MGM UNIVERSITY, CHH. SAMBHAJINAGAR

INSTITUTE OF BIOSCIENCES AND TECHNOLOGY

CHOICE BASED CREDIT SYSTEM (CBCS)

SEMESTER PATTERN

Faculty of Sciences

Post Graduate (PG) Programme

Bioinformatics - CURRICULUM

w. e. f. Academic Year 2023-24

M.Sc. Bioinformatics

CURRICULUM

Prepared By
Dr. Preenon Bagchi

Submitted By
Dr. G. W. Narkhede

Approved By
Board of Studies

Illustrative Credit distribution structure for Two Years/ One Year PG									
M.Sc. Post Graduation Programme (M.Sc. BI)									
Year	**Level**	**Sem.**	**Major**		**RM**	**OJT/ FP**	**RP**	**Cum. Cr.**	**Degree**
			Mandatory	**Electives**					
I	**6**	**I**	14 (3*4 +2)	4	4			22	**PG Diploma (after 3 Yr Degree)**
		II	14 (3*4 +2)	4		4		22	
Cum. Cr. For PG Diploma			**28**	**8**	**4**	**4**	**-**	**44**	
Exit option: PG Diploma (44 Credits) after Three Year UG Degree									
II	**6.5**	**III**	12 (3*4)	4			4	20	
		IV	10 (1*10)	4			8	22	
Cum. Cr. for 1 Yr PG Degree			**22**	**8**	**4**		**12**	**42**	**PG Degree After 3-Yr UG Or**
Cum. Cr. for 2 Yr PG Degree			**50**	**16**	**4**	**4**	**12**	**86**	**PG Degree after 4-Yr UG**
2 Years-4 Sem. PG Degree (86-credits) after Three Year UG Degree or 1 Year - 2 Sem PG Degree (42- credits) after Four Year UG Degree									

Appendix-2023																		
PROGRAMME: M.Sc. Bioinformatics																		
Semester I																		
Level	**Course Code**	**Course Title**	**Type**	**Course Type**	**Teaching Scheme**		**Credit**	**Evaluation Scheme**							**Minimum Passing**			
								Internal				**External**				**External**		
					L	**P**		**CA-I**	**MSE**	**CA-II**	**TW**	**ESE**	**PR**	**Total**	**Internal**	**ESE**	**PR**	**Total**
6.0	**MTMML101**	**MySQL, data warehousing, Cloud computing with AWS**	**Theory**	**Major Mandatory**	3	-	3	20	20	20	-	40	-	100	-	16	-	40
	MTMML102	**Bioinformatics and Biological Database**	**Theory**	**Major Mandatory**	4	-	4	20	20	20	-	40	-	100	-	16	-	40
	MTMML103	**Molecular Cell Biology**	**Theory**	**Major Mandatory**	3	-	3	20	20	20	-	40	-	100	-	16	-	40
	MTMML104	**Programming for Bioinformatics (R, Python & Julia)**	**Theory**	**Major Mandatory**	2	-	2	10	10	10	-	20	-	50	-	8	-	20
		Research Methodology	**Theory**	**RM**	4	-	4	20	20	20	-	40	-	100	-	16	-	40
	MTMEP105 MTMEP106	**1. Bio Lab (Practical) 2. Molecular lab**	**Practical**	**Major Elective**	-	4	2	-	-	-	30	0	20	50	-	-	8	20
	MTMEP107 MTMEP108	**1. Bioinformatics Lab (Practical) 2. Biodata Mining lab**	**Practical**	**Major Elective**	-	4	2	-	-	-	30		20	50	-	-	8	20
	MTMMJ109	**Mini Project**	**Practical**	**Major Mandatory**	-	4	2	-	-	-	30		20	50	-	-	8	20
		Total (L- P) Hrs / week = 28			**16**	**12**	**22**	**90**	**90**	**90**	**90**	**180**	**60**	**600**		**72**	**24**	**240**

Semester II (M.Sc. BI)																		
Level	**Course Code**	**Course Title**	**Type**	**Course Type**	**Teaching Scheme**		**Credit**	**Evaluation Scheme**							**Minimum Passing**			
					L	**P**		**CA-I**	**MSE**	**CA-II**	**TW**	**ESE**	**PR**	**Total**	**Internal**	**ESE**	**PR**	**Total**
6.0	**MTMML110**	**Statistical Methods in Bioinformatics**	**Theory**	**Major Mandatory**	3	-	3	20	20	20	-	40	-	100	-	16	-	40
	MTMML111	**Sequence Analysis, Transcriptomics and Gene Expression Analysis**	**Theory**	**Major Mandatory**	3	-	3	20	20	20	-	40	-	100	-	16	-	40
	MTMML112	**Structural biology & Bioinformatics**	**Theory**	**Major Mandatory**	3	-	3	20	20	20	-	40	-	100	-	16	-	40
	MTMML113	**R & Python language and Data Science, Introduction to quantum computing**	**Theory**	**Major Mandatory**	3	-	3	20	20	20	-	40	-	100	-	16	-	40
	MTMEP114 MTMEP115	**1. Computational Bioinformatics lab (Practical) 2. RDT Lab**	**Practical**	**Major Elective**	-	4	2	-	-	-	30	-	20	50	-	-	8	20
	MTMEP116 MTMEP117	**1. Algorithm design and analysis with python & Julia (Practical) 2. R lab**	**Practical**	**Major Elective**	-	4	2	-	-	-	30	-	20	50	-	-	8	20
	MTMMJ118	**Micro Project**	**Practical**	**Major Mandatory**	-	4	2	-	-	-	30	-	20	50	-	-	8	20
	MTFPJ119	**Field Project**	**Practical**	**FP**	-	8	4	-	-	-	60	-	40	100	-	-	16	40
		Total (L- P) Hrs / week = 32			**12**	**20**	**22**	**80**	**80**	**80**	**150**	**160**	**100**	**650**		**64**	**40**	**260**

Level 6.0 Award of PG Diploma (44 Credits) after Three Year UG Degree

Semester III (M.Sc. BI)																			
Level	**Course code***	**Course Title**	**Type**	**Category**	**Teaching Scheme**		**Credit**	**Evaluation Scheme**							**Minimum Passing**			
								Internal				**External**		**Total**		**External**		
					L	**P**		**CA-I**	**MSE**	**CA-II**	**TW**	**ESE**	**PR**		**Internal**	**ESE**	**PR**	**Total**
6.5	**MTMML201**	**Machine learning, Deep learning and artificial Intelligence for BI**	**Theory**	**Major Mandatory**	4	-	4	20	20	20	-	40	-	100	-	16	-	40
	MTMML202	**System Biology and Network Analysis**	**Theory**	**Major Mandatory**	4	-	4	20	20	20	-	40	-	100	-	16	-	40
	MTMML203	**Data Mining and Machine learning with PyTorch in BI**	**Theory**	**Major Mandatory**	4	-	4	20	20	20	-	40	-	100	-	16	-	40
	MTMEP204 MTMEP205	**1. New Bioinformatics Concepts 2. Molecular Modeling Lab**	**Practical**	**Major Elective**	-	4	2	-	-	-	30	-	20	50	-	-	8	20
	MTMMJ206	**Major Project**	**RP**	**RP**	-	8	4	-	-	-	60	-	40	100	-	-	16	40
	MTMEP207 MTMEP208	**1. Protein Modelling and Engineering 2. AI & ML lab**	**Practical**	**Major Elective**	-	4	2	-	-	-	30	-	20	50	-	-	8	20
		Total (L- P) Hrs / week = 28			**12**	**16**	**20**	**60**	**60**	**60**	**120**	**120**	**80**	**500**	-	**48**	**32**	**200**

Semester IV (M.Sc. BI)																		
Level	**Course code***	**Course Title**	**Type**	**Category**	**Teaching Scheme**		**Credit**	**Evaluation Scheme**							**Minimum Passing**			
								Internal				**External**				**External**		
					L	**P**		**CA-I**	**MSE**	**CA-II**	**TW**	**ESE**	**PR**	**Total**	**Internal**	**ESE**	**PR**	**Total**
6.5	**MTMET209 MTMET210**	**1. Ethics/ Biosafety/ IPR 2. Genomics in Cloud**	**Theory**	**Major Elective**	4	-	4	20	20	20	-	40	-	100	-	16	-	40
	MTJTI211	**On Job Training**	**OJT**	**Major Mandatory**	-	20	10	-	-	-	200	-	50	250	-	-	20	50
	MTRPJ212	**Research Project**	**RP**	**RP**	-	16	8	-	-	-	150	-	50	200	-	-	20	50
		Total (L- P) Hrs / week = 40			**4**	**36**	**22**	**20**	**20**	**20**	**350**	**40**	**100**	**550**	-	**16**	**40**	**140**

Level 6.5 Award of PG Degree after Three Years UG Degree with 86 credits OR Four Years UG Degree with 42 credits

MGM UNIVERSITY, CHH. SAMBHAJINAGAR

INSTITUTE OF BIOSCIENCES AND TECHNOLOGY

CHOICE BASED CREDIT SYSTEM (CBCS)

SEMESTER PATTERN

Faculty of Sciences

Post Graduate (PG) Programme

Bioinformatics - CURRICULUM

w. e. f. Academic Year 2023-24

M.Sc. Bioinformatics

SEMESTER-I

CURRICULUM

Appendix-2023																		
PROGRAMME: M.Sc. Bioinformatics																		
Semester I																		
Level	**Course Code**	**Course Title**	**Type**	**Course Type**	**Teaching Scheme**		**Credit**	**Evaluation Scheme**							**Minimum Passing**			
								Internal				**External**				**External**		
					L	**P**		**CA-I**	**MSE**	**CA-II**	**TW**	**ESE**	**PR**	**Total**	**Internal**	**ESE**	**PR**	**Total**
6.0	**MTMML101**	**MySQL, data warehousing, Cloud computing with AWS**	**Theory**	**Major Mandatory**	3	-	3	20	20	20	-	40	-	100	-	16	-	40
	MTMML102	**Bioinformatics and Biological Database**	**Theory**	**Major Mandatory**	4	-	4	20	20	20	-	40	-	100	-	16	-	40
	MTMML103	**Molecular Cell Biology**	**Theory**	**Major Mandatory**	3	-	3	20	20	20	-	40	-	100	-	16	-	40
	MTMML104	**Programming for Bioinformatics (R, Python & Julia)**	**Theory**	**Major Mandatory**	2	-	2	10	10	10	-	20	-	50	-	8	-	20
		Research Methodology	**Theory**	**RM**	4	-	4	20	20	20	-	40	-	100	-	16	-	40
	MTMEP105 MTMEP106	**1. Bio Lab (Practical) 2. Molecular lab**	**Practical**	**Major Elective**	-	4	2	-	-	-	30	0	20	50	-	-	8	20
	MTMEP107 MTMEP108	**1. Bioinformatics Lab (Practical) 2. Biodata Mining lab**	**Practical**	**Major Elective**	-	4	2	-	-	-	30		20	50	-	-	8	20
	MTMMJ109	**Mini Project**	**Practical**	**Major Mandatory**	-	4	2	-	-	-	30		20	50	-	-	8	20
		Total (L- P) Hrs / week = 28			**16**	**12**	**22**	**90**	**90**	**90**	**90**	**180**	**60**	**600**		**72**	**24**	**240**

SYLLABUS STRUCTURE SHEET

MySQL, data mining, data warehousing

University: MGM University, Aurangabad	**Faculty:** Basic & Applied Science
Institute: Institute of Biosciences and Tech.	**Degree:** M.Sc. Bioinformatics (PG)
Course Unit Code: MTMML101	**Course Unit Title:** MySQL, data mining, data warehousing
Credits allocated: 3(3 Theory+ 0 Practical)	**Level of Study:** PG

Mode of delivery planned learning activities and teaching method: Lecture 3 hrs / weekly

Prerequisites for registration: Registration of a student in various courses in consultation with the respective course teacher and Adviser and acceptance by the principal. The approved courses must be mentioned in the roster form.
Candidates should pass in undergraduate Life Science.

COURSE OVERVIEW:

MySQL is the open source community's most popular Relational Database Management System (RDBMS) offering, and is a key part of LAMP – Linux, Apache, MySQL, PHP/Perl/Python. Many Fortune 500 companies adopt MySQL to reap the benefits of an open source, platform-independent RDMS, such as simplifying conversion from other platforms and lowering database Total Cost of Ownership by 90%. This class encourages the student to explore database fundamentals, as well as MySQL features. Students learn the basics of MySQL use and
the programming of stored routines. This course covers MySQL 8.0.

OBJECTIVES

After completing this course, you will be able to:.

- Update and insert data into the existing tables.
- Understand how the relationships between tables will affect the SQL.
- Understand the advantages of stored procedures along with storing data using variables and functions

OUTCOMES:

- Understand basic concepts of how a database stores information via tables.
- Understand SQL syntax used with MySQL.
- Learn how to retrieve and manipulate data from one or more tables.
- Learn how to filter data based upon multiple conditions.

Detailed syllabus ((Lecture 45)

UNIT 1 (Lecture 10)

Introduction:

Introduction to Data, Types of Data, Data structure, Database, Database Management Systems (DBMS), Structured, Unstructured and Semi-structured, Data models – Relational, Object Oriented, Network, Hierarchical, Document, XML etc, Level of Abstractions, Advantages of DAMS,

Database Designing:

Entity- relationship model: - attributes and its types, entity- entity sets, relationship, relationship- set, degree of relationship, Constraints- not null, default, unique, primary key, Foreign Key, Check, and index etc. Cardinality Constraints, E-R diagrams, EER model- Specialization, Generalization, Aggregation

Relational model: Relation attributes tuple, domain, constraints, schema, schema diagram, Normalization- atomic domain and First Normal form (1 NF), decompositions, functional and Multivalued dependency and its algorithms, second normal form (2NF), Third Normal Form (3NF), Boyce-Codd Normal Form (BCNF), Fourth Normal Form (4NF), Fifth Normal Form (5NF).

Object-Oriented Data Model and Object-Oriented Database Development

UNIT II (Lecture 10)

File organization, Data storage, and Querying :

Physical and logical storage: File structure, Magnetic disk, Optical disk, Flash storage, RAID, Database buffer etc, File Organizing: Sequential, Heap, Hash, and index file organization etc, Query processing and query optimization

Transaction, concurrency, and Recovery:

Transaction processing: introduction, Life cycle of transaction, ACID property, multiple transactions, Serializability etc, Concurrency Control: introduction, scheduling, protocols etc, Recovery: Recovery algorithms, lockup system, Remote back, security, and authorization etc. Database Implementation: Introduction to SQL, Advanced SQL, database application development, Formal Relational Query Languages- Relational algebra and relational calculus

UNIT III (Lecture 10)

Advanced database Topics:

Client Server Architecture, Parallel Databases: - Parallelism, Query Optimization, Distributed Databases:- Architecture, data distribution, query processing, concurrency control etc, mobile database, multimedia database, Active database.

UNIT VI

Data warehousing:

Concepts, Needs of Data Warehousing, Blocks of Data Warehousing, trends in data warehousing, Architectural components of Data Warehousing, information access OLAP in data warehousing, OLAP Servers, Data Warehouse Schema, Metadata, Partitioning, Data Marts, Process and system management, security and backup, data warehousing and web, data warehouse deployments, Growth and maintenance, Big Data and NoSQL, unstructured data and data warehouse.

UNIT V (Lecture 5)

Cloud computing

Introduction to Cloud Computing and AWS, Cloud Computing Architecture, Service Management in Cloud Computing, Data Management in Cloud Computing, Resource Management in Cloud, Cloud Security, Open Source and Commercial Clouds, Cloud Simulator, Research trend in Cloud Computing, Fog Computing

Suggested Reading/ Reference Books/ Textbooks

1. Database System Concepts, 6th Edition (2010, McGraw-Hill) by Abraham Silberschatz, Henry F. Korth, S. Sudarshan
2. Modern Database Management, Pearson Education (2015) by Hoffer, Jeffrey A. Ramesh, Venkataraman Topi, Heikki
3. Building the Data Warehouse by W. H. Inmon - (2005, Wiley)
4. Data Warehousing Fundamentals by Ponniah P., Reddy P. -. Volume 1 (2001) A Wiley- Interscience Publication JOHN WILEY & SONS, INC.
5. Data Mining and Data Warehousing Principles and Practical Techniques by Parteek Bhatia, Cambridge University Press (2019)
6. Data warehousing for biomedical informatics by Verne, Jules - -Dalmatian Press (2016), CRC Press Taylor & Francis Group
7. Data Mining for Bioinformatics by Sumeet Dua, Pradeep Chowriappa - -CRC Press (2012)
8. Data Mining for Bioinformatics Applications by HeZengyou - -Woodhead Publishing (2015)

Bioinformatics and Biological Database

University: MGM University, Aurangabad

Faculty: Basic & Applied Science

Institute: Institute of Biosciences and Tech.

Degree: M.Sc. Bioinformatics (PG)

Course Unit Code: MTMML102

Course Unit Title: Bioinformatics and Biological Database

Credits allocated: 4(4 Theory+ 0 Practical)

Level of Study: PG

Mode of delivery planned learning activities and teaching method: Lecture 3 hrs / weekly

Recommended Year /Semester: Bioinformatics Year 1/ Semester I

Prerequisites for registration: Registration of a student in various courses in consultation with the

respective course teacher and Adviser and acceptance by the principal. The approved courses must be mentioned in the roster form.

COURSE OVERVIEW:

Biological databases emerged as a response to the huge data generated by low-cost DNA sequencing technologies. One of the first databases to emerge was GenBank, which is a collection of all available protein and DNA sequences. It is maintained by the National Institutes of Health (NIH) and the National Center for Biotechnology Information (NCBI). GenBank paved the way for

The Human Genome Project (HGP). The HGP allowed complete sequencing and reading of the

Genetic blueprint. The data stored in biological databases is organized for optimal analysis and consists of two types: raw and curated (or annotated). Biological databases are complex,

Heterogeneous, dynamic, and yet inconsistent.

OBJECTIVES

- Bioinformatics is the science of storing, extracting, organizing, analyzing, interpreting and using information.
- The approaches to the discipline of bioinformatics incorporate expertise from the biological sciences, computer science and mathematics.
- The major in bioinformatics is designed for students interested in molecular biology and genetics, information technologies and computer science.
- Bioinformaticists are involved in the analysis of the human genome, identification of

targets for drug discovery, development of new algorithms and analysis methods, the study of structural and functional relationships, and molecular evolution.

OUTCOMES:

A student completing a major in Bioinformatics shall be able to apply knowledge and awareness of the basic principles and concepts of biology, computer science and mathematics existing software effectively to extract information from large databases and to use this information in computer modeling problem-solving skills, including the ability to develop new algorithms and analysis methods an understanding of the intersection of life and information sciences, the core of shared concepts, language and skills the ability to speak the language of structure-function relationships, information theory, gene expression, and database queries.

Detail Course Content (Lecture 60)

Unit 1 Introduction (Lecture 12)

What is bioinformatics, Principles of protein structure Tertiary structure Quaternary structure Similarity of ternary and quaternary structure

Bioinformatics databases: Introduction Nucleotide sequence databases Protein sequence databases Sequence motif databases Protein structure databases Other relevant databases

Alignment : Similarity and Homology ,Types of divergence, Conserved regions, Methodological principles, Substitution scores, Insertion/deletion scores, Statistical significance, Database search, Multiple alignment, Structure alignment, Matching algorithms, Searching 3D Databases, Classifying 3D shapes

Unit 2 Basics: Nucleic Acid and Protein Sequences (Lecture 12)

Sequence database and information retrieval, pairwise sequence comparison, BLAST, FASTA, and advanced BLAST, pairwise Sequence and structure analysis, MSA's Multiple sequence alignments, Molecular Phylogenetic analyzes

Unit 3 Biomolecular Simulations (Lecture 12)

Basic concepts: Units and derivatives, Force field and energy landscape, Truncation of nonbonded interactions , Conformational Sampling: Introduction , Minimization and alogrithms , Molecular dynamics, Ensembles (statistical mechanics), Monte Carlo simulations, Solvation: Introduction, Periodic boundary condition, Ewald summation, Implicit solvent model and continuum electrostatics, Monte Carlo simulation on parallel computers, Advanced Techniques : Introduction , Replica-exchange simulations, Restraint potentials, Free energy calculations, Membrane simulations

Unit 4 Protein Structure and Design (Lecture 12)

Protein secondary structure: Introduction, Hydrogen bond , Defining a secondary structure element, Methods for predicting secondary structure ,

Experimental methods for protein structure determination : X-ray crystallography, Nuclear magnetic resonance (NMR)

Protein tertiary structure modeling: Basic concepts, Protein folding and dynamic simulation, Modeling protein side chains, Comparative modeling, Threading, Ab initio modeling, Combined Modeling approaches, CASP: A blind protein structure prediction competition Introduction to protein design: Rational‖ design efforts, Experimental methods (directed evolution), Computational protein design

Unit 5 PROTEIN INTERACTION (Lecture 12)

Protein quaternary structure modeling: Basic concepts,Energy landscapes, Docking algorithms – foundation, Docking algorithms – current & future, Docking example, CAPRI, Protein Structure Initiative, Computational proteomics

Designing protein-protein interfaces: Designing for affinity, Designing for specificity

Suggested Reading/ Reference Books/ Textbooks

1. Essential Bioinformatics by Jin Xiong
2. Introduction to Bioinformatics by A. Bagchi
3. Bioinformatics: A Practical Guide to the Analysis of Genes and Proteins (Methods of Biochemical Analysis) by Andreas D. Baxevanis, B. F. Francis Ouellette
4. Introduction to Bioinformatics by Teresa Attwood
5. Structural Bioinformatics by Philip E. Bourne, Jenny Gu
6. Introduction To Bioinformatics By Lesk
7. Bioinformatics Sequence And Genome Analysis By David W. Mount
8. Web resource
   http://dpuadweb.depauw.edu/cfornari_web/Genomics/Resources/ResourcesBio325.htm

SYLLABUS STRUCTURE SHEET

Molecular Cell Biology

University: MGM University, Aurangabad	**Faculty:** Basic & Applied Science
Institute: Institute of Biosciences and Tech.	**Degree:** M.Sc. Bioinformatics (PG)
Course Unit Code: MTMML103	**Course Unit Title:** Molecular Cell Biology
Credits allocated: 3(3 Theory+ 0 Practical)	**Level of Study:** PG

Mode of delivery planned learning activities and teaching method: Lecture 3 hrs / weekly

Recommended Year /Semester: Bioinformatics Year 1/ Semester I

Prerequisites for registration: Registration of a student in various courses in consultation with the respective course teacher and Adviser and acceptance by the principal. The approved courses must be mentioned in the roster form.

Candidates should pass in undergraduate Life Science.

COURSE OVERVIEW:

The focus of Cell Biology is the study of the structure and function of the cell. In this course we will focus on Eukaryotic cell biology and will cover topics such as membrane structure and composition, transport, and trafficking; the cytoskeleton and cell movement; the breakdown of macromolecules and generation of energy; and the integration of cells into tissues. We will also cover important cellular processes such as cell cycle regulation, signal transduction, apoptosis (programmed cell death), and cancer cell biology. Throughout the semester we will attempt to relate defects in these various cellular processes to human diseases to help gain a better understanding for what happens when cells don't work as they should.

OBJECTIVES

1. Describe the structure and function of cellular components.
2. Explain how cellular components are localized and organized.
3. Explain the regulatory mechanisms that enable diversity and dynamics of cellular components.
4. Recognize, discuss examples, and apply common themes in cell biology.
5. Propose experiments to answer questions or test hypotheses about cellular structures and functions.
6. Predict experimental results, interpret experimental data, and use experimental evidence to generate and/or support a hypothesis

OUTCOMES:

Upon completion of this course, the student will be able to:

1. Describe the fundamental principles of cellular biology.
2. Apply these principles to current biological questions of today.
3. demonstrate knowledge of the dynamic character of cellular organelles
4. Develop a deeper understanding of cell structure and how it relates to cell functions.
5. Understand cell movement and how it is accomplished.
6. Understand how cells grow, divide, and die and how these important processes are regulated.
7. Understand cell signaling and how it regulates cellular functions. Also how its dysregulation leads to cancer and other diseases.
8. Demonstrate knowledge of the use of chemical energy in running cellular activities
9. Understand the nature of cellular regulation and relate it to the development of cancer
10. Be able to relate topics of cell biology to physiological processes in plants and animals

Detailed Syllabus

Total Lectures = 45

UNIT 1: Cell Structure and Function (9 Lectures)

Subtopics:

Overview of cell structure and organization

Cell membrane structure and transport mechanisms

Cytoskeleton and cell motility

Cell cycle and cell division

UNIT 2: Cellular Signaling and Communication (9 Lectures)

Subtopics:

Introduction to cell signaling

Signal transduction pathways and second messengers

Receptor-mediated signaling

Intracellular signaling networks

UNIT 3: Gene Expression and Regulation (9 Lectures)

Subtopics:

DNA structure and packaging

Transcription and RNA processing

Translation and protein synthesis

Regulation of gene expression

UNIT 4: Cell Death and Cell Senescence (9 Lectures)

Subtopics:

Apoptosis and programmed cell death

Autophagy and cell survival mechanisms

Cellular senescence and aging

UNIT 5: Cell-Cell Interactions and Tissue Homeostasis (9 Lectures)

Subtopics:

Cell adhesion molecules and cell junctions

Extracellular matrix and cell-matrix interactions

Cell communication in tissue development and repair

Stem cells and tissue regeneration

SUGGESTED READINGS / REFERENCE BOOKS/ TEXTBOOKS

1. Molecular Biology of Gene by Watson, Baker, Bell
2. Lodish, et al. Molecular Cell Biology. 5th ed. New York,NY: W.H. FreemanandCompany, 2003. ISBN: 9780716743668.
3. Hardin, J, and Bertoni, G.P. 2015. Becker's World of the Cell, 9th edition, Pearson
4. Bruce Alberts, et al. Molecular biology of the cell. Garland Science, 2015. 6th edition.
5. Alberts, Bray, Hopkin, Johnson, Lewis, Raff, Roberts, and Walter. 2014. EssentialCellBiology 4th ed. Garland Science. ISBN: 978-0-8153-4454-4.

SYLLABUS STRUCTURE SHEET

Programming for Bioinformatics (R, Python & Julia)

University: MGM University, Aurangabad **Faculty: Basic & Applied Science**

Institute: Institute of Biosciences and Tech. **Degree: M.Sc. Bioinformatics (PG)**

Course Unit Code: MTMML104 **Course Unit Title: Programming for Bioinformatics (R, Python & Julia)**

Credits allocated: 2 (2Theory+ 0 Practical) **Level of Study: PG**

Mode of delivery planned learning activities and teaching method: Lecture 2 hrs / weekly

Recommended Year /Semester: Bioinformatics Year 1/ Semester I

Prerequisites for registration: Registration of a student in various courses in consultation with the respective course teacher and Adviser and acceptance by the principal. The approved courses must be mentioned in the roster form.

Candidates should pass in undergraduate Life Science.

COURSE OVERVIEW:

One of the most important skills for a data analyst is proficiency in a programming language. Data analysts use SQL (Structured Query Language) to communicate with databases, but when it comes to cleaning, manipulating, analyzing, and visualizing data, you're looking at either Python or R.

OBJECTIVES

- The course aims to provide students with a basic understanding of programming language.
- In order to teach yourself how to do bioinformatics, it's important you start with learning a programming language if you aren't familiar with programming already.
- Then you can begin reading data and running statistics, as well as completing a project where you put your findings together.

STUDENT LEARNING OUTCOMES:

Students who have completed the requirements will:

- Apply reasoning about core biological concepts with emphasis on the cellular and molecular scale of biology
- Design, implement and evaluate computer-based systems, processes, components or programs in relation to the contexts of molecular and cellular biology and genomics research.
- Analyze and evaluate bioinformatics data to discover patterns, critically evaluate conclusions and generate predictions for subsequent experiments.
- Communicate biological information relating to bioinformatics in both written and oral forms

Detail Course Content (Lecture 30)

Unit 1 (Lecture 7)

Basics of Operations

Basic Operators, Functions, Variables, Introduction to Data Structures, Objects and Classes

Unit 2

Packages (Lecture 7)

R, Python & Julia packages and their installation

Unit 3

Objects (Lecture 7)

Vectors, Lists, Matrices, Arrays, Factors, Data Frames, Time Series

Unit 4

Programming (Lecture 9)

Basics, Class, Objects, Expression, Loop, Saving, Loading, Editing, Preparing, Visualization, Basic statistics (Correlation, Principal Component Analysis, Sampling)

SUGGESTED READINGS / REFERENCE BOOKS/ TEXTBOOKS

1. 1st EditionR Programming for Bioinformatics By Robert Gentleman
2. Practical Bioinformatics For Beginners: From Raw Sequence Analysis To Machine Learning Applications by Lloyd Wai Yee Low and Martti Tapani Tammi
3. Python: - The Bible- 3 Manuscripts in 1 Book: -Python Programming for Beginners -Python Programming for Intermediates -Python Programming for Advanced by Maurice J Thompson

SYLLABUS STRUCTURE SHEET

Bio Lab

University: MGM University, Aurangabad	**Faculty:** Basic & Applied Science
Institute: Institute of Biosciences and Tech.	**Degree:** M.Sc. Bioinformatics (PG)
Course Unit Code: MTMEP105	**Course Unit Title:** Bio Lab
Credits allocated: 2 (Practical)	**Level of Study:** PG

Mode of delivery planned learning activities and teaching method: Practical 4 hrs / weekly

Recommended Year /Semester: Bioinformatics Year 1/ Semester I

Prerequisites for registration: Registration of a student in various courses in consultation with the respective course teacher and Adviser and acceptance by the principal. The approved courses must be mentioned in the roster form.

Candidates should pass in undergraduate Life Science.

Subject – Bio Lab (Lecture 30)

1. Study of different bioinformatics software.
2. Analysis of Gene sequencing with help of different methods.
3. Genome Analysis of workflow and pipeline development.
4. NGS data analysis (next generation sequencing)
5. Protein structure visualization and analysis.
6. Ligand Docking study for protein.
7. Ramchandran plot study.
8. Cell line culturing and subculturing.
9. Cell line Development.
10. Different cell line related assay.

11.Studies of development of different cell lines including insects, different animal, human cells and other eukaryotes.

12. Image analysis of different classes of Microbes.

13.Preparation of Microbial media (bacteria, yeast, mold, algae, protozoa)

14.Sterilization: principles & operations – Autoclave, Hot Air Oven, Filtration, Laminar Air Flow

15. Principles & operations of Incubators & Shaker

16.Principle & operation of Centrifuge

17. Principle & operation of pH meter

18.Principle & operation of Colorimeter

19. Principle & operation of Spectrophotometer (3 Periods) 10. Electrophoresis techniques

20. Photosynthesis and Respiration

Suggested Reading/ Reference Books/ Textbooks

1. Talaro, K.P. and Talaro A(2004) *Foundations of Microbiology* 5 th edition McGraw-Hill
2. Aneja, K.R., Jain ,P. and Aneja, R (2008)*Text book of Basic and Applied Microbiology* New Age International

Molecular Lab

University: MGM University, Aurangabad	**Faculty:** Basic & Applied Science
Institute: Institute of Biosciences and Tech.	**Degree:** M.Sc. Bioinformatics (PG)
Course Unit Code: MTMEP106	**Course Unit Title:** Molecular Lab
Credits allocated: 2 (Practical)	**Level of Study:** PG

Mode of delivery planned learning activities and teaching method: Practical 4 hrs / weekly

Recommended Year /Semester: Bioinformatics Year 1/ Semester I

Prerequisites for registration: Registration of a student in various courses in consultation with the respective course teacher and Adviser and acceptance by the principal. The approved courses must be mentioned in the roster form.

Candidates should pass in undergraduate Life Science.

Subject – Molecular Lab (Lecture 30)

1) Measurements, Micropipetting and Sterile Techniques
2) Bacterial Culture Techniques- an introduction
3) Serial dilution and bacterial plating
4) Molecular problems and a sense of scale
5) Analysis of bacterial results
6) DNA Restriction and Electrophoresis (lambda genome)
7) analysis -restriction digest of the lambda genome
8) introduction to eukaryotic DNA analysis
9) Plant Genomic DNA Isolation
10) An Introduction to Cloning- bacterial transformation
11) Test gel on Plant DNA digestion
12) Southern blot I- Plant DNA restriction digest
13) Southern blotting tape
14) Analysis/Colony for DNA amplification1) O/N Plant DNA gel electrophoresis
15) Colony picking for DNA amplification
16) Hybridization of plant DNA Southern blots
17) Restriction digest of Lambda DNA, plasmid

SYLLABUS STRUCTURE SHEET

Bioinformatics Lab

University: MGM University, Aurangabad	**Faculty:** Basic & Applied Science
Institute: Institute of Biosciences and Tech.	**Degree:** M.Sc. Bioinformatics (PG)
Course Unit Code: MTMEP107	**Course Unit Title:** Bioinformatics Lab
Credits allocated: 2 (Practical)	**Level of Study:** PG

Mode of delivery planned learning activities and teaching method: Practical 4 hrs / weekly

Recommended Year /Semester: Bioinformatics Year 1/ Semester I

Prerequisites for registration: Registration of a student in various courses in consultation with the respective course teacher and Adviser and acceptance by the principal. The approved courses must be mentioned in the roster form.

Candidates should pass in undergraduate Life Science.

Practical List (Lecture 30)

1. Exploration of NCBI.
2. Exploration of file format.
3. Exploration of PDB/NDB.
4. Secondary structure prediction tool Jpred.
5. Secondary structure prediction tool phyre2.
6. Secondary structure prediction tool PSIpred.
7. Swiss model.

8. Protein and small molecule Databases
   a. PFAM
   b. PRODOM
   c. PROSITE
   d. Pubchem
   e. Drug Bank
   f. SCOP
   g. CATH
   h. DSSP
9. Exploration of DALI Server.
10. Exploration of VAST.
11. Exploration of FSSP.
12. Visualization tools.
   a. Pymol
   b. Rasmol
   c. Cn3D
12. Sequence alignment BLAST & FASTA
13. Sequence alignment ALIGN.
14. Sequence alignment Clustal Omega
15. Plant Bioinformatics
16. Explore Primary Databases
17. Explore Derived Databases
18.

Suggested Reading/ Reference Books/ Textbooks

1. Structural Bioinformatics by Philip E. Bourne, Jenny Gu
2. Introduction To Bioinformatics By Lesk
3. Bioinformatics Sequence And Genome Analysis By David W. Mount
4. Web resource http://dpuadweb.depauw.edu/cfornari_web/Genomics/Resources/ResourcesBio325.htm

Bio Data Mining Lab

University: MGM University, Aurangabad

Faculty: Basic & Applied Science

Institute: Institute of Biosciences and Tech.

Degree: M.Sc. Bioinformatics (PG)

Course Unit Code: MTMEP108

Course Unit Title: Bio Data Mining Lab

Credits allocated: 2 (Practical)

Level of Study: PG

Mode of delivery planned learning activities and teaching method: Practical 4 hrs / weekly

Recommended Year /Semester: Bioinformatics Year 1/ Semester I

Prerequisites for registration: Registration of a student in various courses in consultation with the respective course teacher and Adviser and acceptance by the principal. The approved courses must be mentioned in the roster form.

Candidates should pass in undergraduate Life Science.

Practical List

1. Explore visualization features of the tool for analysis
2. Perform data preprocessing tasks and Demonstrate performing association rule mining on data sets
3. Demonstrate performing classification on data sets
4. Demonstrate performing clustering on data sets
5. Sample Programs using German Credit Data.
6. One approach for solving the problem encountered in the previous question is using cross-validation? Describe what is cross validation briefly. Train a decision tree again using cross validation and report your results. Does accuracy increase/decrease? Why?
7. Check to see if the data shows a bias against “foreign workers” or “personal-status”.. Did removing these attributes have any significantly effect? Discuss.
8. Another question might be, do you really need to input so many attributes to get good results? Try out some combinations. Train your decision tree and report the Decision Tree and cross validation results. Are they significantly different from results obtained in problem
9. How does the complexity of a Decision Tree relate to the bias of the model?
10. One approach is to use Reduced Error Pruning. Explain this idea briefly. Try reduced error pruning for training your Decision Trees using cross validation and report the Decision Trees you obtain? Also Report your accuracy using the pruned model Does your Accuracy increase?
11. How Can you Convert Decision Tree in to “If then else Rules”.Make Up your own Small Decision Tree consisting 2-3 levels and convert into a set of rules. Report the rule obtained by training a one R classifier. Rank the performance of j48,PART,oneR.

Suggested Reading/ Reference Books/ Textbooks

1. Mentor lecture on Decision Trees
2. Andrew Moore’s Data Mining Tutorials (See tutoals on Decision Trees and Cross Validation)
3. Decision Trees (Source: Tan, MSU) Tom Mitchell’s book slides (See slides on Concept Learning and Decision Trees)

SYLLABUS STRUCTURE SHEET

MINI PROJECT

University: MGM University, Aurangabad	**Faculty:** Basic & Applied Science
Institute: Institute of Biosciences and Tech.	**Degree:** M.Sc. Bioinformatics (PG)
Course Unit Code: MTMMJ109	**Course Unit Title:** MINI PROJECT
Credits allocated: 2 (Practical)	**Level of Study:** PG

Mode of delivery planned learning activities and teaching method: Lecture 4 hrs / weekly

Recommended Year /Semester: Bioinformatics Year 1/ Semester I

Prerequisites for registration: Registration of a student in various courses in consultation with the respective course teacher and Adviser and acceptance by the principal. The approved courses must be mentioned in the roster form.

Candidates should pass in undergraduate Life Science.

Course Outcomes:

1. Students will be able to practice acquired knowledge within the chosen area of technology for project development.
2. Identify, discuss and justify the technical aspects of the chosen project with a comprehensive and systematic approach.

Ideas of project:

Defining project ideas is crucial for setting realistic expectations and laying out a clear vision for a project life cycle. Project-based learning not only provides opportunities for students to collaborate or drive their own learning, but it also teaches them skills such as problem solving, and helps to develop additional skills integral to their future, such as critical thinking and time management.

Literature survey:

A literature review establishes familiarity with and understanding of current research in a particular field before carrying out a new investigation. Conducting a literature review should enable you to find out what research has already been done and identify what is unknown within your topic.

Performance:

Performance measurement during a project is to know how things are going so that we can have early warning of problems that might get in the way of achieving project objectives and so that we can manage expectations. The criteria of it as given below.

1. Implementation:

Follows closely the design, uses appropriate techniques with skill and understanding to produce a good solution.

2. Evaluation:

Clearly relates to the problem. Shows a good understanding and appreciation of the solution. Objectives of what has been done.

3. Project Log:

   a. The individual student's effort and commitment.
   b. The quality of the work produced by the individual student.

c. The student's integration and co-operation with the rest of the group.

d. The completeness of the logbook & time to time signature of guide

Objective: To elaborate the procedure for Guiding Student projects

Responsibility:

- All the ProjectGuide.
- All Semester B.Sc. students
- Project Heads

Procedure:

Sr.	Activities	Responsibility
1.	UG students are to decide on their team members for their semester project with their proposed project domain and title.	UG students, Project Head.
2.	Director shall allocate the Project Guide based on their area of expertise (not more than 3 batches to a Guide)	Director
3.	Ensuring discussion guides. That students meetings with have their regular Project	Project Guide, Project Head
4.	Synopsis pre preparation and submission	project head
4.	Verification of Student project log book.	Project Head and Project Guide.
5.	Approval of PPT: Abstract, Existing, Proposed system. 30% of proposed work. 80% of proposed work. 100% of proposed work.	Project Guide
6.	Preparation and submission of progress report during project	Students, Project Head.
7.	Preparing list for Redo students (Insufficient content,Plagiarism, poor presentation Genuine Absentees)	Project Heads
8.	Submission of hard copy of Project report	Project Head
9.	Evaluation of Project report	External Examiner
8.	Organizing final project viva-voce.	Project Heads
9.	Ensuring that If a candidate fails to submit the project report on or before the specified deadline, he/she is deemed to have failed in the Project Work and shall re-enroll for the same in a subsequent semester.	Project Head, Project Guide, Director
10.	Collecting copies of the approved project report after the successful completion of viva examinations.	Project Head.

Research Methodology

University: MGM University, Aurangabad	**Faculty:** Basic & Applied Science
Institute: Institute of Biosciences and Tech.	**Degree:** M.Sc. Bioinformatics (PG)
Course Unit Code:	**Course Unit Title:** Research Methodology
Credits allocated: 4+0	**Level of Study: PG**

Mode of delivery planned learning activities and teaching method: Practical 3 hrs / weekly

COURSE OVERVIEW:

Research techniques and methods will be examined for the formulation of hypotheses, development of testable objectives, experimental design, subject selection, data collection, data analysis and interpretation, and report preparation. This course will focus on laboratory-based methods and simple statistical procedures for the analysis of data.

Prerequisites for registration: Registration of a student in various courses in consultation with the respective course teacher and Adviser and acceptance by the principal. The approved courses must be mentioned in the roster form. Candidates should pass in undergraduate Life Science.

STUDENT LEARNING OUTCOMES:

- Demonstrate the ability to choose methods appropriate to research aims and objectives
- Understand the limitations of particular research methods
- Develop skills in qualitative and quantitative data analysis and presentation
- Develop advanced critical thinking skills
- Demonstrate enhanced writing skills

Objectives:

- To get introduced to research philosophy and process in general
- To be able to formulate the problem statement and research plan for the problem under investigation
- To be able to apply various numerical/ quantitative techniques for data analysis
- To be able to communicate the research findings effectively

Unit I: (12 Lectures)

Research Methodology: Introduction, Meaning of Research, Objectives of Research, Types of Research, Research Approaches, Significance of Research, Research Methods versus Methodology, Research and Scientific Method, Research Process, Criteria of Good Research, Problems Encountered by Researchers in India. Defining the Research Problem: Research Problem, Selecting the Problem, Necessity of Defining the Problem, Technique Involved in Defining a Problem, An Illustration.

Unit II: (12 Lectures)

Reviewing the literature: Place of the literature review in research, Bringing clarity and focus to research problem, Improving research methodology, Broadening knowledge base in research area, Enabling contextual findings, Review of the literature, searching the existing literature, reviewing the selected literature, Developing a theoretical framework, Developing a conceptual framework, Writing about the literature reviewed. Research Design: Meaning of Research Design, Need for Research Design, Features of a Good Design, Important Concepts Relating to Research Design, Different Research Designs, Basic Principles of Experimental Designs, Important Experimental Designs.

Unit III: (12 Lectures)

Design of Sample Surveys: Design of Sampling: Introduction, Sample Design, Sampling and Non-sampling Errors, Sample Survey versus Census Survey, Types of Sampling Designs. Measurement and Scaling:Qualitative and Quantitative Data, Classifications of Measurement Scales, Goodness of Measurement Scales, Sources of Error in Measurement, Techniques of Developing Measurement Tools, Scaling, Scale Classification Bases, Scaling Technics, Multidimensional Scaling, Deciding the Scale. Data Collection: Introduction, Experimental and Surveys, Collection of Primary Data, Collection of Secondary Data, Selection of Appropriate Method for Data Collection, Case Study Method**.**

Unit IV: (12 Lectures)

Testing of Hypotheses: Hypothesis, Basic Concepts Concerning Testing of Hypotheses, Testing of Hypothesis, Test Statistics and Critical Region, Critical Value and Decision Rule, Procedure for Hypothesis Testing, Hypothesis Testing for Mean, Proportion, Variance, for Difference of Two Mean, for Difference of Two Proportions, for Difference of Two Variances, P-Value approach, Power of Test, Limitations of the Tests of Hypothesis. Chi-square Test: Test of Difference of more than Two Proportions, Test of Independence of Attributes, Test of Goodness of Fit, Cautions in Using Chi Square Tests**.**

Unit V: (12 Lectures)

Interpretation and Report Writing: Meaning of Interpretation, Technique of Interpretation, Precaution in Interpretation, Significance of Report Writing, Different Steps in Writing Report, Layout of the Research Report, Types of Reports, Oral Presentation, Mechanics of Writing a Research Report, Precautions for Writing Research Reports.

Suggested Readings

1. 'Management Research Methodology' by K.N. Krishnaswamy, Appa Iyer Sivakumar & M. Mathirajan, Person Education.
2. 'Research Methodology. G.C. Ramamurthy, Dream Tech Press, New Delhi
3. 'Research Methodology: A Step by Step Guide for Beginners' by Ranjit Kumar,2nd Edition
4. 'Research Methodology: An Introduction for Science and Engineering Students', byStuart Melville and Wayne Goddard
5. 'Research Methodology: An Introduction' by Wayne Goddard and Stuart Melville 'Research Methodology: Methods and Techniques', by Dr. C.R. Kothari, New AgeInternational Publisher

MGM UNIVERSITY, CHH. SAMBHAJINAGAR

INSTITUTE OF BIOSCIENCES AND TECHNOLOGY

CHOICE BASED CREDIT SYSTEM (CBCS)

SEMESTER PATTERN

Faculty of Sciences

Post Graduate (PG) Programme

Bioinformatics - CURRICULUM

Academic Year 2023-24

M.Sc. Bioinformatics

SEMESTER-II

CURRICULUM

Semester II (M.Sc. BI)																		
Level	**Course Code**	**Course Title**	**Type**	**Course Type**	**Teaching Scheme**		**Credit**	**Evaluation Scheme**							**Minimum Passing**			
					L	**P**		**CA-I**	**MSE**	**CA-II**	**TW**	**ESE**	**PR**	**Total**	**Internal**	**ESE**	**PR**	**Total**
6.0	**MTMML110**	**Statistical Methods in Bioinformatics**	**Theory**	**Major Mandatory**	3	-	3	20	20	20	-	40	-	100	-	16	-	40
	MTMML111	**Sequence Analysis, Transcriptomics and Gene Expression Analysis**	**Theory**	**Major Mandatory**	3	-	3	20	20	20	-	40	-	100	-	16	-	40
	MTMML112	**Structural biology & Bioinformatics**	**Theory**	**Major Mandatory**	3	-	3	20	20	20	-	40	-	100	-	16	-	40
	MTMML113	**R & Python language and Data Science, Introduction to quantum computing**	**Theory**	**Major Mandatory**	3	-	3	20	20	20	-	40	-	100	-	16	-	40
	MTMEP114 MTMEP115	**1. Computational Bioinformatics lab (Practical) 2. RDT Lab**	**Practical**	**Major Elective**	-	4	2	-	-	-	30	-	20	50	-	-	8	20
	MTMEP116 MTMEP117	**1. Algorithm design and analysis with python & Julia (Practical) 2. R lab**	**Practical**	**Major Elective**	-	4	2	-	-	-	30	-	20	50	-	-	8	20
	MTMMJ118	**Micro Project**	**Practical**	**Major Mandatory**	-	4	2	-	-	-	30	-	20	50	-	-	8	20
	MTFPJ119	**Field Project**	**Practical**	**FP**	-	8	4	-	-	-	60	-	40	100	-	-	16	40
		Total (L- P) Hrs / week = 32			**12**	**20**	**22**	**80**	**80**	**80**	**150**	**160**	**100**	**650**		**64**	**40**	**260**

Level 6.0 Award of PG Diploma (44 Credits) after Three Year UG Degree

SYLLABUS STRUCTURE SHEET

Statistical Methods in Bioinformatics

University: MGM University, Aurangabad
Faculty: Basic & Applied Science
Institute: Institute of Biosciences and Tech.
Degree: M.Sc. Bioinformatics (PG)
Course Unit Code: MTMML110
Course Unit Title: Statistical Methods in Bioinformatics

Credits allocated:3+0(Theory)

Mode of delivery planned learning activities and teaching method: Lecture 3 hrs / weekly

Recommended Year /Semester: Bioinformatics Year 1/ Semester II

Prerequisites for registration: Registration of a student in various courses in consultation with the respective course teacher and Adviser and acceptance by the principal. The approved courses must be mentioned in the roster form.

Candidates should pass in undergraduate Life Science.

COURSE DESCRIPTION

This course introduces students to statistical methods commonly used in bioinformatics. Students will learn to use statistical programs and related bioinformatics resources locally and on the Internet. Lectures and lab discussion will emphasize on the statistical models and methods underlying the computational tools.

OBJECTIVES

- The course will focus on the application of the newer statistical methods and the reasoning behind these applications.
- More emphasis will be placed on the analysis of genomic and proteomic experiments and students will learn statistical techniques to handle RNA-seq, microRNA, microarray, methylation, and proteomic data.

OUTCOMES

After completion of the course, students should be able to:

- State the fundamental concepts of statistics in bioinformatics.
- Describe the formulation of stochastic models for high throughput data
- Apply statistical techniques to solve bioinformatics problems
- Interpret the results of the analysis of high throughput data
- Apply Markov chains and Hidden Markov Models to solve bioinformatics problems.
- Use statistical tests commonly employed in bioinformatics.
- Recognize modern statistical methods and software to solve problems in bioinformatics.
- Interpret the statistical results as reported in the bioinformatics literature.

Detailed Syllabus (Lecture 45)

Unit I

Introduction (Lecture 9)

Introduction to statistical methods in molecular biology, Introduction to R and Bioconductor

Unit II

Modelling (Lecture 9)

Modeling DNA, Markov Chains, Hidden Markov model

Unit III

Phylogeny (Lecture 9)

Evolutionary models, Phylogenetic tree estimation

Unit IV

Hypothesis and models (Lecture 9)

Statistical hypothesis testing, Linear models, Bayesian models

Unit V (Lecture 9)

Data Analysis

Analysis of frequency data, Survival analysis, Multivariate analysis

Suggested Reading/ Reference Books/ Textbooks

1. All About Bioinformatics: From Beginner to Expert by Yasha Hasija
2. A Guide to Bioinformatics Tools: A Beginner's Guide to Bioinformatics by Mehmet Keçeci
3. Bioinformatics a Beginner's Guide by Jean Michael Claverie and Cedric Notredame

SYLLABUS STRUCTURE SHEET

Sequence Analysis, Transcriptomics and Gene Expression Analysis

University: MGM University, Aurangabad **Faculty:** Basic & Applied Science

Institute: Institute of Biosciences and Tech. **Degree:** M.Sc. Bioinformatics (PG)

Course Unit Code: MTMML111 **Course Unit Title:** Sequence Analysis, Transcriptomics and Gene Expression Analysis

Credits allocated:3+0(Theory) **Level of Study:** PG

Mode of delivery planned learning activities and teaching method: Lecture 3 hrs / weekly

Recommended Year /Semester: Bioinformatics Year 1/ Semester II

Prerequisites for registration: Registration of a student in various courses in consultation with the respective course teacher and Adviser and acceptance by the principal. The approved courses must be mentioned in the roster form.

Candidates should pass in undergraduate Life Science.

COURSE DESCRIPTION:

An understanding of the range of methods available to interrogate gene expression on a large scale as well as the correct usage and interpretation of high-throughput data is indispensable for the modern biologist. Together with its complementary course on proteomics and protein engineering, Accordingly, this course provides an overview of methods available to analyse gene transcription.

OBJECTIVES:

1. To present an integrative view of cellular processes at progressively complex levels.
2. To enable synthesis of isolated information in order to analyze biological phenomena in a contextually relevant manner.
3. To delineate the overarching role of evolutionary considerations at multiple levels of complexity.

Course contents

OUTCOME

- Starting with due emphasis to the biological complexity that high-throughput methods aim to interrogate
- The course moves progressively from a description of the different techniques available and their comparative analysis to an overview of the approaches to and problems in analysis, integration and biological inference.

Detailed syllabus (Lecture 45)

Unit I

The biological problem (Lecture 9)

Regulation of gene expression in prokaryotes and eukaryotes, similarities and differences in gene regulation across the domains of life, historical impact of genetic approaches on the study of gene expression. Levels of regulation – transcriptional to post-translational, phenotypic plasticity and epigenetics; the impact of DNA rearrangements on gene
expression. Evolutionary considerations in gene regulation and their role in speciation

Unit II

Tools and techniques for gene expression analysis (Lecture 9)

Low to medium throughput methods (blotting and PCR). High throughput platforms/methods – Microarrays, RNA-seq, Nanostring, Nanopore, PacBio, pyrosequencing, flow cytometry and phenotyping of single cells, Quality control, comparison of methods – their scope and limitations

Unit III

Analysis (Lecture 9)

Inference and integration, Multiple hypothesis testing and the false discovery rate,

Unit IV

Gene Expression (Lecture 9)

Normalization, correlation and clustering to determine differential gene expression, guilt-by-association and regulatory networks

Unit V

Prospects and perspectives (Lecture 9)

Meta-omics and single-cell omics

Suggested Reading/ Reference Books/ Textbooks

1. An Introduction to Genetic Engineering(link is external) - 3rd Edition - Desmond S. T. Nicholl - Cambridge University Press
2. Molecular Biotechnology: Principles and Applications of Recombinant DNA (link is external)- 4th Edition - Bernard R. Glick, Jack J. Pasternak, Cheryl L. Patten - ASM Press
3. Synthetic Biology: Tools and Application by Huimin Zhao
4. Bioengineering: A conceptual Approach by Mirjana Pavlovic
5. Principles of Gene Manipulation and Genomics – 7th Edition – Sandy B. Primrose, Richard Twyman – Blackwell Publishing
6. Gene Cloning and DNA Analysis: An Introduction(link is external) - 6th Edition - T. A.Brown - John Wiley & Sons

SYLLABUS STRUCTURE SHEET

Structural biology & Bioinformatics

University: MGM University, Aurangabad

Faculty: Basic & Applied Science

Institute: Institute of Biosciences and Tech.

Degree: M.Sc. Bioinformatics (PG)

Course Unit Code: MTMML112

Course Unit Title: Structural biology & Bioinformatics

Credits allocated:3+0(Theory)

Level of Study: PG

Mode of delivery planned learning activities and teaching method: Lecture 3 hrs / weekly

Recommended Year /Semester: Bioinformatics Year 1/ Semester II

Prerequisites for registration: Registration of a student in various courses in consultation with the respective course teacher and Adviser and acceptance by the principal. The approved courses must be mentioned in the roster form.

Candidates should pass in undergraduate Life Science.

COURSE DESCRIPTION:

Structural biology, determining the three-dimensional shape of a protein, can tell us a lot about how a protein functions and the role it plays within a cell. Bioinformatics data derived from structural determination experiments can aid biological researchers asking a wide variety of questions. It aids the understanding of how DNA mutations might alter a protein's shape, disrupt a catalytic site, or alter the binding affinity of a pharmaceutical compound.

This course explores bioinformatics data resources and tools for the interpretation and exploitation of bio-macromolecular structures. It will focus on how best to analyse available structural data to gain useful information given specific research contexts. The course content will investigate the impact of genetic variation on structure, predicting protein structure and function, and exploring interactions with other macromolecules as well as with low-MW compounds. Participants will also have an opportunity to explore protein docking using HADDOCK. The students shall obtain necessary skills to analyze and predict structural properties of biological macromolecules and complexes, which includes proteins and nucleic acids. Our students shall gain a good understanding of key concepts of structure and dynamics of biological assemblies at the atomic, molecular, and cellular level.

OBJECTIVES:

This course will enable the students to:

- understand the levels of structural organization of macromolecules and experimental methods of structure determination
- know the approaches for structure analysis
- acquire knowledge of various algorithms & methods of structure prediction
- understand the principles of macromolecular interactions

OUTCOME

On completion of the course, the student should be able to:

1. Access and browse a range of structural data repositories
2. Explain the relationship between protein sequence and protein structure
3. Describe how structure translates into function within different biological fields such as catalysis, transport and regulation
4. Estimate the validity of information in macromolecular structure databases, and use computer programs to visualize and analyze macromolecular structures from a functional perspective
5. Use bioinformatics tools for sequence alignment, sequence motif identification and prediction of secondary and tertiary structures

DETAIL COURSE CONTENT (Lecture 45)

UNIT I (Lecture 9)

Relation between sequence, structure and function. Structural basis for macromolecular dynamics,binding specificity and catalysis. Overview of biological databases, servers and information centers. Sequence comparisons. Basic macromolecular structure: three-dimensional structure, PDB coordinates, classification of proteins in structure families, programs for analysis and comparison of structures. Introduction to the theory of classification and comparison of sequences and extraction of common distinctive features (e.g., motifs). Sequence analysis for

prediction of secondary and tertiary structures, and homology modelling of three-dimensional structures based on sequence data.

UNIT II (Lecture 9)

Macromolecular Structure Protein - Primary, Secondary, Super secondary, Tertiary and Quaternary structure, Potential energy maps, Ramachandran map, Nucleic acid – DNA and RNA, Carbohydrates o Coordinate systems

UNIT III (Lecture 9)

Overview of experimental techniques to study macromolecular structures o Methods to study 3D structure: X-ray, NMR, Cryo-electron microscopy o Validation using Procheck, ProsaII

UNIT IV (Lecture 9)

Principles of protein folding and methods to study protein folding · Macromolecular interactions , Protein – Protein, Protein – Nucleic acids Protein - carbohydrates

UNIT V (Lecture 9)

Structure of Ribosome · Prediction of protein structure o secondary structure prediction methods First, second and third generation methods o Tertiary structure prediction ,Homology modelling, fold recognition and ab initio methods

Public repositories of structural data: Protein Data Bank (PDB) and Electron Microscopy Data Bank (EMDB), and tools to search and analyze information in these repositories from PDBe (Protein Data Bank in Europe)

Computational approaches to structure prediction: ModBase, Rosetta, PHYRE, Interactome 3D Protein docking: HADDOCK

Reading

1. The Molecules of Life – Physical and Chemical Principles. First Edition, 2012. John Kuriyan, Boyana Konforti, and David Wemmer. Garland Science. Taylor & Francis.
2. Forbes Burkowski. Structural bioinformatics: An algorithmic approach. Publisher: CRC
3. Introduction to Proteins – Structure, Function, and Motion. First Edition, 2011. Amit Kessel and Nir Ben-Tal.
4. Structural Bioinformatics, Vol. 44, Series: Methods of Biochemical Analysis; 2005, Editor(s): Philip E. Bourne, Helge Weissig. Print ISBN: 9780471202004; Online ISBN: 9780471721208; DOI: 10.1002/0471721204
5. Drenth Jan. Principles of Protein X-Ray Crystallography. Publisher: Netherlands, Springer Science. 2007. ISBN: 9780387333342.
6. Bourne Philip E., Weissig Helge. Structural Bioinformatics (Methods of Biochemical Analysis, V. 44), 2003. Publisher: Wiley-Liss. ISBN: 0471202002.
7. Höltje Hans-Dieter, Sippl Wolfgang, Rognan Didier, Folkers Gerd. Molecular Modeling: Basic Principles and Applications. Publisher: New York, Wiley-VCH. 2003. ISBN: 3527305890.

8. Leach, Andrew. Molecular Modelling: Principles and Applications. Publisher: Prentice Hall. 2001. ISBN: 0582239338. ·

9. Friesner Richard A. Computational Methods for Protein Folding:advances in Chemical Physics Volume 120 Kindle Edition. Publisher: New York, John Wiley & Sons. 2002. ISBN: 0471209554.

10. Heilmeyer L., Friedrich P. Protein Modules in Cellular Signalling. Publisher: Amsterdam, IOS Press. 2001. ISBN: 1586031805.

SYLLABUS STRUCTURE SHEET

R & Python language and Data Science, Introduction to quantum computing

University: MGM University, Aurangabad
Faculty: Basic & Applied Science
Institute: Institute of Biosciences and Tech.
Degree: M.Sc. Bioinformatics (PG)
Course Unit Code: MTMML113
Course Unit Title: R & Python language and Data Science, Introduction to quantum computing
Credits allocated:3+0(Theory)
Level of Study: PG

Mode of delivery planned learning activities and teaching method: Lecture 3 hrs / weekly

Recommended Year /Semester: Bioinformatics Year 1/ Semester II

Prerequisites for registration: Registration of a student in various courses in consultation with the respective course teacher and Adviser and acceptance by the principal. The approved courses must be mentioned in the roster form.

COURSE DESCRIPTION:

R and Python is an open-source programming language that is widely used as a statistical software and data analysis tool. They generally comes with the Command-line interface. They available across widely used platforms like Windows, Linux, and macOS. Also, the programming language is the latest cutting-edge tool.

OUTCOMES:

Learning Outcomes After the successful completion of this module, students will be able to: Install, Code and Use Programming Language in RStudio/IDE to perform basic tasks on Vectors, Matrices and Data frames. Describe key terminologies, concepts and techniques employed in Statistical Analysis.

Detailed syllabus (Lecture 45)

Unit 1

Introduction (Lecture 9)

Introduction to R and Python, Data structures, Data visualization, Data analysis, Important statistical concepts used in data science, Difference between population and sample

Types of variables, Measures of central tendency, Measures of variability, Coefficient of variance, Skewness and Kurtosis

Unit II

Introduction to quantum computing (Lecture 9)

(Just) enough quantum mechanics to understand quantum computation., Quantum algorithms., Simon's algorithm, The prime factorization algorithm, Grover's search algorithm

Mathematical models of quantum computation, their relationships to each other, and to physical systems., Quantum error correcting codes, Quantum cryptography, Quantum fault tolerance

Unit III (Lecture 9)

Inferential statistics

Normal distribution, Test hypotheses, Central limit theorem, Confidence interval, T-test, Type I and II errors, Student's T distribution

Unit IV

Regression and Anova(Lecture 9)

Regression, ANOVA, Correlation and causation

Unit V

Exploratory data analysis (Lecture 9)

Data visualization, Missing value analysis, The correction matrix, Outlier detection analysis, Neural networks, Support vector machine, Logistic and linear regression, Decision tree classifier

Suggested Reading/ Reference Books/ Textbooks

1) R for Data Science: Import, Tidy, Transform, Visualize, and Model Data
2) The Book of R: A First Course in Programming and Statistics
3) R For Dummies
4) Discovering Statistics Using R
5) The Art of R Programming: A Tour of Statistical Software Design
6) R for Everyone: Advanced Analytics and Graphics
7) Machine Learning with Python

SYLLABUS STRUCTURE SHEET

Computational Bioinformatics lab

(Practical)

University: MGM University, Aurangabad

Faculty: Basic & Applied Science

Institute: Institute of Biosciences and Tech.

Degree: M.Sc. Bioinformatics (PG)

Course Unit Code: MTMEP114

Course Unit Title: Computational Bioinformatics lab (Practical)

Credits allocated: 2 (Practical)

Level of Study: PG

Mode of delivery planned learning activities and teaching method: Practical 3 hrs / weekly

Recommended Year /Semester: Bioinformatics Year 1/ Semester II

Prerequisites for registration: Registration of a student in various courses in consultation with the respective course teacher and Adviser and acceptance by the principal. The approved courses must be mentioned in the roster form.Candidates should pass in undergraduate Life Science.

Practical List (Lecture 30)

1. Data Analytics
2. Quantitative Genomics
3. Genomics, Computing, Economics, and Society
4. Genomic Medicine
5. Information Technology in the Health Care System of the Future
6. Computational Evolution Biology
7. Introduction to Computational Molecular Biology
8. Computational Neuroscience
9. Health Information Literacy for Data Analytics Specialization
10. Command Line Tools for Genomic Data Science
11. Bioconductor for Genomic Data Science
12. Genome Assembly Programming Challenge
13. Business Application of Machine Learning and Artificial Intelligence in Healthcare
14. Principles of fMRI 2
15. Design technology and innovation

Suggested Reading/ Reference Books/ Textbooks

1. Introduction to Bioinformatics by A. Bagchi
2. Bioinformatics: A Practical Guide to the Analysis of Genes and Proteins (Methods of Biochemical Analysis) by Andreas D. Baxevanis, B. F. Francis Ouellette
3. Introduction to Bioinformatics by Teresa Attwood
4. Structural Bioinformatics by Philip E. Bourne, Jenny Gu
5. Introduction To Bioinformatics By Lesk
6. Bioinformatics Sequence And Genome Analysis By David W. Mount
7. Web resource http://dpuadweb.depauw.edu/cfornari_web/Genomics/Resources/ResourcesBio325.htm
8. Essential Bioinformatics by Jin Xiong

RDT lab (Practical)

University: MGM University, Aurangabad
Faculty: Basic & Applied Science
Institute: Institute of Biosciences and Tech.
Degree: M.Sc. Bioinformatics (PG)
Course Unit Code: MTMEP115
Course Unit Title: RDT lab (Practical)
Credits allocated: 2 (Practical)
Level of Study: PG

Mode of delivery planned learning activities and teaching method: Practical 3 hrs / weekly

Recommended Year /Semester: Bioinformatics Year 1/ Semester II

Prerequisites for registration: Registration of a student in various courses in consultation with the respective course teacher and Adviser and acceptance by the principal. The approved courses must be mentioned in the roster form.Candidates should pass in undergraduate Life Science.

Practical List (Lecture 30)

ISOLATION OF PLASMID FROM E. coli CELLS

Analysis of Plasmid DNA by agarose gel electrophoresis

RESTRCTION DIGESTION OF DNA

LIGATION OF DNA

ISOLATION OF RNA FROM MAMMLIAN CELLS

cDNA SYNTHESIS AND REAL TIME PCR

PROTEIN SEPARATION BY SDS- PAGE

WESTERN BLOTTING

Reverse Pipetting Technique

Light Microscopy

Blood film preparation: Staining and Reading

Dilution Procedure

Suggested Reading/ Reference Books/ Textbooks

1. WHO METHODS MANUAL FOR LABORATORY QUALITY CONTROL TESTING OF MALARIA RAPID DIAGNOSTIC TESTS V.10_MARCH 2023

SYLLABUS STRUCTURE SHEET

Algorithm design and analysis (python, Julia and R)

University: MGM University, Aurangabad	**Faculty:** Basic & Applied Science
Institute: Institute of Biosciences and Tech.	**Degree:** M.Sc. Bioinformatics (PG)
Course Unit Code: MTMEP116	**Course Unit Title: Algorithm design and analysis (python, Julia and R)**
Credits allocated:2 (Practical)	**Level of Study:** PG

Mode of delivery planned learning activities and teaching method: Practical 4 hrs / weekly

Recommended Year /Semester: Bioinformatics Year 1/ Semester II

Prerequisites for registration: Registration of a student in various courses in consultation with the respective course teacher and Adviser and acceptance by the principal. The approved courses must be mentioned in the roster form.

Candidates should pass in undergraduate Life Science.

Practical List (Lecture 30)

1. Program to peak finding.

2. Implementation Merge Sort and Binary Search Sort.

3. Implementation Bubble Sort.

4. Program to worst case.

5. Implementation of Complexity classes

(a) Linear complexity

(b) Constant complexity.

6. Program to Iterative and Recursive and factorial using Recursion

7. Program to Floyd and Warshall algorithm.

8. Implementation of Brute force algorithm.

9. Implementation of Divide and Conquer algorithm.

10. Program to numerical algorithm.

11. Program to Heap and Quick Sort.

12. Implementation of Traversal tree.

13. Program to Adjacency tree.

14. Program to Depth and Breadth first Traversals.

15. Program to Dijkstra's algorithm.

R Lab

University: MGM University, Aurangabad

Faculty: Basic & Applied Science

Institute: Institute of Biosciences and Tech.

Degree: M.Sc. Bioinformatics (PG)

Course Unit Code: MTMEP117

Course Unit Title: R Lab

Credits allocated:2 (Practical)

Level of Study: PG

Mode of delivery planned learning activities and teaching method: Practical 4 hrs / weekly

Recommended Year /Semester: Bioinformatics Year 1/ Semester II

Prerequisites for registration: Registration of a student in various courses in consultation with the respective course teacher and Adviser and acceptance by the principal. The approved courses must be mentioned in the roster form.

Candidates should pass in undergraduate Life Science.

Practical List (Lecture 30)

1. Download and install R-Programming environment and install basic packages using install.packages() command in R.
2. Learn all the basics of R-Programming (Data types, Variables, Operators etc,.)
3. Write a program to find list of even numbers from 1 to n using R-Loops.
4. Create a function to print squares of numbers in sequence.
5. Write a program to join columns and rows in a data frame using cbind() and rbind() in R.
6. Implement different String Manipulation functions in R.
7. Implement different data structures in R (Vectors, Lists, Data Frames)
8. Write a program to read a csv file and analyze the data in the file in R.
9. Create pie chart and bar chart using R.
10. Create a data set and do statistical analysis on the data using R.

Suggested Reading/ Reference Books/ Textbooks

Norman Matloff, The Art of R Programming, UC Davis 2009.

WEB REFERENCE: https://www.r-project.org/

SYLLABUS STRUCTURE SHEET

MICRO PROJECT

University: MGM University, Aurangabad	**Faculty:** Basic & Applied Science
Institute: Institute of Biosciences and Tech.	**Degree:** M.Sc. Bioinformatics (PG)
Course Unit Code: MTMMJ118	**Course Unit Title:**Micro PROJECT
Credits allocated:0+2(Practical)	**Level of Study:** PG

Mode of delivery planned learning activities and teaching method: Practical 4 hrs / weekly

Recommended Year /Semester: Bioinformatics Year 1/ Semester II

Prerequisites for registration: Registration of a student in various courses in consultation with the respective course teacher and Adviser and acceptance by the principal. The approved courses must be mentioned in the roster form.

Candidates should pass in undergraduate Life Science.

Course Outcomes:

1. Students will be able to practice acquired knowledge within the chosen area of technology for project development.
2. Identify, discuss and justify the technical aspects of the chosen project with a comprehensive and systematic approach.

Ideas of project:

Defining project ideas is crucial for setting realistic expectations and laying out a clear vision for a project life cycle. Project-based learning not only provides opportunities for students to collaborate or drive their own learning, but it also teaches them skills such as problem solving, and helps to develop additional skills integral to their future, such as critical thinking and time management.

Literature survey:

A literature review establishes familiarity with and understanding of current research in a particular field before carrying out a new investigation. Conducting a literature review should enable you to find out what research has already been done and identify what is unknown within your topic.

Performance:

Performance measurement during a project is to know how things are going so that we can have early warning of problems that might get in the way of achieving project objectives and so that we can manage expectations. The criteria of it as given below.

Implementation:

Follows closely the design, uses appropriate techniques with skill and understanding to produce a good solution.

1. Evaluation:

Clearly relates to the problem. Shows a good understanding and appreciation of the solution. Objectives of what has been done.

2. Project Log:

a. The individual student's effort and commitment.

b. The quality of the work produced by the individual student.

c. The student's integration and co-operation with the rest of the group.

d. The completeness of the logbook & time to time signature of guide **Objective**: To elaborate the procedure for Guiding Student projects **Responsibility:**

- All the Project Guide.
- All Semester B.Sc. students
- Project Heads

PROCEDURE

SN	Activities	Responsibilities
1	PG students are decide on their team members for their semester project with their proposed project domain and title	Project head, PG students
2	Director shall allocate the project guide based on their area of expertise (ot more than 3 batches to a guide)	Director
3	Ensuring that students have regular discussion meetings with their project guides.	Project guide Project head
4	Synopsis preparation and submission	Project head
5	Verification of student project log book	Project guide Project head
6	Approval of PPT : Abstract,existing, proposed system. 30% of proposed work. 80% of proposed work. 100% of proposed work.	Project guide
7	Preparation and submission of progress report during project	Students Project head
8	Preparing list for Redo students (insufficient content, plagiarism, poor presentation, genuine absentees.	Project head
9	Submission of hard copy of project report	Project head
10	Evaluation of project report	External examiner
11	Organizing final project viva-voce	Project heads
12	Ensuring that if a candidate fails to submit the project report on or before the specified deadline , he/she is deemed to have failed in the project work and shall re – enroll for the same	Project head Project guide Director

FIELD PROJECT

University: MGM University, Aurangabad	**Faculty:** Basic & Applied Science
Institute: Institute of Biosciences and Tech.	**Degree:** M.Sc. Bioinformatics (PG)
Course Unit Code: MTFPJ119	**Course Unit Title:** Field Project
Credits allocated: 0+4 (Practical)	**Level of Study: PG**

Mode of delivery, planned learning activities and teaching method: Practical 4 hrs / weekly

Prerequisites for registration: Registration of a student in various courses in consultation with the respective course teacher and Adviser and acceptance by the principal. The approved courses must be mentioned in the roster form.Candidates should pass in undergraduate Life Science.

Course Outcomes:

1. Students will be able to practice acquired knowledge within the chosen area of technology for project development.
2. Identify, discuss and justify the technical aspects of the chosen project with a comprehensive and systematic approach.

Ideas of project:

Defining project ideas is crucial for setting realistic expectations and laying out a clear vision for a project life cycle. Project-based learning not only provides opportunities for students to collaborate or drive their own learning, but it also teaches them skills such as problem solving, and helps to develop additional skills integral to their future, such as critical thinking and time management.

Literature survey:

A literature review establishes familiarity with and understanding of current research in a particular field before carrying out a new investigation. Conducting a literature review should enable you to find out what research has already been done and identify what is unknown within your topic.

Performance:

Performance measurement during a project is to know how things are going so that we can have early warning of problems that might get in the way of achieving project objectives and so that we can manage expectations. The criteria of it as given below.

3. Implementation:

Follows closely the design, uses appropriate techniques with skill and understanding to produce a good solution.

4. Evaluation:

Clearly relates to the problem. Shows a good understanding and appreciation of the solution. Objectives of what has been done.

5. Project Log:

a. The individual student's effort and commitment.

b. The quality of the work produced by the individual student.

c. The student's integration and co-operation with the rest of the group.

d. The completeness of the logbook & time to time signature of guide **Objective**: To elaborate the procedure for Guiding Student projects **Responsibility:**

- All the Project Guide.
- All Semester B.Sc. students
- Project Heads

PROCEDURE

SN	Activities	Responsibilities
1	PG students are decide on their team members for their semester project with their proposed project domain and title	Project head, PG students
2	Director shall allocate the project guide based on their area of expertise (ot more than 3 batches to a guide)	Director
3	Ensuring that students have regular discussion meetings with their project guides.	Project guide Project head
4	Synopsis preparation and submission	Project head
5	Verification of student project log book	Project guide Project head
6	Approval of PPT : Abstract,existing, proposed system. 30% of proposed work. 80% of proposed work. 100% of proposed work.	Project guide
7	Preparation and submission of progress report during project	Students Project head
8	Preparing list for Redo students (insufficient content, plagiarism, poor presentation, genuine absentees.	Project head
9	Submission of hard copy of project report	Project head
10	Evaluation of project report	External examiner
11	Organizing final project viva-voce	Project heads
12	Ensuring that if a candidate fails to submit the project report on or before the specified deadline , he/she is deemed to have failed in the project work and shall re – enroll for the same	Project head Project guide Director