmati, Turmeric and Neem), ethics in science practicals

4.3 Plagiarism and Common Errors in Scientific Writing. Misconduct in science

Unit 5 (13 Hours)

Tools for research

5.1 Use of Encyclopaedias, Research Guides, Handbook etc., Academic Databases for Computer Science Discipline.

5.2 Use of tools / techniques for Research: methods to search required information effectively, Reference Management Software like Zotero/ Mendeley,

5.3 Software for paper formatting like LaTeX/MS Office, Software for detection of Plagiarism

BOOKS FOR STUDY

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

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

BOOKS FOR REFERENCE

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

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

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-researchmethodologies/
https://explorable.com/research-methodology

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SYLLABUS
(Effective from the academic year 2019 -2020)

SOFT SKILLS

CODE:19BI/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
- To develop self-motivation, raised aspirations and belief in one's own abilities

COURSE LEARNING OUTCOMES

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

- Connect and work with others to achieve a set task
- Assessing the requirements of a task, identifying the strengths within the team
- Create awareness of one's place and role within a community through volunteering and conservation opportunities
- Responsible for one's self, learning self-reliance and independence
- Develop Employability skills, time and resource management, conflict resolution, teaching and mentoring others

Unit 1 (6 Hours)

Behavioural Traits

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 (5 Hours)

Team Work

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 (5 Hours)

Time Management

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 **(5 Hours)**

Conflict Resolution

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 **(5 Hours)**

Career Mapping

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.

Anjali Ghanekar and Ghankear. *Communication and Soft Skill Development*. India: Everest Publishers, 2016