

2017 – 2020

Structure of B.Sc. Programme (3 Years Degree Course)

Subject – Bioinformatics (as one subject)

YEAR	PAPER(S)	Maximum Marks		
		Total	CCE	External
I	BI 101 : Introduction to Bioinformatics	100	15	42.5
	BI 102: Concepts in Bioinformatics			42.5
	BI 103: Practical	50	-	50
II	BI 201: Introduction to Computers and Programming	100	15	42.5
	BI 202 : Structural Bioinformatics			42.5
	BI 203 :Practical	50	-	50
III	BI 301 : Biostatistics	100	15	42.5
	BI 302 : Mathematics for Biological Sciences			42.5
	BI 303 : Practical a) Practical Work b) Project Work	50	-	50 25 25

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27/04/17
(Y.K. Jaiswal)

Dr. Rakesh Mehta
27/4/17
(Dr. Rakesh Mehta)

A. Tiwari
27.4.17
(Dr. A. Tiwari)

Sandhya
(Dr. Sandhya Pandey)
27.04.17

Sugandha
27/4/17

Dr. Sugandha Singh

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①**B.Sc. FIRST YEAR****THEORY PAPER 1****BI 101: INTRODUCTION TO BIOINFORMATICS**

Objectives: To enable students to learn important databases and tools commonly employed to Bioinformatics.

UNIT I Introduction

Definition, History, Branches of Bioinformatics, Aims, Scope & research Areas, Human genome project, Role of computer in Bioinformatics, Bioinformatics in India, BIO-IT-The Flourishing future. Application of bioinformatics.

UNIT II Introduction to database

Introduction to genomics & proteomic data, Post genomics era, Data acquisition –functions and purposes, Biological databases-relational and object orient concepts. Information retrieval, concepts of digital libraries, information retrieval from biological databases ENTREZ-SRS, Methods for presenting large quantities of data, sequence viewer, structure viewer, RASMOL, ligand explorer.

UNIT III Introduction to Nucleic Data Bases

Primary & Secondary Data Base, gene banks, ENBC nucleotide, sequence data bank- DDBJ- RNA sequence data bases: 16S & 23S rRNA, Mutation data bases, HIV sequence data base, NON CODE sequence submission tools, sequin, webin, sqkura, bank etc.

UNIT IV Protein sequence data bases

Protein sequence data bases – PIR, SWISSPROT, UNIPROT-Tr EMBL, EXPASY,NCBI,Protein, Databases – PRF, UNIPROT-MIPS-O/P-protein sequence motif database, E blocks- eblocks- PROSITE, PROTEIN DOMAIN, databases, ADDA, INTERPRO, Pfame-protein

UNIT V Introduction to structure data bases

PDB- PDBSum SCOP-CATH-MMDB-EMSD-SWISS-MODEL repository-ModBase-Protein MODEL portal, Eurocarb DB-DIP-BNND, STRNG

Books Recommended:

- 1 Orpita Basu & Simminder Kaur, Thakural “ Bioinformatics Databases, Tools, Algorithm,2007 Oxford University Press”
- 2 Higgins,D.Willie, Taylor “ Bioinformatics; Sequence,Structure and Data bank, A Practical Approach,2000, 1st Ed, Oxford University Press
- 3 Allwood T, David Parry Smith ; Introduction to bioinformatics, 2008 Pearson Education, Singapore D.ED.
- 4 Murthy, C.S.V., 2016, Himalaya Publishing House

On 27/4/17
(Dr. Rakesh Mehta)

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THEORY PAPER 2**BI 102: CONCEPTS IN BIOINFORMATICS**

Objectives: To provide students with foundation in the important concepts of Bioinformatics.

UNIT I

Introduction, sequence alignment, Scoring matrix, PAM BLOSUM, Gaps and Gap penalties, Different Gap weights, Biological significance of Gaps.

UNIT II

Pairwise sequence alignment, DotPlot analysis, Dynamic programming, Needleman-Wunch algorithm, Smith-Waterman algorithm, Edit distance dynamic programming, Database similarity search, BLAST, FASTA.

Multiple sequence alignment, sum of pairs, Divide and Conquer, Progressive and Iterative alignment, ClustalW, TCPFFEE, Profile methods, Gribskov profile, PSI_BLAST.

UNIT III

Phylogenetic relationships, Clustering and Phylogeny, Phylogenic analysis, Concept of Phylogenetic Tree, Methods of Phylogeny analysis, Distance and character based methods, Motif detection, Protein family databases.

UNIT IV

Data mining, Introduction, Definition, Data mining problems, Cluster analysis, Data mining techniques, Tools and Methods. Management of Databases. DBMS, Difference between DBMS and file system.

UNIT V

Metabolic pathway database (KEGG pathway database), Concept of Metabolome and Metabolomics, Drug discovery and Design, Target identification, Target validation, Lead identification, Lead Optimization, Preclinical Pharmacology and Taxology, Chemoinformatics tools for Drug discovery, Chemical structure representation (SMILE & SMART), Chemical databases: CSD, ACD, WDI, ChEMBL, PUBCHEM.

Books Recommended:

- 1 Orpita Basu & Simminder Kaur, Thakural " Bioinformatics Databases, Tools, Algorithm, 2007 Oxford University Press"
- 2 Higgins, D. Willie, Taylor " Bioinformatics; Sequence, Structure and Data bank, A Practical Approach, 2000, 1st Ed, Oxford University Press
- 3 Allwood T, David Parry Smith; Introduction to bioinformatics, 2008 Pearson Education, Singapore D.ED.
- 4 Murthy, C.S.V., 2016, Himalaya Publishing House
- 5 Ghosh, Z and Mallick, B, 2008, Bioinformatics – Principles and Applications

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BI 103: PRACTICAL**LIST OF PRACTICALS**

1. To explore NCBI.
2. To explore GenBank .
3. To compare data files from NCBI, DDBJ and EMBL.
4. To Perform Sequence alignment using online Blast.
5. To Perform Sequence alignment using offline Blast.
6. To Perform Sequence alignment using Fasta.
7. To Explore PDB.
8. Perform sequence alignment using clustal w.
9. Study phylogenetic relationship using phylip
10. Draw phylogenetic tree using MEGA
11. Find motif using motif search
12. Study drug bank database
13. Explore secondary database prosite and pfam
14. Study OMIM database

(Note: 75% of the practicals from the prescribed list should be completed every year)

Scheme for Practical Examination

1. Major Exercise	15 Marks
2. Minor Exercise	10 Marks (05+05)
3. Spotting (Related to theory papers)	10
4. Viva-voce Examination	10
5. Lab Journals (Sessionals)	05
TOTAL MARKS	50

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B.Sc. SECOND YEAR**THEORY PAPER 3****BI 201: INTRODUCTION TO COMPUTERS AND PROGRAMMING**

Objective: To equip students with fundamental knowledge and concepts of Computers and Basic Programming Skills.

UNIT I Introduction to Computers

Overview and function of computers, Characteristics of computers, History of Computers, Evolution. Generation of Modern Computers, Classification of Computers, Micro-computers, Mini computers, Main Frame, Super computers, Special purpose computer (Comparison in their memory, power, cost and Size), PC types, Tower, Desktop, Notebook, Laptops, Handheld, Palmtop, PDA, Types of Modern Computers, Workstations, Servers.

UNIT II Computer components and Number System

Components of a computer, Input devices, Output device, CPU, Memories (RAM and ROM), Secondary storage devices, Hard Disk, Magnetic tapes, Zip drives, Digital tapes, CD-ROM, DVD, BluRay, Number system , introduction, Decimal , Binary, Octal, Hexadecimal number systems and their inter conversion.

UNIT III Operating system (OS) and software Development

Hardware and Software definitions, Introduction to O/S, Functions, Classification real time, single user single task, single user multi task, Basic description about DOS, WINDOWS, Windows server NT/2000, UNIX/LINUX, MVS, Overview of Software development. Software development phases, problem definition, analysis, algorithm design and representation, coding and debugging (simple description about each phase).

UNIT IV Flow charts, Pseudo codes and Programming Languages

Basic flowchart symbols and their meaning, Pseudo codes, definition and importance, Syntax and Semantics, Programming approaches, Procedural, Object oriented programming languages, Definition, categories, low level languages, Machine language, Assembly language, Advantages and disadvantages, High level languages, Advantages and disadvantages, Interpreters, Compilers and Translators, Overview of compilation process, Types of High level languages. Introduction to Pearl.

UNIT V Multimedia and Internet

Multimedia, Introduction, Characteristics, Elements and Applications, The internet and its resources, World Wide Web(WWW), Associated tools, services, resources and various terminologies, An overview of Computer viruses, virus definitions, symptoms, transmission, danger and general precautions.

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Recommended Books:

1. Glenn Brookshear J., "Computer Science: An Overview", 2011 11th ed, Addison Wesley Publishers.
2. Alexis Leon & Mathews Leon, "Fundamentals of Information Technology". 2009, 2nd ed, Vikas Publishing House Pvt. Ltd.
3. Rajaraman V, " Fundamentals of Computer", 2004, 4th ed, Prentice Hall India Pvt. Ltd.
4. Francis Glasborrow & Roberta Allen, " A Beginner's Introduction to Computer Programming", 2003, John Wiley and Sons.
5. Anurag Seetha, " Introduction to Computers and Information Technology", 2005 Ram Prasad and Sons Bhopal
6. Basandra S.K., " Computer Today", 2011, 1st ed, Ga

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THEORY PAPER 4

BI 202: STRUCTURAL BIOINFORMATICS

Objectives: To understand the levels of structural organization of macro molecules and experimental methods of structural determination. To know the approaches for structural analysis.

UNIT I Macromolecular structure

Nucleic acids – DNA and RNA, Protein-Primary, secondary, tertiary and quaternary structures, Amino acids, Ramchandran plot.

UNIT II Macromolecular Interactions

Protein-Protein, Protein- Nucleic acid, Protein- Carbohydrates, Structure of Ribosome.

UNIT III Principles of Protein folding

Overview of experimental techniques to study macro molecular structure, Methods to study 3D structure – X-ray, NMR, Cryo electron microscopy, Microarray., MALDI-TOFF.

UNIT IV Proteomics

Proteomics, Homology modelling, Protein tertiary structure, Prediction, Methodology

UNIT V Genomics

Introduction, Genome mapping, assembly annotative and comparison, Comparative Genomics, Free of life and some completed Genomics, Drug research in the era of Genome sequencing.

Books Recommended:

- 1 Watson, J.D., Baker, T.A., Bell, S.P. et al., 2008, Molecular Biology of the Gene, Cold Spring Harbor, New York.,
- 2 Sheehan, D. 2010, Physical Biochemistry: Principles and Applications, Wiley Blackwell
- 3 Baxevanis, A.D. and Ouellette, B.F., 2005, Bioinformatics – A Practical Guide to the Analysis of Genes & Proteins, John Wiley & Sons, Inc, USA.

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BI 203: PRACTICAL**LIST OF PRACTICALS**

1. String concatenation
2. Using perl perform translation
3. Using Perl perform transcription
4. Perform parsing of BLAST output and PDB file using perl.
5. To perform C/C++ line/circle Computer Graphic program.
6. Find ORF's in all six reading frames of a given DNA sequence.
7. To access the SCOP database to study protein classification.
8. To access CATH database.
9. To determine similarities and differences between the PDB entries of the protein which have been identified by X-ray crystallography and NMR.
10. To conduct secondary structure prediction using J-Pred secondary structure prediction server.
11. Predict secondary structure using GOR server.
12. Explore HSSP or FSSP databases.

(Note: 75% of the practical from the prescribed list should be completed every year)

Scheme for Practical Examination

1. Major Exercise	15 Marks
2. Minor Exercise	10 Marks (05+05)
3. Spotting (Related to theory papers)	10
4. Viva-voce Examination	10
5. Lab Journals (Sessionals)	05
TOTAL MARKS	50

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B.Sc. THIRD YEAR**THEORY PAPER 5****BI 301: BIOSTATISTICS**

Objectives: To review the basic concepts of statistics relevant to biology data handling.

UNIT I Introduction

Biostatistics: Definition, standard terms, population sample, unit, variable, parameters, limitations and uses of statistics.

UNIT II Data Collection

Data and its collection, classification of data, purpose of classification, advantages, types of classification, Tabulation of data, Objectives of tabulation, rules of tabulation, Difference between classification and Tabulation, Diagrammatic presentation of data, Line diagram, Bar diagram, Percentage bar diagram, Pie diagram, Graphical representation of data, Histogram, Frequency curve, frequency polygon, Olives.

UNIT III Central Tendency and Probability

Mean, Mode, Median and their merits, Mean deviation, measures of dispersion, Range, Standard deviation and its relative measures, Probability, Distribution, Basics of Binomial, Poisson and Normal distribution and their applications to Biology.

UNIT IV Correlation and regression analysis

Concepts of correlation, coefficient of correlation, Types of correlation, Scatter diagram or Dot diagram method, Kar Pearson's coefficient of correlation, Spearman's rank correlation coefficient, Probable error in correlation, Regression: meaning, linear regression, regression coefficient and its properties, Regression equations, Fitting, Prediction, Difference between correlation and regression.

UNIT V Statistical Analysis

Test of significance, Null hypothesis, alternative hypothesis, simple hypothesis and composite hypothesis, two types of errors, single tail and two tailed test, Large sample test, Test of significance of a single mean and difference between two means, Student's "t" test, test of significance of a single mean and difference between means when $n_1=n_2$ and $n_1 \neq n_2$, Chi square test for goodness of fitness, Analysis of variance, meaning, assumptions, one way classification and two way classification (simple problems)

Recommended Books:-

1. Zar, J.H. "Biostatistical Methods", 2009, 5th ed, Prentice Hall Publication

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2. Gurumani N, "Introduction to Biostatistics", 2004, 1st ed, MJP Publishers Chennai
3. Sunder Rao, P.S.S, & Richards, J. " An Introduction to Biostatistics", 2003, 3rd ed, CMC
4. Denial W.W. "Biostatistics- A Foundation for analysis in the Health Sciences", 1999, 1st ed, John Wiley & Sons.
5. Bishop O.N., "Statistics for Biology", 3rd ed, Prentice Hall Press

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THEORY PAPER 6

BI 302: MATHEMATICS FOR BIOLOGICAL SCIENCES

Objectives: To review the basic concepts of mathematics relevant to biology.

UNIT I Series

Basic series and series AP, standard AP, Sum of first n terms of AP, GP, standard GP, sum of n terms in GP, geometric mean, HP, Basic logarithmic and exponential series.

UNIT II Vectors and Matrices

Sets, inverse of a matrix, matrix method, Cramer's rule, vectors, addition and subtraction, dot product, cross product, gradient, divergence, curl.

UNIT III Basic Calculus

Differentiation and Integration, concept of limit, continuity, differentiation, maxima and minima, introduction to partial differentiation, integral calculus, definite integral.

UNIT IV Numerical Computation

Errors in computer arithmetic, normalization, polynomial interpolation, solution of non-linear equations, Errors, convergence of solutions, Iterative methods for system of linear equations, Numerical differentiation and integration.

UNIT V Trigonometry and Analytical Geometry

Trigonometric ratios, De Moivre's theorem, the general equation of a straight line, slope of a line, intercept of a line, angle between two lines, intersection of two lines, The general equation of a circle.

Recommended Books:-

1. Boas M.L." Mathematical Methods in the Physical Sciences", 2005, 3rd ed, Wiley Publication.
2. Prasad G., "text book of Differential Calculus", 2003, 4th ed, Poothishala Publications.
3. Prasad G., "text book of Integral Calculus", 2003, 3rd ed, Poothishala Publications.
4. Ayers F, "Matrices and Vectors", 1962, 1st ed, Schaum Outline Series Publishing Co.
5. Schwartz, J.T. "Introduction to Matrices and Vectors", 2001, Courier.

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BI 303: PRACTICAL**LIST OF PRACTICALS**

1. Find Mean, median, mode using excel.
2. Study formulas in excel.
3. Construct bar diagrams and pie charts.
4. Construct ogives.
5. Construct histogram.
6. Perform correlation analysis.
7. Find standard deviation.
8. Explore Mfold.
9. Explore Ensemble
10. Hex docking server
11. Swiss-model/Modeller
12. Binomial Theorem
13. To use various HTML tags.

(Note: 75% of the practical from the prescribed list should be completed every year)

Scheme for Practical Examination

a) Practical Work (25 Marks)

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|--|----------|
| 1. Major Exercise | 06 Marks |
| 2. Minor Exercise | 04 Marks |
| 3. Spotting (Related to theory papers) | 10 Marks |
| 4. Lab Journals (Sessionals) | 05 Marks |

b) Project Work (25 Marks)

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|--------------------------|----------|
| 1. Project Report | 10 Marks |
| 2. Project Presentation | 10 Marks |
| 3. Viva-voce Examination | 05 Marks |

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