Dr. BABASAHEB AMBEDKAR MARATHWADA UNIVERSITY, AURANGABAD

CIRCULAR NO.SU/Sci. & Tech./Colleges./NEP/16/2023

It is hereby inform to all concerned that, the syllabi prepared by the Board of Studies & Ad-hoc Boards and recommended by the Dean, Faculty of Science & Technology, the Hon'ble Vice-Chancellor has accepted **the following curriculum of All Post Graduate Degree Courses as per Norms of National Education Policy – 2020 under the Faculty of Science & Technology run to the Affiliated Colleges, Dr.Babasaheb Ambedkar Marathwada University** in his emergency powers under section 12(7) of the Maharashtra Public Universities Act, 2016 on behalf of the Academic Council as appended herewith.

Sr.No.	Syllabi of Affiliated BAMU, Aurangabad.	Semester
1.	M.Sc.Zoology	Ist and IInd Semester
2.	M.Sc.Microbiology	Ist and IInd Semester
3.	M.A/M.Sc.Mathematics	Ist and IInd Semester
4.	M.Sc.Geology	Ist and IInd Semester
5.	M.Sc.Biophysics	Ist and IInd Semester
6.	M.Sc.Bioinformatics	Ist and IInd Semester
7	M.Sc. Information Technology	Ist to IVth Semester
8.	M.Sc.Computer Science	Ist to IVth Semester
9.	M.Sc.Botany	Ist and IInd Semester
10.	M.Sc.Enviornmental Science	Ist and IInd Semester

This is effective from the Academic Year 2023-24 and onwards.

All concerned are requested to note the contents of this circular and bring the notice to the students, teachers and staff for their information and necessary action.

University Campus,
Aurangabad-431 004.
REF.NO.SU/NEP/2023/ 8752-60
Date:- 08.08.2023.

★ ★ ★ ★ ★★★★★

Deputy Registrar,
Academic Section

Copy forwarded with compliments to :-

1] **The Principal of all concerned affiliated Colleges, Dr. Babasaheb Ambedkar Marathwada University,.**
2] **The Director, University Network & Information Centre, UNIC, with a request to upload this Circular on University Website.**

Copy to :-

1] The Director, Board of Examinations & Evaluation, Dr.BAMU,A'bad.

2] The Section Officer,[M.Sc.Unit] Examination Branch,Dr.BAMU,A'bad.
3] The Programmer [Computer Unit-1] Examinations, Dr.BAMU,A'bad.
4] The Programmer [Computer Unit-2] Examinations, Dr.BAMU,A'bad.
5] The In-charge,[E-Suvidha Kendra], Rajarshi Shahu Maharaj Pariksha Bhavan, Dr.BAMU,A'bad.
6] The Public Relation Officer, Dr.BAMU,A'bad.
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DR. BABASAHEB AMBEDKAR MARATHWADA

UNIVERSITY, AURANGABAD

FACULTY OF SCIENCE & TECHNOLOGY

2 Years P.G. Programme in Science

(M.Sc.)

As per National Education Policy-2020

Course Structure and Curriculum

(Outcome Based Credit System)

[For Affiliated Colleges]

Subject: Bioinformatics

(Effective from 2023-24)

Dean
Faculty of Science & Technology
Dr. Babasaheb Ambedkar Marathwada
University, Aurangabad

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1. Preamble

Bioinformatics is a rapidly maturing field at the confluence of biology, mathematics and computer science. It strives to better understand the molecules essential for life, by harnessing the power and speed of computers. Mathematical models and software are developed by computational biologists, who must have good skills in math and computer science. However, the working (experimental) biologist is generally a user of "black box" bio informatics software and databases, with little knowledge of the underlying algorithms. While there's no need for the working biologist to be able to be able to develop sophisticated mathematical models or design and implement novel algorithms, there is a need to understand the broad ideas of algorithms underlying the tools the biologist uses. As a working professional in the medical and life sciences, this knowledge is important to understand the scope, applicability, and limitations of certain tools -- and, who knows, you may become turned on by the idea of ferreting out biological insights by applying mathematics and computer science, and so choose to pursue further courses to become a computational biologist.

Master of Science in Bioinformatics i.e. M.Sc. (Bioinformatics) is a 2-years 4-Semesters) Post Graduate Programme of professional nature. It is primarily aimed to enable biological science graduates with bioinformatics skills for a career in the Post-Genomics era. Though, its courses cater well specifically for biological science graduates but also suited to especially inspired aspirants from other backgrounds. It is now firmly accepted that computing and information technologies applies equally well to furtherance of research on proteins, genes etc. And that the new age biological research highly driven by high-end computing and computational modelling is inevitable. The Programme includes training in the major areas of Bioinformatics. In particular, the rigorous exposure in interdisciplinary areas is aimed additionally at equipping the students with strong analytical and technical skills to work competently in diverse areas including teaching, research and developments.

Bioinformatics refers to the creation and development of databases, software, computational and statistical techniques and theory to solve

problems generated from the management and analysis of biological data. On the other hand, computational biology refers to the hypothesis based investigation of a specific biological problem using computers, carried out with experimental or simulated data, with the primary goal of discovery and the advancement of biological knowledge.

In the recent years in this age of Internet and sequenced genome we have more information at our fingertips than ever before. Organizing this entire data and combating information overload is becoming more and more important. The advent of genetic engineering vastly increased size of the information. It is thus necessary for institutes like university evolve a system, which is most accurate and more student friendly. After completion of course, there are multiple job opportunities available for bioinformatics post graduate students in national & multinational companies in the field of life sciences, information technology, software development, database administration, pharmaceutical, agricultural, health & clinical research.

2. Structure

Two-Year Post-graduate Program

Course and Credits Distribution of Two years Master's Degree Program with Entry & Exit Option

Faculty of Science & Technology

Year / level	Sem.	Major subject		RM	OJT /FP	RP	Credits	Degree
		DSC Core Mandatory	DSE (Elective)					
First year 6.0	I	3(4) +2=14	4	4			22	PG Diploma (after 3 years degree)
	II	3(4) +2=14	4		4 Complete during summer break		22	
Cum. Cr. For PG Diploma		28	08	4	4		44	
Exit option with Post-graduate Diploma (44 credits) after first year or two semester with completion of courses equivalent to 44 credits								
Second Year 6.5	III	3(4)+2=14	4			4	22	PG Degree after 3 years UG or PG Degree after 4 years UG
	IV	3(4)=12	4			6	22	
Cum. Cr. For 1 year PG Degree		26	8			10	44	
Cum. Cr. For 2 years PG Degree		54	16	4	4	10	88	
2 Years -4 sem.PG Degree (88 credits) after three year UG Degree or 1 Year -2 sem. PG Degree (44 credits) after four year UG degree								

Discipline Specific Core (DSC) –Mandatory Major: A course, which should compulsorily be studied by the student as requirement of core or major subject is termed as a core course.

Discipline Specific Core (DSE): Generally, a course which can be chosen from a pool of course and which may be very specific or specialized or advanced or supportive to the discipline/subject of study or which provides an extended scope or which enables an exposure to some other discipline/subject/domain or nurtures the candidates proficiency/skill is called as elective course.

OJT: On-the- Job Training
FP: Field Project/Internship/Apprenticeship (Corresponding to the Major (Core) Subject
RP:-Research Project Corresponding to the Major (Core) Subject

AS PER NEP 2020

Illustrative Credit distribution structure for Two Years P.G. Programme

Class: M.Sc. First Year **Semester: I**

Course type	Course Code	Course Name	Teaching Scheme (Hrs./ week)		Credits Assigned		Total Credits
			Theory	Pract.	Theory	Pract	
Major Mandatory DSC	BIOIN/MJ/500	Biological Databases & Data Analysis	2	-	2	-	14
	BIOIN/MJ/501	Concept in Computing	2	-	2	-	
	BIOIN/MJ/502	Bio-molecular structure & organization	2	-	2	-	
	BIOIN/MJ/503	Practical based on BIOIN/MJ/500	-	4	-	2	
	BIOIN/MJ/504	Practical based on BIOIN/MJ/501	-	4	-	2	
	BIOIN/MJ/505	Practical based on BIOIN/MJ/502	-	4	-	2	
	BIOIN/MJ/506	Skills in 'C' Programming	-	4	-	2	
DSE (Choose any one from pool of courses)	BIOIN/DSE/507	Basic Mathematics & Statistics or Basic Biology or Computer Hardware-I or Web Designing	2	-	2	-	04
	BIOIN/DSE/508	Practical based on BIOIN/DSE/507	-	4	-	2	
RM	BIOIN/RM/509	Research Methodology	4	-	4	-	04
			16	12	16	06	22 credits

1. **Major Mandatory (DSC)**:-

BIOIN/MJ/500: Biological Databases & Data Analysis

BIOIN/MJ/501: Concept in Computing

BIOIN/MJ/502: Bio-molecular structure & organization

BIOIN/MJ/503: Practical based on BIOIN/MJ/500

BIOIN/MJ/504: Practical based on BIOIN/MJ/501

BIOIN/MJ/505: Practical based on BIOIN/MJ/502

BIOIN/MJ/506: Techniques in 'C' Programming

2. Discipline Specific Elective (DSE): (Choose any one from Pool /Basket)

BIOIN/DSE/507:- Basic Mathematics & Statistics

or

Basic Biology

or

Computer Hardware-I

or

Web Designing

BIOIN/DSE/508:- Practical based on BIOIN/DSE/507

3. Research Methodology - BIOIN/RM/509: Research Methodology

Class: M.Sc. First Year **Semester: II**

Course type	Course Code	Course Name	Teaching Scheme (Hrs./ week)		Credits Assigned		Total Credits
			Theory	Pract.	Theory	Pract	
Major Mandatory DSC	BIOIN/MJ/550	Structural Bioinformatics	2	-	2	-	14
	BIOIN/MJ/551	Database Management System	2	-	2	-	
	BIOIN/MJ/552	Chemoinformatics	2	-	2	-	
	BIOIN/MJ/553	Practical based on BIOIN/MJ/550	-	4	-	2	
	BIOIN/MJ/554	Practical based on BIOIN/MJ/551	-	4	-	2	
	BIOIN/MJ/555	Practical based on BIOIN/MJ/552	-	4	-	2	
	BIOIN/MJ/556	Skills In JAVA & BioJAVA	-	4	-	2	
DSE (Choose any one from pool of courses)	BIOIN/DSE/557	Genetic Information Flow & Processing or Advanced Computing or Computer Hardware-II or Techniques in Experimental Biology	2	-	2	-	04
	BIOIN/DSE/558	Practical based on BIOIN/DSE/557	-	4	-	2	
OJT/FP	BIOIN/OJT/559	OJT/FP-I		4		4	04
			16	12	16	06	22 credits

1. **Major Mandatory (DSC)**:-

BIOIN/MJ/550: Structural Bioinformatics

BIOIN/MJ/551: Database Management System

BIOIN/MJ/552: Chemoinformatics

BIOIN/MJ/553: Practical based on BIOIN/MJ/550

BIOIN/MJ/554: Practical based on BIOIN/MJ/551

BIOIN/MJ/555: Practical based on BIOIN/MJ/552

BIOIN/MJ/556: Skills In JAVA & BioJAVA

2. **Discipline Specific Elective (DSE): (Choose any one from Pool /Basket)**

BIOIN/DSE/557:- Genetic Information Flow & Processing

or

Advanced Computing

or

Computer Hardware-II

or

Techniques in Experimental Biology

BIOIN/DSE/558:- Practical based on BIOIN/DSE/557

3. **OJT/FP-1: BIOIN/OJT/559:** OJT/FP-I

Class: M.Sc. Second Year

Semester: III

Course type	Course Code	Course Name	Teaching Scheme (Hrs./ week)		Credits Assigned		Total Credits
			Theory	Pract.	Theory	Pract	
Major Mandatory DSC	BIOIN/MJ/600	Molecular Phylogenetics	2	-	2	-	14
	BIOIN/MJ/601	Genomics & Proteomics	2	-	2	-	
	BIOIN/MJ/602	Immunology & Immunoinformatics	2	-	2	-	
	BIOIN/MJ/603	Practical based on BIOIN/MJ/600	-	4	-	2	
	BIOIN/MJ/604	Practical based on BIOIN/MJ/601	-	4	-	2	
	BIOIN/MJ/605	Practical based on BIOIN/MJ/602	-	4	-	2	
	BIOIN/MJ/606	Skills in Python & Bio-Python	-	4	-	2	
DSE (Choose any one from pool of courses)	BIOIN/DSE/607	LINUX for Bioinformatics or Glycoinformatics or Reverse Vaccinology or Computational Biology	2	-	2	-	04
	BIOIN/DSE/608	Practical based on BIOIN/DSE/607	-	4	-	2	
RP	BIOIN/RP-1/649	Research Project-1		8	-	4	04
			16	12	16	06	22 credits

1. **Major Mandatory (DSC)**:-

BIOIN/MJ/600: Molecular Phylogenetics

BIOIN/MJ/601: Genomics & Proteomics

BIOIN/MJ/602: Immunology & Immunoinformatics

BIOIN/MJ/603: Practical based on BIOIN/MJ/550

BIOIN/MJ/604: Practical based on BIOIN/MJ/551

BIOIN/MJ/605: Practical based on BIOIN/MJ/552

BIOIN/MJ/606: Skills in Python & Bio-Python

2. **Discipline Specific Elective (DSE): (Choose any one from Pool /Basket)**

BIOIN/DSE/607:- LINUX for Bioinformatics

or

Glycoinformatics

or

Reverse Vaccinology

or

Computational Biology

BIOIN/DSE/508:- Practical based on BIOIN/DSE/607

3. **RP: BIOIN/RP-1/649: Research Project-1**

Class: M.Sc. Second Year **Semester: IV**

Course type	Course Code	Course Name	Teaching Scheme (Hrs./ week)		Credits Assigned		Total Credits
			Theory	Pract.	Theory	Pract	
Major Mandatory DSC	BIOIN/MJ/650	Metabolomes & Metabolic Pathway Engineering	2	-	2	-	12
	BIOIN/MJ/651	Advanced Techniques in Biological Data Analysis	2	-	2	-	
	BIOIN/MJ/652	R Programming	2	-	2	-	
	BIOIN/MJ/653	Practical based on BIOIN/MJ/650	-	4	-	2	
	BIOIN/MJ/654	Practical based on BIOIN/MJ/651	-	4	-	2	
	BIOIN/MJ/655	Practical based on BIOIN/MJ/652	-	4	-	2	
DSE (Choose any one from pool of courses)	BIOIN/DSE/656	Programming in PERL & Bio-PERL or Translational Bioinformatics or Neuroinformatics or Data Science for Bioinformatics	2	-	2	-	04
	BIOIN/DSE/657	Practical based on BIOIN/DSE/656	-	4	-	2	
RP	BIOIN/RP-2/699	Research Project-2		12	-	6	06
			16	12	16	06	22 credits

1. **Major Mandatory (DSC)**:-

BIOIN/MJ/600: Molecular Phylogenetics

BIOIN/MJ/601: Genomics & Proteomics

BIOIN/MJ/602: Immunology & Immunoinformatics

BIOIN/MJ/603: Practical based on BIOIN/MJ/550

BIOIN/MJ/604: Practical based on BIOIN/MJ/551

BIOIN/MJ/605: Practical based on BIOIN/MJ/552

BIOIN/MJ/606: Skills in Python & Bio-Python

2. Discipline Specific Elective (DSE): (Choose any one from Pool /Basket)

BIOIN/DSE/607:- LINUX for Bioinformatics

or

Glycoinformatics

or

Reverse Vaccinology

or

Computational Biology

BIOIN/DSE/508:- Practical based on BIOIN/DSE/607

3. RP: BIOIN/RP-1/699: Research Project-2

3. Vision

- To empower students through the development of bioinformatics, computational & analytical skills required to excel in the field of "life sciences"

4. Mission

- To make students globally competent by training them on advanced techniques through state-of-the-art facilities.
- Facilitating skill based training in computational and statistical techniques for biological data analysis.
- Enable students to efficiently involve themselves in data ware housing and data mining.
- To familiarize and train students on all biological databases along with on-line and many advanced off-line bio molecular data analysis software.
- To provide basic to core biological knowledge to relate biological information on gene function and protein structure/function with sequence and genome.
- To enable students to work on platforms like Drug designing, Molecular Docking, Chemoinformatics, NGS data analysis, Microarray data analysis etc.
- To deliver ICT enabled teaching and learning.

5. Programme educational Objectives

- Advance knowledge through quality research in important emerging areas in the discipline and to build strong relationship with industry, academia and society.
- Able to analyse, design and implement optimized solutions for the real-world problems and become engineering professional, innovator, product developer or entrepreneur.
- Develop an ability to adapt, work as a team to implement trans-disciplinary and multidisciplinary projects using the cutting edge tools and technologies.

- Post-Graduates will be ethical and socially responsible and be able to pursue higher education/research in reputed institutions

6. Programme outcomes (POs) and Programme Specific Outcomes

- Students will learn through applying the strategies and tools used in bioinformatics to topical problems drawn from ongoing research and applications in a variety of fields.
- A number of recent workforce studies have shown that there is a high current and unmet demand for people trained to various levels of expertise in bioinformatics.
- The emergence of new Internet technologies, new and more accurate algorithms and the development of High Performance Computing coupled with DNA sequencing, serial analysis of gene expression, microarrays, and new mass spectrometry has enabled bioinformatics to address the biological problems from several different angles. It is this change in paradigm that has led to the development of Bioinformatics as a separate skill oriented discipline.
- This course provides scope for employment opportunities in various industries in the applied aspects Biotechnology, Microbiology, Molecular biology, Drug discovery and Drug design and Information technology.
- The ability to formulate mathematical models and problem-solving skills through programming techniques for addressing real-time problems using appropriate data structures and algorithms.
- The ability to design hardware and software through system programming skills based on the knowledge acquired in the system software and hardware courses.
- The ability to interpret relationships among living things and analyse the biological problems, from molecular to ecosystem level, solving those using basic biological concepts, algorithms, and tools available in computer science and to facilitate the biological database system.

7. Eligibility

- B. Sc. degree in Science (Bioinformatics, Biotechnology, Botany, Zoology, Microbiology, Physics, Chemistry, Computer Science, IT, Data Science and Agriculture)/B.E./B.Tech/B.Pharm/BCA (Sci)/Medical Science, Veterinary Science.

8. Duration

- The course will be of two years duration and shall be completed in four semesters.

9. Medium of Instruction: English

10. Attendance

- A candidate is required to put in a minimum of 75% of attendance in both theory papers practical separately in each subject before admission to the examination. This relaxation in attendance includes for medical & any other reasons approved by the head of the Institution. A candidate lacking in the prescribed attendance and progress in any one of the subjects in theory and practical in the first appearance shall not be permitted for admission to the entire examination.

11. Evaluation Methods/Scheme of Examination

- It is necessary to have uniform **pattern of 40:60 for Continuous** Assessment Test (CAT) and Semester End Theory examinations respectively for theory and practical examination **for CAT and** Semester End practical Examinations respectively, in all the university departments, and their affiliated colleges.
- **Minimum passing 40%**

12. Curriculum for semester-I

Name of Course: Biological Databases & Data Analysis

Course Code: BIOIN/MJ/500 **Course Type:** Major (DSC)

Credit: 02 **Contact Hours:** 30 **Hours/Week:** 02

Total Marks: 50

Course Objectives:

- Understand the nature of biological data and need for biological databases
- Understand and explore a few major biological databases (organization and contents).
- Search and retrieve data from the databases using their respective search engines.
- Understand the techniques and tools required for biological data analysis.

Course Outcomes:

Upon successful completion of this course, students will be able to:

- To describe the contents and properties of the most important bioinformatics databases, perform text- and sequence-based searches, and analyze and discuss the results in light of molecular biological knowledge.
- To explain the major steps in pairwise and multiple sequence alignment, explains the principle for, and executes pairwise sequence alignment by dynamic programming.
- To predict the secondary and tertiary structures of protein sequences.

Unit-1- **10**

Introduction of Bioinformatics, scope & applications, Bioinformatics Resources – NCBI, EBI, SIB, Sources of Biological data, Nature of Biological data, Biological Database-Concept & types, Nucleic Acid Sequence Databases: Genbank, EMBL, DDBJ, Protein Sequence

Databases: Swissprot, TrEMBL, PIR, Pfam. Structural Databases-PDB, NDB, MMDB, Genome Databases: EnsEMBL, UCSC Genome Browser.

Unit-2. **10**

Entrez: Concept & application, Overview of concepts in sequence analysis, pairwise and multiple sequence alignment and their and significance, Local and global sequence alignment and its algorithm, Sequence similarity search tools- BLAST-Concept, algorithm and working procedure, FASTA, Multiple sequence alignment, Clustal Omega

Unit-3. **10**

Protein structures; Primary, Secondary, Tertiary and Quaternary. Protein folding, Secondary structure prediction methods-Chou-Fasman, GOR, Jpred, Three-dimensional structure prediction Methods; Comparative modeling (Homology modeling), Fold recognition or Threading method, Ab-Initio methods, Molecular Visualization using Rasmol, Cn3D, Comparative Genomics and Proteomics.

List of Reference –Books

- Introduction to Bioinformatics: by Arthur Lesk, Oxford University press.
- Bioinformatics: Databases and Systems, by Stanley I. Letovsky
- Bioinformatics and functional genomics: by Pevzner, Wiley publication.
- Data base annotation in molecular biology, principles and practices, Arthur M. Lesk
- Current topics in computational molecular biology, Tao, Jiang, Ying Xu, Michael Q. Zang

Name of Course: Concept in Computing

Course Code: BIOIN/MJ/501 **Course Type:** Major (DSC)

Credit: 02 **Contact Hours:** 30 **Hours/Week:** 02

Total Marks: 50

Course Objectives:

- To understand concept and functions of computer
- To handle application software & to perform application specific task
- To understand the file handling concept
- To understand how computer is helpful for life science research

Course Outcomes:

Upon successful completion of this course, students will be able to:

- Identify basic terms, concepts, and functions of computer system components.
- Select and use the appropriate software application to complete a particular task such as a word Processing skills to create, save, and modify documents.
- Identify basic concepts and procedures for creating, viewing, and managing files, and folders for different operating systems.
- Identify basic concepts of organization and procedures for creating, and viewing will software presentation such as PowerPoint.
- Explain what a computer is, how it processes data, and its use to produce information in life sciences.

Unit-1- **10**

Introduction to Computer, Characteristics & features of Computers. Components of Computers. Organization of Computer. Generation of Computers, Classification of Computers. Computer Languages: Types of Programming Languages, Machine Languages, Assembly Languages, High Level Languages, Interpreter & Compiler.

Unit-2. **10**

Input Devices, Output Devices, Computer Memory, Types of computer Memory (Primary and Secondary), Storage devices & measurement of its performance, Computer Software and Types. Introduction to Microsoft Office-Word, Excel, Powerpoint, Access.

Unit-3. **10**

Operating system Concepts: Functions of Operating System, Types of Operating System, Comparison of Windows, Linux, Unix etc. Computer Networking, Network Topologies, FTP, TCP/IP Protocols, Local Area Network (LAN), Wide Area Network (WAN), Metropolitan Area Network (MAN).

List of Reference –Books

- Peter Norton, Introduction to computers, Sixth Edition Tata McGraw Hill.
- Microsoft Word, Excel, and PowerPoint: Just for Beginners by Dorothy House.
- Computer Fundamentals by P. K. Sinha.
- Fundamentals of Computer Networks by Kundu
- Fundamentals of Computers by E Balagurusamy

Name of Course: Bio-molecular Structure & Organization

Course Code: BIOIN/MJ/502 **Course Type:** Major (DSC)

Credit: 02 **Contact Hours:** 30 **Hours/Week:** 02

Total Marks: 50

Course Objectives:

- Basic physico-chemical principles involved in structural organization of macromolecules
- Organization of the structures of proteins, DNA, RNA, carbohydrates and lipids
- Experimental methods of structure determination

Course Outcomes:

Upon successful completion of this course, students will be able to:

- Understand biomolecular structure organization
- Understand principle & working of biomolecular structure determination

Methods

Unit-1- 10

Physicochemical Principles of biomolecular structure organization

Basic concepts of atom structure, hybridization of atomic orbitals, valence, covalent bonds, atomic interactions and forces, formation of polymeric molecules, Co-ordinate systems: Rectangular, Cylindrical and spherical coordinate systems, **Experimental Methods for determination of biomolecular structures-** X-ray Diffraction & NMR Spectroscopy, **Carbohydrates-**Conformations of mono and oligosaccharides and Correlation with properties, Glycoproteins, Proteoglycans and Glycolipids: Structural aspects, **Lipids & Membranes-** Membrane micro domains and organization

Unit-2. 10

DNA and RNA Structure-Base pairing in DNA & RNA, Double Helix – Organization, types and structural features, Structural & Geometric parameters associated with DNA, Secondary structures of DNA (triple helices, quadruplex, cruciform), Sequence-structure relationships in

DNA, Secondary Structures in RNA; Representations of RNA structures, Energetics of RNA structure, tRNA structure.

Unit-3. **10**

Protein Structure-Internal Coordinates – Bond lengths, bond angles, torsional angles; peptide unit, Ramachandran Map; Calculation of dihedral angles; Fourth atom fixing, Hierarchical Organization of Protein structure - Primary, Secondary, Super-secondary, Tertiary and Quaternary structure; Membrane Protein Structures, Principles of protein folding and Energetics; Mechanism of Protein folding; methods to study protein folding.

List of Reference –Books

- Creighton, T. E. Ed.: Protein Structure: A Practical Approach.
- Creighton, T.E.: Proteins: Structure And Molecular Properties. Second Edition. New York. W. H. Freeman and Company
- Creighton, T.: Protein Folding, 1992.
- Sternberg, M.I.E.: Protein structure prediction: a practical approach
- Pain, R.G.: Mechanisms of protein folding
- Leach. A.R: Molecular modelling: principles and applications
- Lehninger Principles of Biochemistry

Name of Course: Practical based on BIOIN/MJ/500

Course Code: BIOIN/MJ/503 **Course Type:** Major (DSC)

Credit: 02 **Contact Hours:** 30 **Hours/Week:** 04

Total Marks: 50

Practical:

1. Exploring bioinformatics resources: NCBI, EBI & SIB.
2. Exploring and querying the Genbank database
3. Exploring and querying the Swissprot database using Uniprot.
4. Exploring and querying the PDB database
5. Exploring and querying the EnsEMBL
6. Exploring and querying UCSC Genome browser
7. Sequence Similarity Searching using BLAST
8. Sequence Similarity Searching using FASTA
9. Pairwise sequence alignment using EMBOSS_WATER & EMBOSS_NEEDLE
10. Multiple sequence alignment using CLUSTAL OMEGA
11. Protein secondary structure prediction using SOPMA & GOR
12. Protein 3D structure prediction using SWISSMODEL
13. Protein 3D structure prediction using PHYRE
14. Protein 3D structure prediction using ROBETTA
15. Protein 3D structure visualization using RASMOL & Cn3D.

Name of Course: Practical based on BIOIN/MJ/501

Course Code: BIOIN/MJ/504 **Course Type:** Major (DSC)

Credit: 02 **Contact Hours:** 30 **Hours/Week:** 04

Total Marks: 50

Practical:

1. Handling of Windows OS
2. Open MS-DOS window, Change drive to C: drive, create new directory & Create a file COPY CON FILE1.TXT and Copy FILE1.TXT and make a file2.txt, file3.dat, file4.xyz, file5.txt.
3. Basic LINUX commands
4. Installation of bioinformatics software in LINUX system
5. Compute the division of each and every student of a class by using MS-EXCEL
6. To compute mean/median/mode by using MS-EXCEL
7. Create a Student database in Design View, by using Wizard, and by entering data by using MS-ACCESS.
8. Create a query on Student database in design view and by using wizard MS-ACCESS
9. Create and Design biological sequence submission forms (BANKIT) using MS WORD
10. Use smart art and create PLANTDB charts and showcase relations (https://www.researchgate.net/figure/Database-schema-for-PlantGDB-showing-data-sources-update-frequency-computation-and-web_fig1_5783898) using MS WORD.
11. Practice hyperlinking and creating links between word document texts to D: /, Play songs from Microsoft word text, and create the link between internal and external files.
12. Calculate Sum and Average of sequence entries present databases maintained by NCBI

13. Create table of provided ER diagram (https://www.marquette.edu/~owt/access/ex1.pdf). Only the primary keys and the intersection data are shown in the diagram. How could you implement it using Access? Use Relational Model using MS ACCESS.

14. Make a presentation on "Wild Life" and apply the following: (MS-POWERPOINT)

Add audio and video effects

Apply various Color Schemes

Apply various animation schemes.

Apply Slide Show

15. Create a document and (MS-WORD)

a. Put Bullets and Numbers
b. Apply various Font parameters.
c. Apply Left, Right, and Centre alignments.
d. Apply hyperlinks
e. Insert pictures
f. Insert ClipArt

Name of Course: Practical based on BIOIN/MJ/502

Course Code: BIOIN/MJ/505 **Course Type:** Major (DSC)

Credit: 02 **Contact Hours:** 30 **Hours/Week:** 04

Total Marks: 50

Practical:

1. Exploring & querying Protein Data Bank
2. Exploring & querying Nucleic Acid Databank
3. Visualization of protein 3D structures using (SWISS-PDB Viewer, Discovery Studio)
4. Exploring & querying Carbohydrate Structure Database - CSDB Glycoscience
5. Exploring & querying LIPID MAPS® Structure Database (LMSD)
6. Calculation of structural parameters of Proteins
7. Computational generation of Ramachandran Plot
8. Calculation of structural parameters of DNA
9. Calculation of structural parameters of RNA
10. Calculation of structural parameters of Carbohydrates
11. Calculation of structural parameters of Lipids
12. Understanding Macromolecular interactions through visualisation
13. Structure analysis-Protein – Protein
14. Structure analysis-Protein – Nucleic acids
15. Structure analysis-Protein - carbohydrates

Name of Course: Skills in C Programming

Course Code: BIOIN/MJ/506 **Course Type:** Major (DSC)

Credit: 02 **Contact Hours:** 30 **Hours/Week:** 04

Total Marks: 50

Practical:

1. Create, compile, debug, run and test simple C programs
2. Using different data types available in C, perform arithmetic operations in C, perform formatted input/output operations, and perform character input/output operations.
3. Using relational operator, logical operator, assignment operator, ternary operator, and other operators. Evaluation of Expression to check operator precedence and associativity.
4. Create decision making programs using control statements like; if, if..else, if..else ladder, nested if, and switch cases.
5. Create programs using loops (for, while, do while, nested loops) and realize the differences between entry controlled and exit controlled loops.
6. Create, manipulate arrays and matrices (single and multi-dimensional), work with pointers, dynamically allocate/de-allocate storage space during runtime, manipulate strings (character arrays) using various string handling functions.
7. Create user-defined functions with/without parameters or return type, create recursive functions, use function call by value and call by address, work with automatic, global and static variables.
8. Create and use simple structures, array of structures, nested structure. Passing structure and array of structure to function, concept of pointer to structure
9. Create programs that addresses pointer arithmetic, pointers and arrays, pointer and character strings, pointers and functions, pointer and structure, and dynamic memory allocation.
10. Create files that address random access and input/output operations in file, create files to keep records and manipulation of records etc.

11. Determining the base composition in a nucleic acid sequence and amino acid composition in a protein sequence using C program
12. Generating the complimentary sequence of a DNA sequence
13. Locate palindromic sequence stretches in a DNA sequence.
14. Translate a DNA sequence into protein sequence in the forward and reverse frames.
15. To calculate G+C & A+T percentage in given genomic sequences using C program.

DISCIPLINE SPECIFIC ELECTIVES (DSE)
(Choose any one from pool of courses)

Name of Course: Basic Mathematics & Statistics

Course Code: BIOIN/DSE/507 **Course Type:** DSE

Credit: 02 **Contact Hours:** 30 **Hours/Week:** 02

Total Marks: 50

Course Objectives:

- This course will enable the students to achieve skills in statistics and mathematics that are essential for application in bioinformatics.

Course Outcomes:

Upon successful completion of this course, students will be able to:

- Gain statistical & mathematical skills required for bioinformatics applications.

Unit-1- 10

Introduction to Set Theory, Trigonometry-Trigonometric Functions, Series Expansion, Inverse, General Values, Graphs, Taylor series, Vector & Matrices, Vector Algebra, Vector Calculus, Basic Computations, Matrices, Calculus-Limits, Continuity, Analysis, Differentiation (1D & Partial), Reimann Integration, Definite Integrals, Ordinary & Partial Differential Equation, 1st Order & 2nd Order Ordinary Differential Equations. Self-Adjoint Equations, Method of Separation of Variables.

Unit-2- 10

Integral transform-Fourier series, Fourier Transform, Laplace Transform, Overview of applications of statistics in Bioinformatics, Introduction to principles of statistical sampling from a population, Frequency Distributions and Statistical Measures: mean, mode, median, variance, standard

deviation, coefficient of variation, measures of skewness and kurtosis. Computation of these measurements for the given data.

Unit-3- **10**

Introduction to theory of Probability, Conditional Probability, Bayesian Rules, Random variable, Distributions of random variables, Binomial, Poisson, Geometric, Normal and extreme value distribution, Regression, correlation, fitting regression line, Hypothesis testing-Test of significance viz. Z test, t test, paired t test, chi2 test of goodness of fit.

List of Reference –Books

- Isaev Alexander. Introduction to Mathematical Methods in Bioinformatics. Publisher: Berlin; New York: Springer, ISBN: 3540219730
- Raman K. V. & Pal Sourav. Mathematics in Chemistry. New Delhi, Vikas Publishing House Pvt Ltd., ISBN: 8125912886
- Jones D.S., Sleeman B.D. Differential Equations and Mathematical Biology Publisher: Chapman & Hall. ISBN:1584882964
- Bracewell Ronald. The Fourier transform and its applications 3rd edition. Publisher: New Delhi: McGraw Hill, ISBN: 0073039381.

Name of Course: Basic Biology

Course Code: BIOIN/DSE/507 **Course Type:** DSE

Credit: 02 **Contact Hours:** 30 **Hours/Week:** 02

Total Marks: 50

Course Objectives:

- Understand the basic principles of biology.
- Appreciate the basic nature and diversity of microbial, plant and animal life.
- Understand the classification of organisms and taxonomy.

Course Outcomes:

Upon successful completion of this course, students will be able to:

- The process of evolution of life
- Classify organisms by analysing their morphological features
- Understand the biology of virus.

Unit-1- 10

Origin and evolution of Life: Living and non-living things; theories and evidences of origin and evolution of life, **Unit of life**: Basic unit of life; prokaryotic cell, eukaryotic cell, plant cell and animal cell; structure and functions.

Unit-2- 10

Diversity of life: Classification of organisms- five-kingdom classification (Monera, Protista, Fungi, Plantae and Animalia); classification and characteristics of different kingdoms; Biodiversity- hotspots of biodiversity; threats to biodiversity.

Unit-3- 10

Ecology and nutrition: Biotic and abiotic components; food chain; trophic levels; food webs; ecological pyramids; ecosystems- structure, types of ecosystem, **Viruses:** Biology of viruses; bacteriophages, plant and animal viruses

List of Reference –Books

- Wallace Robert A., Sanders Gerald P., Ferl Robert J. The science of life. Publisher: New York, NY: Harper Collins, ISBN: 0673380440.
- Solomon Eldra P., Berg Linda R., Martin Diana W. Biology 6th edition. Publisher: Pacific Grove, CA, Brooks/Cole Thomson Learning, ISBN: 0030335035.
- Recknagel F. Ecological Informatics: Understanding Ecology by Biologically

  Inspired Computation, Springer, New York.
- Odum E.P. Basic Ecology. Saunders International Edition, Japan.
- The Cell: A Molecular Approach (5th edition) by Cooper, G.M. and Hoffman, R.E., A. S. M. Press.

Name of Course: Computer Hardware-I

Course Code: BIOIN/DSE/507 **Course Type:** DSE

Credit: 02 **Contact Hours:** 30 **Hours/Week:** 02

Total Marks: 50

Course Objectives:

- To understand the architecture of computer
- To understand the BIOS system
- To understand computer management system

Course Outcomes:

Upon successful completion of this course, students will be able to:

- Handle hardware of computers
- Maintain & troubleshooting the computer system

Unit-1- 10

Description of Different parts of a computer. Idea about System Software and Application Software. Operating system concept (Basic knowledge), Fundamentals of Electricity, About AC and DC, How AC is converted into DC in a Computer, Introduction to SMPS & UPS- SMPS Features, Functions, Types of SMPS, Power distribution in SMPS, Components and Circuits inside the SMPS Unit, Types of UPS Offline, Line Interactive & Online, Working Principle of each type of UPS, Connecting, Maintenance and Troubleshooting.

Unit-2- 10

Introduction to Basic Input Output System, Introduction to BIOS/CMOS Setup, POST (Power on Self-Test), Demonstration of BIOS/CMOS Configuration (Date, Time, Enable/Disable Devices), Dual BIOS Feature BIOS/CMOS Setup, Booting Sequence/Boot Order, Introduction to Operating System- Process of Booting the Operating System, Installation of Windows 8.1, 10, 11 Activation and Automatic Updating procedures, Installation of Linux Server and Creating groups with file/ resource permission.

Unit-3- **10**

Computer Management- Computer Management, Disk Management, Defragmentation, Advanced System Settings, Device Manager, Task Manager, Windows Registry, Disk Partitioning- Partitioning of Hard Drive/ SSD - Primary, Extended, Logical partitions using Partition Tools in Windows, Partitioning of Hard Drive/ SSD - Primary, Extended, Logical partitions using Partition Command (mkpart) in Linux.

List of Reference –Books

- Upgrading and Repairing PCs by Scott Mueller
- Computer Architecture: A Quantitative Approach by John L. Hennessy
- The Elements of Computing Systems: Building a Modern Computer from First Principles by Noam Nisan
- Understanding Electronics by R.H. Warring
- Electricity and Basic Electronics by Stephen R. Matt

Name of Course: Web Designing

Course Code: BIOIN/DSE/507 **Course Type:** DSE

Credit: 02 **Contact Hours:** 30 **Hours/Week:** 02

Total Marks: 50

Course Objectives:

- To understand the principle of HTML
- To gain the knowledge required for Web designing
- To create website

Course Outcomes:

Upon successful completion of this course, students will be able to:

- Understand practical concept of web designing

Unit-1- 10

Basic principles involved in developing a web site, Planning process, rules of web designing, designing a vigation bar, Page design, Home Page Layout, Design Concept, Brief History of Internet, what is World Wide Web, Why create a website, Web Standards, What is HTML, HTML Documents, Basic structure of an HTML document, Creating an HTML document, Markup Tags, Heading-Paragraphs, Line Breaks, Introduction to elements of HTML, Working with Text, Working with Lists, Tables and Frames, Working with Hyperlinks, Images and Multimedia, Working with Forms and controls.

Unit-2- 10

Concept of CSS, Creating Style Sheet, CSS Properties, CSSS tyling (Background, Text Format, Controlling Fonts), Working with block elements and objects, Working with Lists and Tables, CSS Id and Class, CSS Color, Javascript Basics, Javascript Events, Javascript conditions and loop control structures, Alert, Prompt and Confirm statements, Javascript validation

Unit-3- 10

Creating the WebSite, Saving the site, working on the website, Creating website structure, Themes-Publishing web sites. History, Fundamentals of Bootstrap, Bootstrap Grid System, Bootstrap Form and Form Components,

Introduction Jquery, Element Selector, Document ready function, Events, Event handling with Html or Bootstrap components.

List of Reference –Books

- Kogent Learning Solutions Inc. HTML 5 in simple steps Dreamtech Press
- Murray,Tom/Lynchburg Creating a Web Page and Web Site College
- Steven M. Schafer HTML, XHTML, and CSS Bible, 5ed Wiley India
- John Duckett Beginning HTML, XHTML, CSS, and JavaScript Wiley India
- Ian Pouncey, Richard York Beginning CSS: Cascading Style Sheets for Web Design Wiley In.

Name of Course: Practical based on BIOIN/DSE/507

Course Code: BIOIN/DSE/508 **Course Type:** DSE

Credit: 02 **Contact Hours:** 30 **Hours/Week:** 04

Total Marks: 50

Practical:

1. Graphical representation of data.
2. Problems based on measures of central tendency.
3. Problems based on measures of dispersion.
4. Problems based on moments, skewness and kurtosis.
5. Karl Pearson and rank correlation coefficient.
6. Lines of regression, angle between lines and estimated values of variables.
7. Calculate price and quantity index numbers using simple and weighted average of price relatives.
8. Applications of differential equations in bioinformatics
9. Problems based on binomial distribution
10. Problems based on Poisson distribution
11. Problems based on Normal distributions.
12. Testing of significance and confidence intervals for single mean and difference of two means and paired tests.
13. Testing of significance and confidence intervals for difference of two standard deviations.
14. Exact Sample Tests based on Chi-Square Distribution.
15. Problems on T test & F test

Name of Course: Practical based on BIOIN/DSE/507

Course Code: BIOIN/DSE/508 **Course Type:** DSE

Credit: 02 **Contact Hours:** 30 **Hours/Week:** 04

Total Marks: 50

Practical:

1. Morphological study of representative member of Algae
2. Morphological study of bryophytes
3. To study anatomy bryophytes
4. To study reproductive structures of bryophytes
5. Study of important fossil gymnosperms from prepared slides and specimens.
6. To study prokaryotic cell
7. To study Eukaryotic cell
8. To study animals on the basis of their external features
9. Evaluate the effect of environmental factors variations on the ecological characteristics of an ecosystem.
10. Using random sampling to measure the abundance of various different species on an area of grassland

Name of Course: Practical based on BIOIN/DSE/507

Course Code: BIOIN/DSE/508 **Course Type:** DSE

Credit: 02 **Contact Hours:** 30 **Hours/Week:** 04

Total Marks: 50

Practical:

1. Identification of different Components of a computer and demonstration and uses of them.
2. Different Tools / equipment used for assembling/ disassembling a PC.
3. Demonstrations of the power flow inside a computer through slides/ PPT
4. Identification of the power source, coloured wires of interest etc.
5. A running SMPS demonstration
6. Installation of a SMPS on a cabinet
7. Isolated Power testing by sorting.
8. Live UPS Demonstration.
9. Changing dead battery from an UPS. Demonstration of BIOS / CMOS setup, POST in a Computer step by step.
10. Installation of different types of OS & Hands on practices of basic Dos command in cmd prompt.

Name of Course: Practical based on BIOIN/DSE/507

Course Code: BIOIN/DSE/508 **Course Type:** DSE

Credit: 02 **Contact Hours:** 30 **Hours/Week:** 04

Total Marks: 50

Practical:

1. Introduction to HTML Tags :- Working of Web browser, Introduction to static Web pages and dynamic web pages, HTML body structure, HTML Tags:- Elements, Attribute, Heading tag, Paragraph tag, Formatting tags (Bold text, Important text, Italic text, Emphasized text, Marked text, Small text, Deleted text, Inserted text, Subscripts, Superscripts), Background color, image, font color, effects, Table tag List.
2. Advanced HTML tags: - Frames iframes, anchor tag, Multimedia
3. Create Static Website by using all HTML Tags.
4. Introduction to Internal CSS
5. Introduction to External CSS
6. HTML Form tags(Elements, Attributes, properties, etc)
7. Introduction to JAVA Script(Programming basics)
8. Advance JAVA Script programming basics (Alert, Confirm, prompt) and Validations.
9. Create 3 Web page using Bootstrap framework use bootstrap table, image and form elements etc.
10. Create the web page using Jquery effects, events on different elements

Name of Course: Research Methodology

Course Code: BIOIN/RM/509 **Course Type:** RM

Credit: 04 **Contact Hours:** 60 **Hours/Week:** 04

Total Marks: 100

Course Objectives:

- To define research and describe the research process and research methods
- To understand qualitative research and methods used to execute and validate qualitative research
- To know how to apply the basic aspects of the research process in order to plan and execute a research project.
- To provide insight into the processes that lead to the publishing of research.
- To be able to present, review and publish scientific articles

Course Outcomes:

Students will be able to -

- Understand and explain research process
- Do systematic literature survey, formulation of a research topic, study design, analysis and interpretation of data.
- To design a research approach for a specific research issue of their choice.
- Select a suitable analytical method for a specific research approach.
- Demonstrate a good understanding of how to write a research report.
- Critically assess published quantitative research with regard to the statistical methods and approaches adopted
- Create a research document for implementation research project

Course Contents:

Part – 1 (02 credit : 30 Contact Hours)

Unit - I: Research Fundamentals and Identification of Research Problem: (10 Hrs.)

Research Fundamentals

Introduction: Definition, objectives of the research, characteristics of the research, what makes people to do research, importance of research, Qualitative and Quantitative Research: Qualitative research -

Quantitative research - Concept of measurement, causality, generalization, and replication. Merging the two approaches.

Identification of Research Problem

Defining the research problem: Identification of research problems, selection of research problem, facts one should know regarding selection of research problem, the process of research problem definition, some facts involved in defining research problem, Research Design: Concept and Importance in Research - Features of a good research design - Exploratory Research Design - concept, types and uses, Descriptive Research Designs - concept, types and uses. Experimental Design: Concept of Independent & Dependent variables, Case Studies,

Unit - II: Formulation of Research Problem (10 Hrs.)

Formulation of the problems: steps involved in defining a problem, formulation of the problems, Formulation of hypothesis: Concept of hypothesis, hypothesis testing, developing the research plan: implementation, interpreting and reporting the findings, Importance of hypothesis in decision making, Case Studies. Interpretation of Data. Measurement: Concept of measurement- what is measured? Problems in measurement in research- Validity and Reliability. Levels of measurement Nominal, Ordinal, Interval, and Ratio.

Unit – III: Research Report and Proposal Writing (10 Hrs.)

Introduction, research proposal writing: costing, the research proposal, rationale for the study, research objectives, research methodology, target respondents, research Centres, sample size and sample composition, sampling procedures, research project execution, research units; An insight into research report and proposal, research project synopsis, research report writing : types of research reports, guidelines for writing reports; Steps in writing report, report presentation, typing the report, documentation and bibliography, formatting guidelines for writing a good research report / research paper, Paper Writing- Layout of a Research Paper, Journals in Computer Science, Impact factor of Journals, When and where to publish ? Ethical issues related to publishing, Plagiarism and Self-Plagiarism. Case Studies.

Part – 2 (02 credit : 30 Contact Hours)

Presentations, case studies, Assignments, Tutorials based on Module I to III **(30 Hrs.)**

Students are expected to do the Followings

i) Select Broad topic of Research Project (to be implemented from second semester onwards)
ii) Read the Basic concepts / fundaments of broad topic
iii) Identify 10 SCOPUS / WEB OF SCIENCE Indexed Journals related to broad topic
iv) Search and download 20 research articles from above research Journals
v) Do systematic review of above 20 research articles
vi) While doing review of each of above mentioned 20 research articles, students are expected prepare notes on following points
   a) What are the objectives of the research article?
   b) What methodology has been adopted?
   c) What are prominent results?
   d) How these results of relevant to the latest development of the subject?
   e) What is novelty of research article?
   f) What are prominent shortcomings of this research a presented in this research article?
   g) What are your plans to address those shortcoming?

vii) Draft the fine-tuned title of research project
viii) Draft hypothesis
ix) Draft Objectives and Methodology
x) Draft expected outcome of the research project

At the end of the assignment, students are expected to prepare a report having following points

i) Fine-tuned title of Research Project
ii) Fundamental aspects of the fine-tuned research topic
iii) Hypothesis
iv) Objectives
v) Methodology
vi) Detailed Experimental plan
vii) Expected outcome
viii) References

References:

- Research Methodology by Dr. S. L. Gupta, Hitesh Gupta; International Book House Pvt Ltd **(2013),** ISBN-10: 8191064278, ISBN-13: 978-8191064278
- Basic Research Methods-Gerard Guthrie SAGE Publications, India, Pvt Ltd, New Delhi **(2010),** ISBN-10: 8132104579, ISBN-13: 978-8132104575
- Research Methodology-methods and techniques By C. R. Kothari, New Age International Publishers **(2011)** ISBN 978-81-224-1522-3
- Principles of Research Methodology- Phyllis G. Supino, Jeffrey S. Borer; Springer, Verlag New York **(2012),** ISBN-ebook: 1461433592, ISBN (Hardcover): 978-1461433590
- Research Design Qualitative, Quantitative. and Mixed Methods Approaches- John W. Creswell; SAGE Publications Ltd, UK **(2011),** ISBN-9780857023452
- Research Methodology -A Step-by-Step Guide for Beginners- Ranjit Kumar; Sage Publications Ltd **(2010)**, ISBN- 1849203016.
- Scientific Writing and Communication- Angelika Hofmann; Oxford University Press, US **(2010),** ISBN-13-: 978-0 199947560, ISBN-10: 01 99947562
- Writing Science: How to Write Papers That Get Cited and Proposals That Get Funded- Joshua Schimel, Oxford University Press, **(2011)**, ISBN: 9780199760237
- Handbook of Scientific Proposal Writing- A.YavuzOruc; CRC Press, Taylor & Francis group **(2011)**, ISBN: 9781439869185

13. Curriculum for semester-II

Name of Course: Structural Bioinformatics

Course Code: BIOIN/MJ/550 **Course Type:** Major (DSC)

Credit: 02 **Contact Hours:** 30 **Hours/Week:** 02

Total Marks: 50

Course Objectives:

- To know how three dimensional structures can be analysed for gaining insights into functions and other biological aspects
- To know the computational approaches for structure analysis
- To acquire knowledge of various algorithms & methods for structure prediction
- To understand the principles of macromolecular interactions

Course Outcomes:

Upon successful completion of this course, students will be able to:

- Understand 3D structures of protein
- Understand various computational approaches for structural analysis.

Unit-1- **10**

Overview of Structural Bioinformatics, Prediction of protein structure, secondary structure prediction methods, First, second and third generation methods-Tertiary structure prediction-Homology modelling.

Unit-2. **10**

Fold Recognition: 1D-3D Profile-based methods, threading method, ab *initio* methods, Alphafold. Structural alignments of proteins, Superimposition of structures & calculation of RMSD, Vector-based, distance matrix-based and combined algorithms for structural alignments, Structure-based classification of proteins: SCOP & CATH

Unit-3. **10**

Prediction of binding pockets on protein structures, Structure-based function Prediction, Prediction of RNA structures, Molecular interactions between biomolecules, Introduction to Molecular docking, molecular dynamics & simulation.

List of Reference –Books

- Forbes Burkowski. Structural bioinformatics: An algorithmic approach. Publisher: CRC Press, ISBN: 9781584886839.
- Drenth Jan. Principles of Protein X-Ray Crystallography. Publisher: Netherlands, Springer Science. ISBN: 9780387333342.
- Bourne Philip E., Weissig Helge. Structural Bioinformatics (Methods of Biochemical Analysis, V. 44), Publisher: Wiley-Liss. ISBN: 0471202002.
- Leach, Andrew. Molecular Modelling: Principles and Applications. Publisher: PrenticeHall. ISBN: 0582239338.
- Friesner Richard A. Computational Methods for Protein Folding: advances in Chemical Physics Volume 120 Kindle Edition. Publisher: New York, John Wiley & Sons. ISBN: 0471209554.
- Branden ,Tooze John. Introduction to Protein Structure. Publisher: New York, Garland Publishing Inc. ISBN: 0815323050.

Name of Course: Database Management System

Course Code: BIOIN/MJ/551 **Course Type:** Major (DSC)

Credit: 02 **Contact Hours:** 30 **Hours/Week:** 02

Total Marks: 50

Course Objectives:

- Understand the concepts of data, data models and relationships be aware of various data representation techniques and various types of databases
- Appreciate and implement relational database design create the database systems with user-friendly front-ends for fast and efficient data retrieval and storage
- Acquire the skills of using MySQL, SQL and basic skills in creating front end applications

Course Outcomes:

Upon successful completion of this course, students will be able to:

- Demonstrate the basic elements of a relational database management system.
- Identify the data models for relevant problems.
- Extend normalization for the development of application software's.

Unit-1- 10

Introduction to DBMS: Applications, Purpose of Database Management System, Database Architecture: 3-Level architecture, Database Users & Administrators Functional Components of Database system: Storage & Query Processor, Transaction Management. Type of Data Model: Relation Data Model, E-R Data Model, Object Based Data Model Semi-Structured Data Model, Hierarchical Data Model and Network Data Model E-R. Data Model: Entity, Entity set, Entity types, Attributes, Types of Attributes, E-R diagram. Mapping Cardinalities, Data Association, Specialization, Aggregations and Integrity constraints

Unit-2. **10**

Functional Dependencies and Normalization: First Normal Form (INF), Second Normal Form (2NF), Third Normal Form (3NF), and Boyce-Codd Normal Form (BCNF). Relational Algebra Operations – Select, Project, Rename, Union, Intersection, Set Difference, Join, and Division Operations.

Unit-3. **10**

SQL: Introduction to SQL, Data Types, DDL: create, alter, drop, DML: insert, select, update, delete, DML Queries with where clause, TCL: commit, rollback, savepoint, DCL: grant, revoke, Key Constraint: not null, Primary Key, Foreign Key, Renaming Attributes, Aggregate Functions, Join Operations. Logical Operator

List of Reference –Books

- Fundamentals of Computers by V.Rajaraman, PHI Publication, IVth Edition.
- Computer Organisation by Hamacher,
- Fundamentals of Information Technology By Chetan Srivastava
- Database System concepts: Korth, Siberschatz,
- An Introduction to Database Systems by Date, C.J., Addison Wesley Publishers.
- Fundamentals of Database Systems by Elmasri and Navathe, Addison Wesley Publishers.

Name of Course: Chemoinformatics

Course Code: BIOIN/MJ/552 **Course Type:** Major (DSC)

Credit: 02 **Contact Hours:** 30 **Hours/Week:** 02

Total Marks: 50

Course Objectives:

- To understand the representation and use of chemical information on computer
- To appreciate the complementary aspects of chemoinformatics and bioinformatics

Course Outcomes:

Upon successful completion of this course, students will be able to:

- Understand 2D, 3d representation of chemical compound
- Understand the techniques of chemical structure searching
- Perform QSAR

Unit-1- 10

Introduction to Chemoinformatics-Scope & applications, Representation of chemical compounds: 1D, 2D, 3D, SMILES, InChI, Fingerprints (Daylight), Matrices, Connection Tables, MOL & SDF files, Markush structures, Rotatable bonds and conformers, Molecular surfaces. Representation of reactions: SMARTS, SMIRKS, Matrices.

Unit-2. 10

Searching chemical structures: Exact (Canonicalizing SMILES: Morgan, CANGEN), Substructure, Superstructure and Similarity search (Tanimoto, Euclidean and Tversky index), Clustering small molecules: Hierarchical and non-hierarchical methods, 3D pharmacophore based searching: Common Pharmacophore features, building, hypotheses and searching databases. Chemical Databases: CSD, Pubchem, other relevant databases, Information content and applications Data mining.

Unit-3. **10**

Quantitative Structure Activity Relationship (QSAR), Structure descriptors: topological and shape indices, Training and test data set, Applicability domain, 2D QSAR, Combinatorial chemistry and Library Design- Historical methods: Mix and Split library design and Iterative deconvolution, Computer based methods, Diversity analysis, Lipinski Rules, Tools for cheminformatics algorithm development

List of Reference –Books

- Gasteiger Johann, Engel Thomas. Chemoinformatics: A Textbook. Publisher: Wiley-VCH.
- Leach Andrew R., Valerie J. Gillet. An introduction to chemoinformatics. Publisher: Kluwer academic, ISBN: 1402013477.
- Gasteiger Johann, Handbook of Chemoinformatics: From Data to Knowledge (4 Volumes). Publisher: Wiley-VCH. ISBN: 3527306803.
- Muthukumarasamy Karthikeyan, Renu Vyas. Practical Chemoinformatics. Publisher: Springer. ISBN: 9788132217794
- Bajorath Jürgen. Chemoinformatics and computational chemical biology. Publisher: Humana Press. ISBN: 9781607618386

Name of Course: Practical based on BIOIN/MJ/550

Course Code: BIOIN/MJ/553 **Course Type:** Major (DSC)

Credit: 02 **Contact Hours:** 30 **Hours/Week:** 04

Total Marks: 50

Practical:

1. Model building of nucleic acid, protein and organic molecules using the MoluCAD.
2. Hands on molecular visualization tools-Rasmol
3. Hands on molecular visualization tools Cn3D
4. Hands on molecular visualization tools SPDBViewer
5. Protein primary structure analysis using PROTPARAM
6. Protein secondary structure prediction by using SOMPA & GOR
7. Three dimensional structure prediction by using the homology modelling, threading & ab initio method
8. Energy calculation of the biomolecules using molecular mechanics and quantum mechanics using ArgusLab.
9. Molecular Docking of protein and ligand by using Autodock.
10. Energy Minimization, Molecular dynamics (MD) simulation using AMBER

Name of Course: Practical based on BIOIN/MJ/551

Course Code: BIOIN/MJ/554 **Course Type:** Major (DSC)

Credit: 02 **Contact Hours:** 30 **Hours/Week:** 04

Total Marks: 50

Practical:

1. Design a Database and create required tables. For e.g. Genbank, College Database
2. Apply the constraints like Primary Key, Foreign key, NOT NULL to the tables.
3. Write a sql statement for implementing ALTER, UPDATE and DELETE
4. Write the queries to implement the joins
5. Write the query for implementing the following functions: MAX (), MIN (), AVG (), COUNT ()
6. Write the query to implement the concept of Integrity constrains
7. Write the query to create the views
8. Perform the queries for triggers
9. Perform the following operation for demonstrating the insertion, updation and deletion using the referential integrity constraints with reference to biological database.
10. Write the query for creating the users and their role

Name of Course: Practical based on BIOIN/MJ/552

Course Code: BIOIN/MJ/555 **Course Type:** Major (DSC)

Credit: 02 **Contact Hours:** 30 **Hours/Week:** 04

Total Marks: 50

Practical:

1. To access small molecules 3D structure by accessing PUBCHEM.
2. To access small molecules 3D structure by accessing DRUGBANK
3. Model building of organic molecules (Drug Like) using the ChemSketch.
4. Similarity searching of small drug like molecules using ChemMine Tool
5. Virtual screening analysis of small drug like molecules using DrugMint
6. Evaluation of pharmacokinetics and drug likeliness of small molecules using SwissADME.
7. Drug target prediction using SwissTargetPrediction.
8. 3D structure prediction of drug target using online servers.
9. To perform interaction between ligand & receptor using molecular docking tools available on web.
10. To generate 3D ligand & receptor interaction diagrams using LigPlot+.

Name of Course: Skills in JAVA & BioJAVA

Course Code: BIOIN/MJ/556 **Course Type:** Major (DSC)

Credit: 02 **Contact Hours:** 30 **Hours/Week:** 04

Total Marks: 50

Practical:

1. Develop a program to declare a class 'student' having data members name, roll_no and percentage. Accept and display this data for one object.
2. Write a program to insert an element (specific position) into an array.
3. Write a program that creates box Object and use constructor and method overloading and return result to calling method.
4. Write a program that extends box class and add color information in extended class and display color information with volume of the box.
5. Write a Program to handle Arithmetic exception using try - catch statement.
6. Write a Program to create multiple threads.
7. Write a Program to make a simple moving banner applet.
8. Write a program for creating, opening, closing, reading and writing a file.
9. Write a Program to make a package.
10. Write a class called MyCalculator which implements the interface.

    divisorSum function just takes an integer as input and return the sum of all its divisors. For example divisors of 6 are 1, 2, 3 and 6, so divisor_sum should return 12.
11. Installation of BioJava and their packages
12. Using BioJava package, perform sequence similarity searching

DISCIPLINE SPECIFIC ELECTIVES (DSE)
(Choose any one from pool of courses)

Name of Course: Genetic Information Flow & Processing

Course Code: BIOIN/DSE/557 **Course Type:** DSE

Credit: 02 **Contact Hours:** 30 **Hours/Week:** 02

Total Marks: 50

Course Objectives:

- To impart detailed understanding of key events of molecular biology comprising of mechanism of DNA Replication, Transcription and Translation in Prokaryotes and Eukaryotes.
- To provide adequate knowledge about Post Transcriptional Modifications and Processing of Eukaryotic RNA

Course Outcomes:

Upon successful completion of this course, students will be able to:

- It deals with understanding the molecular aspects of the biology.
- It majorly emphasizes the concepts of central dogma of molecular biology spanning from DNA Replication till Protein Synthesis and Reverse transcription.
- It also helps in understanding the concepts of cellular function

Unit-1- 10

Bacterial, eukaryotic & extrachromosomal replicons, Replication in prokaryotes- –Escherichia coli replication as role model, DNA polymerases –with reference to their functional properties, formation of replication fork, primer formation, replication on leading and lagging strand, termination of replication. Eukaryotic DNA replication: Origin Recognition Complex, Licensing factor, components of replicase and other polymerases. Replication fork –experimental proof for multiple replication forks in eukaryotes. Process of replication, initiation, elongation and termination & their regulation. Extrachromosomal DNA replication.

Unit-2. **10**

Prokaryotic transcription- Transcription in Escherichia coli a role model for prokaryotes –RNA polymerase, structural components and assembly of core and holoenzyme, process of initiation, elongation & termination, antiterminators from bacteria & bacteriophages, Eukaryotic Transcription-RNA polymerase, mechanism and elements involved in initiation, elongation & termination.

Unit-3. **10**

Outline of Translation, The Genetic Code, The Decoding System, Codon Anticodon interaction, the special properties of the prokaryotic Initiator tRNAfMet, Transfer RNA genes, Protein Synthesis in prokaryotes and eukaryotes - formation of initiation complex, initiation factors and their regulation, elongation and elongation factors, termination, aminoacylation of tRNA, tRNA-identity, aminoacyltRNA synthetase, translational proofreading, suppressors, Inhibitors and Modifiers of protein synthesis.

List of Reference –Books

- Molecular Biology of the Gene by Watson James D., Baker Tania A., Bell Stephen P., Gann Alexander, Levine Michael, Losick Richard
- The World of the Cell by Wayne M. Becker, Lewis J. Kleinsmith, Jeff Hardin, Gregory Paul Bertoni
- Cell And Molecular Biology by De Robertis E.D.P.
- Karp's Cell and Molecular Biology by Gerald Karp, Janet Iwasa, Wallace Marshal

Name of Course: Advanced Computing

Course Code: BIOIN/DSE/557 **Course Type:** DSE

Credit: 02 **Contact Hours:** 30 **Hours/Week:** 02

Total Marks: 50

Course Objectives:

- To make effective use of advanced Linux/Unix commands and PHP scripting
- To perform advanced tasks in parallel computing environment

Course Outcomes:

Upon successful completion of this course, students will be able to:

- Handle shell scripting
- Understand the concept of regular expression
- Handle PHP

Unit-1- **10**

Shell Scripting

Shell Basics, Writing and executing scripts, Conditional statements-If-else-elif, Test command, Logical operators-AND, OR, NOT, Loops-While, For, Until, Break & continue, Command line arguments-Positional parameters-Set & shift, Functions & file manipulations-Processing file line by line Functions.

Unit-2. **10**

Regular Expression & Filters-Writing regular expression, Grep, cut, sort commands, Grep patterns SED & AWK, Processes-Concept of process in Unix Background processes, Scheduling processes -at, batch & cron, PHP- Introduction to PHP: Basic Syntax, Defining variable and constant, PHP Data types.

Unit-3. **10**

PHP-Operators and Expressions, Handling HTML Form and generating images with PHP, Decisions and loops, Function, String, Array, working

with file and Directories, State management: using query string (URL rewriting), using hidden field, using cookies, using session, String matching with regular expression, Database Connectivity with MySQL.

List of Reference –Books

- Richard Blum and Christine Bresnahan, Linux Command Line and Shell Scripting Bible,3ed, Wiley publishers. ISBN: 8126554983
- Richard Petersen, Linux: The Complete Reference, Sixth Edition, McGraw Hill Education. ISBN: 0070222940
- Sumitabha Das, Unix Concepts And Applications, McGraw Hill Education. ISBN:0070635463
- Steven Holzner, PHP: The Complete Reference, McGraw Hill Education. ISBN: 0070223629
- Laura Thomson, Luke Welling, PHP and MySQL Web Development, Pearson Education; Fifth edition. ISBN: 9332582734

Name of Course: Computer Hardware-II

Course Code: BIOIN/DSE/557 **Course Type:** DSE

Credit: 02 **Contact Hours:** 30 **Hours/Week:** 02

Total Marks: 50

Course Objectives:

- To study partitioning of Hard drive
- To study I technology & their installation
- To study maintenance & troubleshooting of Computer system.

Course Outcomes:

Upon successful completion of this course, students will be able to:

- Create partition of the HDD, SSD of a Computer System (in Windows and or Linux) according to users need
- Install a CPU on motherboard & underlying technology used.
- Install RAM, SSD, HDD and explain Primary Memory (RAM & ROM) and Secondary Memory in a computer system.
- Install & connect accessories like optical drive, keyboard, mouse, monitor, Printer and troubleshoot them.
- Identify different types of Virus attack and take suitable course of action to disinfect a system

Unit-1- 10

Partitioning of Hard Drive/ SSD - Primary, Extended, Logical partitions using Partition Tools in Windows. Partitioning of Hard Drive/ SSD - Primary, Extended, Logical partitions using Partition Command (mkpart) in Linux, Definition of CPU, Architecture, Speed, Types of CPU (XT and AT technologies) 32/64 Bit, Types process or technologies like Clock speed, Bus speed, Cache memory, Threading technologies, Core technologies, IRQ & DMA Technologies, Brands (Intel/AMD), CPU Series –like Pentium, PI, PII, PIII, PIV etc.

Unit-2. 10

What is" I" Technology, Core series (i3, i5, i7). To explain about PGA and BGA and LGA Model processors,

Pins/Sockets.

Definition, Architecture, Compatibility with CPU's, Chipsets and Brands.

What is Chipset, what is FSB, what is Bus, CPU Sockets, Interface Ports used to connect different Peripherals. I/O Ports (PS/2, Serial, Parallel, USB, VGA, HDMI, Audio, Ethernet, etc.), Identifying Expansion Slots (PCI, AGP etc.), Power Form Factor. Introduction to HDD& SSD, Types, Functioning of HDD, Functioning of SSD, Dual Usage. Installing and Configuring a New HDD / SSD. Types of Optical Drives -ROM/Writer, Types of Keyboards & working principle, Keyboard Problems and Troubleshooting. Types & principle of mouse, Mouse Problems and Troubleshooting.

Unit-3. **10**

Types of Monitors (CRT/LCD/LED), Working Principles of each type, Demonstration and Practical on Monitor Installation, Menu Configuration, Adjusting Monitor Settings, Monitor Power Supply types, Possible Problems and Troubleshooting, Installing a Printer and Configuring Drivers, Possible Printer Problems and Troubleshooting Techniques, installation of Scanner, Device Driver Installation, hat is a computer virus? How Virus Attacks a computer. Types of Viruses (Boot Sector Virus, Partition Virus, File Virus, Trojans, Etc.) Malwares, Adware's, Spywares, Phishing Attacks, etc. Prevention and Curing Virus and Spywares, Antivirus, Internet Security Tools, Updates etc.

List of Reference –Books

- Upgrading and Repairing PCs by Scott Mueller
- Computer Architecture: A Quantitative Approach by John L. Hennessy
- The Elements of Computing Systems: Building a Modern Computer from First Principles by Noam Nisan
- Understanding Electronics by R.H. Warring
- Electricity and Basic Electronics by Stephen R. Matt

Name of Course: Techniques in Experimental Biology

Course Code: BIOIN/DSE/557 **Course Type:** DSE

Credit: 02 **Contact Hours:** 30 **Hours/Week:** 02

Total Marks: 50

Course Objectives:

- To study various microbiological techniques
- To study biochemical techniques
- To study molecular biology techniques

Course Outcomes:

Upon successful completion of this course, students will be able to:

- Media preparation, staining techniques & fermentation
- Purification & analysis of biomolecules
- Perform PCR, Electrophoresis, Chramatography

Unit-1- 10

Microbiological techniques: Media preparation, Sterilization, Inoculum preparation. Staining: Gram staining, endospore staining. Streak, pour and spread plate methods. Growth curve and kinetics, Screening of antibiotic producer, amylase producers, PHA producers, Fermentation.

Unit-2. 10

Biochemical techniques: Extraction and fractionation methods- Cell lysis, protein precipitations, dialysis, density gradient centrifugation/differential centrifugation, ultracentrifugation, Electrophoresis- Native-PAGE, SDS-PAGE, 2DE, 2D-DIGE, agarose gel, Chromatography- AC, IEC, TLC, HPLC, GC, gel filtration and paper chromatography, Western blot, In-gel digestion, metabolism assays, gel image analysis, CD/NMR/MS spectra.

Unit-3. 10

Molecular biology techniques: Bacterial Transformation, Plasmid isolation, Restriction digestion, Polymerase Chain Reaction, Gel Elution of DNA, TA/TOPO-TA cloning of PCR product

List of Reference –Books

- Microbiological Methods (Eighth edition) by C.H. Collins and P.M. Lyne, Arnold, a member of the Hodder Headline Group,338 Euston Road, London NW1 3BH.
- Medical Microbiology: The practice of medical microbiology. Vol. 2 (Twelth edition) by Robert Cruickshank, Churchill Livingstone.
- Practical Handbook of Microbiology (Second Edition) by Emanuel Goldman, Lorrence H Green, CRC Press.
- Biochemical Techniques: Theory and Practice by John F. Robyt and Bernard J. White, Waveland Press.
- Introduction to Practical Biochemistry (Third edition) by Plummer Mu, David T. Plummer, Tata McGraw-Hill Education.
- Principles and Techniques of Practical Biochemistry (7th Edition) by Keith Wilson and John Walker, Cambridge University Press.
- Introductory Practical Biochemistry by S.K. Sawhney and R. Singh, Narosa Publishing House.
- Biochemical Methods (Second edition) by S Sadasivam, A. Manickam, New Age International (P) Ltd. Publisher.

Name of Course: Practical based on BIOIN/DSE/557

Course Code: BIOIN/DSE/558 **Course Type:** DSE

Credit: 02 **Contact Hours:** 30 **Hours/Week:** 04

Total Marks: 50

Practical:

1. DNA isolation - from Plant cell (leaf of cabbage / mustard),
2. DNA isolation - from Animal cell (goat liver).
3. DNA isolation - from Human Blood (Fresh / Stored / Frozen) & Microbes
4. Plasmid DNA isolation
5. Protein separation using Gel electrophoresis
6. Nucleic Acid separation using Gel electrophoresis
7. Amplification DNA using Polymerase Chain Reaction
8. Study of Gel documentation, photography & interpretation
9. Isolation of RNA from given sample
10. Isolation of mitochondrial DNA from given sample

Name of Course: Practical based on BIOIN/DSE/557

Course Code: BIOIN/DSE/558 **Course Type:** DSE

Credit: 02 **Contact Hours:** 30 **Hours/Week:** 04

Total Marks: 50

Practical:

1. Shell Basics, Writing and executing scripts
2. Conditional statements, Loops, Command line arguments, Functions & file manipulations, Regular Expression & Filters
3. Introduction to PHP: Basic Syntax, Defining variable and constant
4. Study of PHP Data types, Operators and Expressions
5. Handling HTML Form and generating images with PHP
6. Decisions and loops
7. Function, String, Array, working with file and Directories
8. State management: using query string (URL rewriting), using hidden field, using cookies, using session
9. String matching with regular expression
10. Database Connectivity with MySQL

Name of Course: Practical based on BIOIN/DSE/557

Course Code: BIOIN/DSE/558 **Course Type:** DSE

Credit: 02 **Contact Hours:** 30 **Hours/Week:** 04

Total Marks: 50

Practical:

1. Demonstration of Partitioning of Hard Drive/ SSD - Primary, Extended, and Logical partitions using Partition Tools in Windows through Disk Manager.
2. Demonstration of Partitioning of Hard Drive/ SSD - Primary, Extended, and Logical partitions using Partition Command (mkpart) in Linux
3. Demonstration of different generation CPU (Intel /AMD), showing clock speed, Bus speed & other features.
4. Hand on practice to install CPU on the slot provided on the compatible main board.
5. Demonstration of different generation's main board (Intel /AMD/ 3rd party) compatible with the system, showing clock speed, Bus speed & other features.
6. Hand on practice to install CPU on the slot provided on the compatible main board.
7. Hand on practice to install RAM on the slot provided on the compatible main board
8. Fresh installation a HDD/SSD, Partition, Installation of OS, Application S/W.
9. Keyboard & Mouse Problems and Troubleshooting.
10. Installing a Printer and Configuring Drivers.
11. Hands on Practice of Assembling and disassembling a PC with accessories.
12. Antivirus software, types, installation, Mechanisms

Name of Course: Practical based on BIOIN/DSE/557

Course Code: BIOIN/DSE/558 **Course Type:** DSE

Credit: 02 **Contact Hours:** 30 **Hours/Week:** 04

Total Marks: 50

Practical:

1. To study pure culture techniques by using different streaking methods.
2. To study microbial media for pure culture & isolation of bacteria
3. Isolation & Screening of antibiotic producer from soil sample
4. To study separation & purification of protein by using gel electrophoresis.
5. To purify protein by using dialysis techniques
6. To study separation & purification of plant extract by using TLC.
7. To study bacterial transformation
8. To study bacterial conjugation
9. To isolate plasmid DNA from given bacterial culture
10. To study bacterial transduction

Name of Course: OJT/FP-1

Course Code: BIOIN/OJT/559 **Course Type:** OJT

Credit: 04 **Contact Hours:** 60 **Hours/Week:** 04

Total Marks: 100
