

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 SQL language

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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M.Sc. DEGREE: BIOINFORMATICS

SYLLABUS

(Effective from the academic year 2019 -2020)

PROGRAMMING IN C++ AND PERL

CODE: 19BI/PC/CP14

: 4

CREDITS

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 programming
- Relate the necessity for programming in biology
- Handling biological concepts with C++ and Perl scripts
- Apply programming 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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M.Sc. DEGREE: BIOINFORMATICS

SYLLABUS

(Effective from the academic year 2019 -2020)

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*. New York: 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

- 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 K_m , 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, *Proteins*, 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. van Holde, 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 Delhi India: 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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M.Sc. DEGREE: BIOINFORMATICS

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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M.Sc. DEGREE: BIOINFORMATICS

SYLLABUS

(Effective from the academic year 2019 -2020)

MOLECULAR BIOLOGY

CODE: 19BI/PC/MB24
: 4

CREDITS

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
: 4**

CREDITS

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
Hours)**

(15

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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STELLA MARIS COLLEGE (AUTONOMOUS), CHENNAI - 600 086

M.Sc. DEGREE: BIOINFORMATICS

SYLLABUS

(Effective from the academic year 2019 -2020)

SOFT SKILLS

CODE:19BI/PK/SS22

: 2

CREDITS

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