MGM UNIVERSITY, AURANGABAD INSTITUTE OF BIOSCIENCES AND TECHNOLOGY

CHOICE-BASED CREDIT SYSTEM (CBCS) SEMESTER PATTERN

Faculty of Basic and Applied Sciences Graduate (UG) Program

BIOINFORMATICS - CURRICULUM

W.e.f. **Academic Year 2023-24**

B.Sc., B. Sc. (Hons.), B. Sc. (Hons.) with Research of Bioinformatics

SEMESTER (I,II)

Prepared By
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Submitted By
Dr. S. V. Maske

Approved By
Board of Studies

BIOINFORMATICS- CURRICULUM

Academic Year 2023-24

B.Sc., B. Sc. (Hons.), B. Sc. (Hons.) with Research Bioinformatics

FIRST YEAR

SEMESTER I , II

MGM University
Chhatrapati Sambhaji Nagar– 431003
(Template format as per discussion at 14/05/2023)

Name of the College/Institute: Institute of Bioscience and Technology **Faculty of** Basic and Applied Sciences Graduate (UG) Program
Name of the Program :**(3/4 Years UG programme)** B.Sc./B.Sc. Hons./B.Sc. Hons with Research Bioinformatics
Program Type: - B.Sc./B.Sc. Hons/B.Sc. Hons with Research Bioinformatics **UG** Duration: - 04 Years (08 Semesters)

Level	First Year (Semester I)																				
4.5	Course Type	Course code	Course Title	Type	Teaching period per week (Hrs /week)			Credits	Duration of exam	Evaluation Scheme (Marks)							Minimum Passing (Marks)			
										Internal				External		Total	Internal	External		Total
					L	T	P			CA-I	MSE	CA-II	T W	ESE	PR		CA/MSE/TW	ESE	PR	
	Core	BTMML101	Physics I-Mechanics and Relativity	Theory	2			2		10	10	10	-	20	-	50		08		20
	Core	BTMML102	C Programming & computer organization	Theory	3		-	3		20	20	20	-	40	-	100		16		40
	IKS		Annexure I	Theory	2		-	2		10	10	10	-	20	-	50		08	-	20
	AEC		Ability Enhancement course	Theory	2	-	-	2		10	10	10	-	20	-	50		08		20
	OE**	BTOEL103	Open Elective I	Theory	2		-	2		10	10	10	-	20	-	50		08		20
	OE	BTOEL104	Open Elective II	Theory	2		-	2		10	10	10	-	20	-	50		08		20
	VSC*	BTVSP105	Bioinformatics Lab	Practical			4	2					30		20	50			08	20
	SEC*	BTSEP106	Programming Lab	Practical			4	2					30		20	50			08	20
	VEC		Value Education Course	Theory	2	-	-	2		10	10	10	-	20	-	50		08		20
	Core	BT MMP107	Foundations of Bioinformatics-I	Practical	-	-	2	1			-		30	-	20	50			08	20
	CC		Co-curricular Course	Practical		-	4	2			-		30	-	20	50			08	20
		Total (L-T-P) Hrs / week = 29			**15**		**14**	**22**												

Level	First Year (Semester II)																							
4.5	Course	Course code	Course Title	Type	Teaching period per week			Credit	Duration of exam	Evaluation Scheme								Total	Minimum Passing				
										Internal					External				Internal		External		Total
					L	T	P			CA-I	MSE	CA-II	TW		ESE	PR			CA/MSE/TW		ESE	PR	
	Core	BTMML108	C++ Programming	Theory	2			2		10	10	10	-		20	-	50			08		20
	Core	BTMML109	Data structures and Algorithms	Theory	3		-	3		20	20	20	-		40	-	100			16		40
	MIN	BTMIL110	Annexure I	Theory	2		-	2		10	10	10	-		20	-	50			08		20
	AEC		Ability Enhancement course	Theory	2	-	-	2		10	10	10	-		20	-	50			08		20
	OE**	BTOEL111	Open Elective I	Theory	2		-	2		10	10	10	-		20	-	50			08		20
	OE	BTOEL112	Open Elective II	Theory	2		-	2		10	10	10	-		20	-	50			08		20
	VSC*	BTVSP113	Bioinformatic Lab II	Practical			4	2					30			20	50				8	20
	SEC*	BTSEP114	Bioinformatics Exploration I	Practical			4	2					30			20	50				8	20
	VEC		Annexure I	Theory	2	-	-	2		10	10	10	-		20	-	50			08		20
	Core	BT MMP115	Foundations of Bioinformatics-II	Practical	-	-	2	1			-		30		-	20	50				08	20
	CC		Annexure I	Practical	-	-	4	2			-		30		-	20	50				08	20
		Total (L-T-P) Hrs / week = 29			**15**		**14**	**22**																

Level	First Year (Semester I)																					
4.5	Course Type	Course code	Course Title	Type	Teaching period per week (Hrs /week)			Credits	Duration of exam	Evaluation Scheme (Marks)							Minimum Passing (Marks)			
										Internal				External		Total	Internal	External		Total
					L	T	P			CA-I	MSE	CA-II	T W	ESE	PR		CA/MSE/TW	ESE	PR	
	Core	BTMML101	Physics I-Mechanics and Relativity	Theory	2			2		10	10	10	-	20	-	50		08		20
	Core	BTMML102	C Programming & computer organization	Theory	3		-	3		20	20	20	-	40	-	100		16		40
	IKS		Annexure I	Theory	2		-	2		10	10	10	-	20	-	50		08	-	20
	AEC		Ability Enhancement course	Theory	2	-	-	2		10	10	10	-	20	-	50		08		20
	OE**	BTOEL103	Open Elective I	Theory	2		-	2		10	10	10	-	20	-	50		08		20
	OE	BTOEL104	Open Elective II	Theory	2		-	2		10	10	10	-	20	-	50		08		20
	VSC*	BTVSP105	Bioinformatics Lab	Practical			4	2					30		20	50			08	20
	SEC*	BTSEP106	Programming Lab	Practical			4	2					30		20	50			08	20
	VEC		Value Education Course	Theory	2	-	-	2		10	10	10	-	20	-	50		08		20
	Core	BT MMP107	Foundations of Bioinformatics-I	Practical	-	-	2	1			-		30	-	20	50			08	20
	CC		Co-curricular Course	Practical		-	4	2			-		30	-	20	50			08	20
		Total (L-T-P) Hrs / week = 29			**15**		**14**	**22**												

BTMML101 PHYSICS I- MECHANICS AND RELATIVITY

University: MGM University, Aurangabad **Faculty**: Basics and Applied Science

Institute: Institute of Biosciences and Tech. **Degree:** Bioinformatics (UG)

Course Unit Code: BTMML101 **Course Unit Title:** Physics I- Mechanics and Relativity

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

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

Recommended Year /Semester: Bachelor of Science, Year 1/ Semester I

Course Outcome:

After completion of this course students will be able to understand types of reasoning, predictions/conjectures, theoretical frameworks, laws, and models, observational inquiry.

Objectives:

To study the fundamentals of Mechanics & Relativity.

COURSE CONTENTS

THEORY (Total Lecture 30)

Unit I Laws Of Motion **(6 Lecture)**

Newton's Laws Of Motion: Force and Interactions, Newton's First Law, Newton's Second Law, Mass and Weight, Newton's Third Law.

Applying Newton's Laws: Applications of Newton's First Law: Particles in Equilibrium, Using Newton's Second Law: Dynamics of Particles, Frictional Forces, Dynamics of Circular Motion, The Fundamental Forces of Nature.

Unit II Work and Energy **(6 Lecture)**

Work and Kinetic Energy: Work, Kinetic Energy and the Work–Energy Theorem, Work and Energy with Varying Forces, Power.

Potential Energy and Energy Conservation: Gravitational Potential Energy, Elastic Potential Energy, Conservative and Non conservative Forces , Force and Potential Energy, Energy Diagrams.

Unit III Momentum & Rotation **(6 Lecture)**

Momentum, Impulse, and Collisions: Momentum and Impulse, Conservation of Momentum, Momentum Conservation and Collisions, Elastic Collisions, Center of Mass, Rocket Propulsion.

ROTATION OF RIGID BODIES: Angular Velocity and Acceleration, Rotation with Constant Angular Acceleration, Relating Linear and Angular Kinematics, Energy in Rotational Motion, Parallel-Axis Theorem, Moment-of-Inertia Calculations.

Unit IV: Gravitation **(6 Lecture)**

Newton's Law of Gravitation, Weight, Gravitational Potential Energy, The Motion of Satellites, Kepler's Laws and the Motion of Planets, Spherical Mass Distributions, Apparent Weight and the Earth's Rotation, Black Holes.

Unit V: Special Relativity **(6 Lecture)**

Relativity, Galilean Relativity, The Postulates of Special Relativity, The Relativity of Time; Four-Dimensional Space-Time; Four-Vectors, The Invariant Scalar Product, The Quotient Rule and Doppler Effect, Collisions, Force in Relativity, Massless Particles; the Photon.

Reference Books:

1.Resnick, Robert. Introduction to Special Relativity. New York, NY: Wiley, 1968. ISBN: 9780471717256.

2.French, Anthony Philip. Special Relativity. New York, NY: Norton, 1968. ISBN: 9780393097931.

3.Einstein, Albert A. Relativity: The Special and the General Theory. New York, NY: Three Rivers Press/Random House, 1995. ISBN: 9780517884416.

4.University Physics, Sears & Zemansky, Young and Freedman Pearson Fundamentals of Physics, Halliday and Resnick.

BTMML102 C Programming & computer organization

University: MGM University, Aurangabad **Faculty:** Basics and Applied Sciences

Institute: Institute of Biosciences and Tech. **Degree:** Bioinformatics (UG)

Course Unit Code: BTMML102 **Course Unit Title:** C Programming & computer organization

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

Mode of delivery planned learning activities and teaching syllabus method: Lecture 3 hrs / week. (On-site method)

Recommended Year /Semester: Bachelor of Science, Year 1/ Semester I

Objective of the Course:

The course is designed to provide complete knowledge of C language. Students will be able

to develop logics which will help them to create programs, applications in C. Also, by learning

the basic programming constructs they can easily switch over to any other language in future.

Learning Outcomes:

After the completion of this course, the students will be able to develop applications

Course Content (45 Total Lecture)

Unit – I: **(Lecture 9)**

Types Of Programming Languages, Introduction To C, Historical Development of C Language, Structure Of C, Program Fundamentals the C Character Set, Identifiers and Keywords, Data Types, Constants, operators.

Used In C, Variables and Types of C Variables, Declaration, Expressions, Statements, Symbolic Constants, I/O Statements used in C.

Unit – II:(Lecture 9)

Branching: If Statement, If-Else Statement, If-Else Ladder, Switch Statement. Looping: While Loop, Do-While Loop, For Loop, Nested Control Structures, Jumps In Loop- Break Statement, Continue Statements, Go to Statement.

Unit – III: (Lecture 9)

What Is An Array? , Declaring And Initializing An Array , One-Dimensional Array , Multi-Dimensional Array, Passing array to function, Strings- What Are Strings ,Declaring And Initializing String Variables ,Reading And Writing Of String , Standard Library Functions User-Defined Functions , Return Types , Passing Arguments To A Functions , Scope And LifeTime Of Variables In Function, Nesting Of Functions ,Recursion, Functions And Array.

Unit – IV: (Lecture 9)

Introduction To Pointers, Declaring And Initializing Pointers, Accessing A Variable Through Its Pointer to Pointer Expression, Pointers And Arrays, Pointers And Character Strings, Array of Pointer

and pointer to pointer Introduction, Structure, Structure Initialization, Array Of Structure**s**, Arrays Within Structure.

Unit – V: (Lecture 9)

Introduction To Union Automatic Storage Class, Register Storage Class, Static Storage Class External Storage Class. Introduction, Defining And Opening A File, Closing A File, Input/Output Operations On File, Error Handling During I/O Operations, Random Access To file.

References:

1. Programming With C By Byron Gottfried Second Edition, Tata-Mcgraw-Hill.

2. Let Us C By Yashwant Kanetkar 4th Edition Bpb Publication.

3. Pointers In C By Yashwant Kanetkar 3rd Edition.

4. Programming in Ansi C by E. Balagurusamy.

BTVSP105 **Bioinformatics LAB- I**

University: MGM University, Aurangabad **Faculty:** Basics and Applied Sciences

Institute: Institute of Biosciences and Technology. **Degree:** Bioinformatics (UG)

Course Unit Title: Bioinformatics Lab- I **Course Unit Title:** Bioinformatics Lab- I

Course Code- BTVSP105 **Credits-** 0+2 (2 Practical)

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

Recommended Year /Semester: Year 1/ Semester 1 **Level of Study**: UG

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.

Objective: Students will get familiar with the topic in detail. They will have hands on different instruments. They will develop technical handling skills.

Learning outcomes: Students will gain knowledge about the need of research in a particular field and the idea development of how the lacuna can be erased that can be of social benefit.

COURSE CONTENTS

Synopsis, Lab work, Thesis Writing, Presentation

Ideas of Lab:

Defining Lab ideas is crucial for setting realistic expectations and laying out a clear vision for a Lab life cycle. Lab-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 Lab is to know how things are going so that we can have early warning of problems that might get in the way of achieving Lab 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. Lab 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 Labs

Responsibility:

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

BTSEP106 **Programming Lab**

University: MGM University, Aurangabad **Faculty:** Basics and Applied Sciences

Institute: Institute of Biosciences and Tech. **Degree:** Bioinformatics (UG)

Course Unit Code: BTSEP106 **Course Unit Title:** Programming Lab

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

Mode of delivery planned learning activities and teaching syllabus method: 4 hrs / week. (On-site method)

Recommended Year /Semester: Bachelor of Science, Year 1/ Semester I

Objective of the Course:

The course is designed to provide complete knowledge of C language. Students will be able to develop logics which will help them to create programs, applications in C. Also, by learning the basic programming constructs they can easily switch over to any other language in future.

Learning Outcomes:

After the completion of this course, the students will be able to develop applications

Course Content

1. C Programs of basic structure and all data types, different format printf and scanf functions.
2. C Programs on all operators.
3. C Programs on all C language tokens.
4. C Programs on Decision making statements.
5. C Programs on looping statements.
6. C programs on functions and arrays.
7. C programs on pointer and structure.
8. C programs on file handling.
9. C Programs on Standard Template Library (STL).
10. C Programs based on any microcontrollers.
11. C++ Programs on object Oriented Concepts.
12. C++ Programs on file and exception handling.

(At least 10 different programs on following topics in C/C++ programming)

13. Programs to basic operations i.e. insert, delete, search and sort on array, and Linked List (circular linked list and doubly linked List).
14. Programs to implement stack queue using linked List and array and perform the all basic

operations.

15. Programs on implementation of tree, tree traversals, Heap and perform all operations on all types of tree.

16. Programs to implement all sorting algorithms

17. Programs on implementation of graph data structure and perform all operations i.e. add Node, remove Node, add Edge, remove Edge.

18. Programs to implement Kruskal and Prim algorithms.

19. Programs to implement shortest path algorithms.

REFERENCE BOOKS

1. Brian W. Kernighan, Dennis Ritchie, C Programming Language: C Programming Language, Prentice Hall

2. Steven Holzner, C++ Programming Black Book, dreamtech press

3. Schildt, C++: The Complete Reference, Tata McGraw-Hill Education

4. R.G. Dromey, How to Solve it by Computer, ISBN:9788131705629, Pearson Education

5. E. Balagurusamy, C – programming Tata McGray Hill

6. Gottfried, Schaums outline of Theory and Problems of programming with C

7. Richard H. Barnett, Sarah Cox, Larry O'Cull, Embedded C Programming and the Atmel AVR, f Cengage Learning

8. Mark Siegesmund, Embedded C Programming: Techniques and Applications of C and PIC MCUS,

Newnes

9. Michael Barr, Programming Embedded Systems in C and C++, "O'Reilly Media, Inc

10. Chuck Hellebuyck, Beginner's Guide to Embedded C Programming, Electronic Products

BTMMP107 **Foundations of Bioinformatics- I**

University: MGM University, Aurangabad **Faculty**: Basics and Applied Sciences

Institute: Institute of Biosciences and Tech. **Degree:** Bioinformatics (UG)

Course Unit Code: BTMMP107 **Course Unit Title:** Foundations of Bioinformatics- I

Credits allocated: 1 (0 Theory+1 Practical) **Level of Study:** UG

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

Recommended Year /Semester: Bachelor of Science, Year 1/ Semester I

Learning Outcomes

Examine and apply the fundamentals of cellular and molecular biology concepts to biotechnology research and its practical applications.

Develop and maintain laboratory records according to standard scientific and industrial guidelines. Employ mathematical skills and knowledge of chemistry to accurately prepare an aqueous solution with the desired chemical concentrations and ph.

Objectives:

1. To explore students with hands-on laboratory techniques.
2. To unable students for different skills sets.
3. To acquire students Lab etiquettes.
4. Applying principles of lab safety.
5. Keeping accurate records with sufficient information to reproduce what was done.
6. Preparing aqueous solutions of varying composition.

PRACTICAL: List of Experiments

1. Laboratory practicals based on Newton's Laws.
2. Practical's based on calculations of work & energy.
3. Measurement of angular velocity/angular momentum.
4. Determination of gravitational acceleration.
5. The Microscope
6. DNA and RNA: Structure and Function
7. Mitosis: Cell Division
8. Meiosis
9. DNA Extraction
10. Genetics Problems
11. Population Demographics
12. Population Genetics Simulation
13. Bacterial Selection

14. The Effect of Abiotic Factors on Habitat Preference
15. Isolation of Plasmid DNA by alkaline lysis method
16. Agarose gel electrophoresis of genomic DNA & plasmid DNA
17. To identify lipids in a given sample by TLC.
18. Isolation of bacteria & their biochemical characterization.
19. Staining methods: simple staining, Gram staining, spore staining, negative staining, hanging drop.
20. Preparation of media & sterilization methods, Methods of Isolation of bacteria from different sources.
21. Determination of bacterial cell size by micrometry.
22. To determine the solubility of compounds in polar & non polar solvents
23. Principles & operations of Incubators & Shaker.
24. Principle & operation of Centrifuge.
25. Principle & operation of pH meter.
26. Principle & operation of Colorimeter.
27. Principle & operation of Spectrophotometer (3 Periods) 10. Electrophoresis techniques.

REFERENCE BOOKS:

1.Biotechnology: A laboratory Skills Course, J. Kirk Brown 2011 (ISBN-13: 978-0-9832396-0-4).

2.Methods in Biotechnology, SB Hong, MB Rashid, LZ Santiago-Vazquez 2017 (ISBN-13: 978-1-119-15678-9).

3.Quantitative Analysis in Chemistry by Vogel (link is external).

4.Practical Chemistry for BSc I, II- & III-year students O.P Pandey, D.N Bajpai, S. Giri.

5.Advanced practical physical chemistry by Yadav.

Level	First Year (Semester II)																							
4.5	Course	Course code	Course Title	Type	Teaching period per week			Credit	Duration of exam	Evaluation Scheme								Total	Minimum Passing				
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					L	T	P			CA-I	MSE	CA-II	TW		ESE	PR			CA/MSE/TW		ESE	PR	
	Core	BTMML108	C++ Programming	Theory	2			2		10	10	10	-		20	-	50			08		20
	Core	BTMML109	Data structures and Algorithms	Theory	3		-	3		20	20	20	-		40	-	100			16		40
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	OE	BTOEL112	Open Elective II	Theory	2		-	2		10	10	10	-		20	-	50			08		20
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	VEC		Annexure I	Theory	2	-	-	2		10	10	10	-		20	-	50			08		20
	Core	BT MMP115	Foundations of Bioinformatics-II	Practical	-	-	2	1			-		30		-	20	50				08	20
	CC		Annexure I	Practical	-	-	4	2			-		30		-	20	50				08	20
		Total (L-T-P) Hrs / week = 29			**15**		**14**	**22**																

BTMML108 **C++ PROGRAMMING**

University: MGM University, Aurangabad **Faculty:** Basics and Applied Sciences

Institute: Institute of Biosciences and Tech. **Degree:** Bioinformatics (UG)

Course Unit Code: BTMML108 **Course Unit Title:** C++ programming

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

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

Recommended Year /Semester: Bachelor of Science, Year 1/ Semester II

Course Outcome:

Students will acquire programming skills.

Students will develop the ability to implant any biological algorithms in C/C++.

Objectives:

To understand the structure of C/C++ programs

To understand the how computer program is compiled and executed

To learn how to write C/ C++ classes

To learn how to implement text files having nucleotide data for analysis

Course Contents (30 Total Lectures)

THEORY

Unit I (6 Lectures)

Introduction: - Overview of Computer Programming languages, History of C programming, application of C Programming Language, How C language is different from machine and Assembly languages, Structure of C program, Creating, compilation, and executing simple C/C++ program, Types of C/C++ instruction (Declaration, Arithmetic and logical, Input and output, and Controlling), keywords, all preprocessors, conditional inclusion; C language concepts (with example of C program) :- printf and scanf function and its different formats, header files; C Tokens:- data types, constants, variables, static variable, register variable, scope of variable, Automatic variable, identifiers, operators, operator precedence, comments, format specifiers and literals, escape sequence, and Special characters, storage classes, types casting, ASCII values, file inclusion, macro substitution, order of evaluation, complicated declaration.

Unit II(6 Lectures)

Controlling Statement:- Introduction to controlling statement, Flow charts; Decision Making:- if, if...else, nested if, multiple if, switch and multiple switch statements, The ? : Operator; Looping:- while, for, do-while statement, nested loop, break, continue, and goto keywords, infinite loop, Scope Rules; Function:-Simple function, call by values, call by variables, call by reference, return keyword, command line arguments, variable length arguments; Array:-what is an array, 1-D array, 2-D array,

array of all data types, pass and retuning array to and from function; Pointer:- what is a pointer variable, array of pointer, passing and returning pointer to and from function, Dangling and wild pointer, static and dynamic memory allocation; Structure:- structure, passing and returning structure variable to and from function, typedef keyword, array of structure, structure in structure (nested structure), pointer to structure, Self-Referential Structures, table lockup, Bit-fields, and union.

Unit III (6 Lectures)

File handling:-create, open, close, update, append simple text file; Standard Template Library (STL):assert.h, complex.h, ctype.h, errno.h, fenv.h, float.h, inttypes.h, iso646.h, limits.h, locale.h, math.h, setjmp.h, signal.h, stdalign.h, stdarg.h, stdatomic.h, stdbool.h, stddef.h, stdint.h, stdio.h, stdlib.h, stdnoreturn.h, string.h, tgmath.h, threads.h, time.h, uchar.h, wchar.h, wctype.h; CPP (C++):

Unit IV (6 Lectures)

Introduction to c++, Difference between C and C++, Basic Concept of C++, characteristic of C++, keywords, input and output; Object Oriented Concepts: -Object, pointer to objects, Class, Inheritance, Polymorphism, Abstraction and encapsulation. File handling, Exception handling; C++ Standard Template Library: - Utilities library, Dynamic memory management, Numeric limits, Error handling, Strings library, Containers library, Iterators library, Ranges library, Algorithms library, Numerics library, Input/output library etc.

Unit V (6 Lectures)

Embedded C and C++: Introduction to microcontroller, types of microcontroller, architecture of microcontroller, how C programs loads and execute on microcontrollers, Input/out operations, controlling statements, LCD and LED programs, serial communication programs, data collection from environment through sensors; Project: development of system based on any real time problem.

REFERENCE BOOKS:

1. Brian W. Kernighan, Dennis Ritchie, C Programming Language: C Programming Language, Prentice Hall.

2. Steven Holzner, C++ Programming Black Book, dreamtech press.

3. Schildt, C++: The Complete Reference, Tata McGraw-Hill Education.

4. R.G. Dromey, How to Solve it by Computer, ISBN:9788131705629, Pearson Education.

5. E. Balagurusamy, C – programming Tata McGray Hill.

6. Gottfried, Schaum's outline of Theory and Problems of programming with C.

7. Richard H. Barnett, Sarah Cox, Larry O'Cull, Embedded C Programming and the Atmel AVR, f Cengage Learning.

8. Mark Siegesmund, Embedded C Programming: Techniques and Applications of C and PIC MCUS, Newnes.

9. Michael Barr, Programming Embedded Systems in C and C++, "O'Reilly Media, Inc.

10. Chuck Hellebuyck, Beginner's Guide to Embedded C Programming, Electronic Products.

BTMML109 DATA STRUCTURES AND ALGORITHMS

University: MGM University, Aurangabad **Faculty:** Basics and Applied Sciences

Institute: Institute of Biosciences and Tech. **Degree:** Bioinformatics (UG)

Course Unit Code: BTMML109 **Course Unit Title**: Data structures and Algorithms

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

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

Recommended Year /Semester: Bachelor of Science, Year 1/ Semester II

Course Outcome:

• Describe how primitive and non-primitive data types are represented in memory.

• Describe common applications of primitive and non-primitive data structure.

• Write programs that use arrays, records, linked structures, stacks, queues, trees, and graphs

Objectives:

• To introduce the fundamental concept of data structures.

• To understand the importance of data structures implementing efficient algorithms.

• To learn and understand the primitive and non-primitive data structure to manage the primary memory for software.

Course Contents (45 Lectures)

THEORY

Unit I Data structures

Linear or Sequential ADTs: Basic concepts of data structure, primitive and non primitive data types, Abstract Data Type (ADT), Basic Operations on ADTs:- Insertion, Deletion, Searching, and Sorting the elements; Static Memory Allocation: Array and List, Implementation of List using Array, Basic operation Array and List; Dynamic Memory Allocation: Linked List, Implementation of Linked List using Node-Pointer, circular and doubly Linked List; Stack:- Introduction to stack, Implementation of using Array and Linked List, Basic Operation on Stack; Queue:-Introduction to Queue, Implementation using array and Linked List, Basic operation on Queue. Recursion: Implementation of recursive procedure by stack.

Unit II Algorithms

Introduction to Algorithms: Introduction to Algorithms, characteristics of Algorithms, Analysis of Algorithms, Role of Algorithms, Algorithm Complexity- Time and space, Asymptotic Analysis: Growth of function, Big Oh Notation (O), Omega Notation (Ω), Theta Notation (θ), Types of Abstract Algorithms: Dynamic programming, Greedy algorithms, Divide and Conquer, Backtracking, Natural Algorithms: GA, SA, ANN, TS, Amortized Analysis.

Unit III Tree

Introduction tree data structure, basic concepts of tree, tree terminologies, tree implementation Using Linked List, Binary tree:-Operation on binary tree, binary tree traversal, preorder traversal, In order traversal, post order traversal, level order traversal, Binary search tree, self adjusting binary search tree, Splay tree, AVL tree, Spanning tree, Red-Black tree, B tree, B+ Tree, single and double rotation, Heap, Disjoint sets.

Unit IV Sorting and searching Algorithms

Introduction to sorting algorithm; Heapsort: Heap property, Building a heap, heapsort algorithm; Qucksort:- description, performance, and analysis of quicksort. Radix and bucket sort, Bubble sort, insertion sort, selection sort, merge sort, shell sort, radix sort, complexity of sorting algorithms, Comparison of sorting algorithms, Searching Algorithms: Linear search, Binary search, Jump search, interpolation and exponential search, Fibonacci Search and sublist search, complexity of searching algorithms, comparison of searching algorithms.

Unit V Graph

Introduction to graph, Graph theory terminology, Representation and Implementation of Graph, Graph traversal, directed and undirected graph, cyclic and acyclic graph, Weighted graph, Minimum spanning tree:- Kruskal and Prim algorithms, shortest path:- Breadth-First search (BFS), Depth-First search (DSF), The Bellman-Ford algorithm, Dijkstra's algorithm, Flog-Warshall Algorithm, Johnson's algorithm, Ford-Fulkerson method, Push-relabel algorithm, Relabel-to-Front algorithm.

REFERENCE BOOKS

1. Seymour Lipschutz, Data Structures, McGraw-Hill Education.

2. Pat Morin, Open Data Structures: An Introduction, of Athabasca University Press.

3. J.A. Storer, An Introduction to Data Structures and Algorithms, Springer Science & Business Media.

4. Cormen, Thomas H Cormen, Charles E Leiserson, Ronald L Rivest, Clifford Stein, Introduction to Algorithms, The MIT Press.

5. Parag H. Dave, Design and Analysis of Algorithms, Pearson Education India.

6. A. A. Puntambekar, Advanced Data Structures, Technical Publications.

7. Mayank Patel, Data Structure and Algorithm With C, Educreation Publishing.

8. Michael T. Goodrich, Roberto Tamassia, David M. Moun, Data Structures and Algorithms in C++, John Wiley & Sons.

9. John Carey, Shreyans Doshi, Payas Rajan, C++ Data Structures and Algorithm Design Principles, Packt Publishing Ltd.

10.Adam Drozdek, Data Structures and Algorithms in Java, Cengage Learning.

11.Michael T. Goodrich, Roberto Tamassia, Michael H. Goldwasser, Data Structures and Algorithms in Java, John Wiley & Sons.

12.John Rast Hubbard, Anita Huray, Data Structures with Java, Pearson Prentice Hall.

BTMIL110 CHEMISTRY I

University: MGM University, Aurangabad **Faculty:** Basic and Applied Sciences

Institute: Institute of Biosciences and Tech. **Degree**: Bioinformatics (UG)

Course Unit Code: BTMIL110 **Course Unit Title:** Chemistry I

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

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

Recommended Year /Semester: Bachelor of Science, Year 1/ Semester II

Course Objectives:

To enable students to understand the Structure of atom and bonding, types of acids and bases and physical properties of liquids, heat mechanism, surface phenomenon, catalyst along with periodic trends and classification of elements.

Learning Outcomes:

By studying this syllabus students are able to:

Understand the chemical composition of the matter in context to chemical bonding.

Describe basic concepts of thermodynamics and different thermos chemical reactions along with heat of reaction.

Explain surface phenomenon and use of catalysts in chemical reactions.

Identifies and uses various types of acids and bases along with various physical properties of the liquids.

Classify various elements according to blocks of the periodic table.

Course Contents (Total Lectures 30)

THEORY

Unit-I Structure of Atom & Chemical Bonding **(6 Lectures)**

Atom - Concept, Subatomic particles, Rutherford's nuclear atomic model, Bohr's atomic model its postulates and limitations, atomic orbitals, Hybridization and its type Planck's quantum theory, quantum numbers, Heisenberg's uncertainty principle, electronic configuration-Aufbau's principle, Pauli's exclusion principle and Hund's rule. Chemical bond and its type, Ionic bond, Covalent bond, Coordinate bond and Hydrogen Bond and its characteristics, Valence bond theory (VBT), Molecular orbital theory (MOT) structure of Homonuclear diatomic molecules (H2, N2, O2, F2) Valence shell electron pair repulsion theory (VSEPR), Shapes of BeCl2, BF3, CH4, NH3 and H2O.

Unit-II Chemical kinetics and energetic **(6 Lectures)**

Homogeneous, Heterogeneous, Reversible, Irreversible reactions, Rate of reaction, Collision theory of reaction rate, Rate equation / Rate law, Factors affecting rate of reaction. Thermochemical reactions-Exothermic & Endothermic reaction, Enthalpy of reaction and its type- Enthalpy of

formation, Enthalpy of combustion, Enthalpy of Neutralization, Hess's law of constant heat summation.

Unit-III Surface chemistry, catalysis **(6 Lectures)**

Adsorption and Absorption, Mechanism of adsorption, Types of adsorptions- Chemisorption, Physisorption, application of adsorption. Catalysis-concept, Types of catalysis, characteristics of catalytic reaction, Promoters and Inhibitors (Poisoning), Enzyme catalysis Acid-Base catalysis, Intermediate compound formation theory and adsorption theory of catalysis.

Unit-IV Acids, Bases, Liquid state **(6 Lectures)**

Acids, Types of acids (Hydracids, Oxy-acids, ic-acids, ous-acids, Hypo-ous acids, per-ic acids, pyro-ic acids) Protocity or Basicity of acids. Bases, Types of bases (metal oxide & metal hydroxide) acidity of bases, Theories of catalysis: Arrhenius theory, Bronsted-Lowry theory, Lewis's theory, PH, POH, Buffer, Common ion effect.

Liquid state: Characteristics of liquid, Boiling point, Freezing point, Surface tension, Viscosity.

Unit-V Periodic classification of elements. **(6 Lectures)**

Modern periodic law, long form of periodic table, Classification of elements, General characteristics of s, p, d & f block elements, Periodic trends: Atomic size, Ionic radii, Electronegativity, Ionization potential/ energy.

Suggested Readings:

1. Essentials of Physical chemistry – B.S.Bahl, Arun Bahl & G.D.Tuli.

2.Physical Chemistry-P.W. Atkins ELBS, 5th edition.

3.Physical chemistry – G.W Castellan.

4.Advanced Physical chemistry – Puri & Sharma.

5.Concise Inorganic Chemistry-J.D. Lee.

6.Physical Chemistry by S. Glasstone.

7. Inorganic chemistry – D.F,Shriver & Atkins.

8.Modern approach to chemistry – Y.R.Sharma. Baidya Nath Bhuyan, Sudarshan Barua.

9. Modern Inorganic Chemistry – R.C Aggarwal.

10.E-Resources:

http://www.chemspider.com

https://openstax.org/subjects/science

BTVSP113 **Bioinformatic LAB- II**

University: MGM University, Aurangabad **Faculty:** Basics and Applied Sciences

Institute: Institute of Biosciences and Technology. **Degree:** Bioinformatics (UG)

Course Unit Title: Bioinformatic Lab- I **Course Unit Title:** Bioinformatic Lab- II

Course Code- BTVSP113 **Credits-** 0+2 (2 Practical)

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

Recommended Year /Semester: Year 1/ Semester II **Level of Study**: UG

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.

Objective: Students will get familiar with the topic in detail. They will have hands on different instruments. They will develop technical handling skills.

Learning outcomes: Students will gain knowledge about the need of research in a particular field and the idea development of how the lacuna can be erased that can be of social benefit.

COURSE CONTENTS

Synopsis, Lab work, Thesis Writing, Presentation

Ideas of Lab:

Defining Lab ideas is crucial for setting realistic expectations and laying out a clear vision for a Lab life cycle. Lab-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 Lab is to know how things are going so that we can have early warning of problems that might get in the way of achieving Lab 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. Lab 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 Labs

Responsibility:

- All the LabGuide.
- All Semester B.Sc. students
- Lab Heads

BTSEP114 BIOINFORMATICS EXPLORATION-I

University: MGM University, Aurangabad **Faculty:** Basics and Applied Sciences

Institute: Institute of Biosciences and Tech. **Degree:** Bioinformatics (UG)

Course Unit Code: BTSEP114 **Course Unit Title:** Bioinformatics Exploration-I

Credits allocated:2(0 Theory+1 Practical) **Level of Study:** UG

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

Recommended Year /Semester: Bachelor of Science, Year 1/ Semester II

Objectives:

1. To unable students with different skills for preliminary needed skills for project designing and development.
2. To aware student for understand market and their problem.
3. To explore and aware the students for finding the solution on different problems.

Course Outcomes As an outcome of completing the course, students will able to

1. Explain the role bioscience scientist as a problem solver
2. Identify multi-disciplinary approach required in solving as biosciences problem
3. Build simple systems using biotechnology and bioinformatics
4. Analyses biosciences solutions from ethical perspectives
5. Analyses biosciences solution from sustainability perspectives
6. Use basics of science project management skills in doing projects
7. Demonstrate data acquisition and analysis skills using a tool

Details Syllabus

UNIT 1 Introduction to Biotechnology and Bioinformatics and its study

Introduction to Biotechnology and Bioinformatics, difference between biosciences and advance life sciences,

UNIT 2 Protocol design and development

bioscientist needs and wants, various disciplines of biotechnology and bioinformatics, some misconceptions of advance sciences, expectation for the 21st century advance sciences

UNIT 3 Mechanism

Protocol development principles, elements of protocols, objectives, process of writing a protocol, format, problem identification, define variable, Hypothesis, Procedure and data interpretation

UNIT 4 Tools, Techniques, Data acquisition

Atoms and molecules, structure of the atom, the fundamental unit of life (Cell the unit of life, Biomolecule and cell cycle and cell division), Tissue , chemical reaction and equations, acids, bases and salt, Metals and Non-metals, Carbon and its compounds, periodic classification of elements, life processes

UNIT 5 Project Management

Control and coordination, how organism reproduce, Microorganism, diversity in living organisms, Heredity and evolution (Molecular basis of inheritance), Bioinformatics principles and Processes

BTMMP115 **Foundations of Bioinformatics- II**

University: MGM University, Aurangabad **Faculty:** Basics and Applied Science

Institute: Institute of Biosciences and Tech. **Degree:** Bioinformatics (UG)

Course Unit Code: BTMMP115 **Course Unit Title:** Foundations of Bioinformatics- II

Credits allocated: 1 (0 Theory+ 1 Practical) **Level of Study:** UG

Mode of delivery planned learning activities and teaching syllabus method: 2 hrs / week

Recommended Year /Semester: Bachelor of Science, Year 1/ Semester II

Course Outcomes:

Students will be able to study & analyze the biological data utilizing the organisms, plants, bacteria etc.

Understand effect of electricity and magnetism on materials

Understand evolution of life

Structure and its relationship with the cell

Objectives:

To understand the Basics of Life

To understand the various organisms and classify.

To understand the various methods can be analyzed by the Biological data.

To understand the role of Bacteria, Plants, Animals etc in Bioinformatics.

Course Contents

PRACTICAL: List of Experiments

1.Measurement of heat changes using a calorimeter(link is external)

2.Inorganic preparations- Synthesis of Coordination complexes and to study the stability of complexes by varying pH, temperature, ligand .

3.Estimation of aspirin in a tablet by colorimetry.

4.Specific heat capacity of metals using calorimeters.

5.Science of Organisms

6.Determination of specific conductivity of soil(link is external)

7.Crystal field theory of complexes

8.Estimation of protein by Folin Lowry method

9.Determination of Km and V max of amylase.

10.Estimation of RNA by Orcinol method

11.Estimation of DNA by diphenyl amine method

12.Verification of Beer's Law Spectrophotometrically

13.Testing of Blood Sugar

14.Testing of Liver Function Test (Bilirubin, SGOT, SGPT, Alkaline Phosphatase, Albumin, Globulin, Total Protein)

15.Testing of Renal Function Test (Urea, Uric acid, Creatine, Creatinine)

16.Basic sterilization techniques required for Media preparation & Cytological techniques

17.Media preparation technique

18.Determination of serum albumin by Bromocresol green method.

19.Determination of total cholesterol.

20.Determination of SGOT.

21.Determination of SGPT.

22.Assaying IAA oxidase activity in green and senescent leaves

23.Studies on induction of amylase activity by GA3 in germinating cereal grains

REFERENCE BOOKS

1. Exploring creation with Biology- Wile and Durnell.

2. Biology by Raven and Johnson.

3. Brock Biology of Microorganisms – Madigan et al, 9th ed.

4. Biology by Campbell and Reece.

5. Biology: Understanding Life by S. Alters & John Wiley & Sons.

List of Options to select from Bucket of Courses provided in various categories (Sample of Faculty of Basic and Applied Sciences):

Major
Bioinformatics

Minor options Within Faculty of Basic Sciences	**Food Nutrition and Dietetics**
	Microbiology
	Biotechnology
	Food Technology and Processing

Minor options from Other Faculty	**Faculty of Engineering and Technology**	**Faculty of Social Sciences and Humanities**	**Faculty of Design**	**Faculty of Management and Commerce**	**Interdisciplinary Faculty**	**Performing Arts**
	Artificial Intelligence (AI)	Journalism and Mass Communication	Product Design	Operations and Supply Management	Cosmetic Technology	Theatre Arts
	Machine Learning (ML)	Film Making	Visual Communication	Human Resource (HR)	Educational Technology	Dance
	Data Analytics	Photography	Contemporary Arts	Finance Management	Yog Sciences	Music
	Robotics	Psychology	Interior Design	Marketing	Physical Education	Painting
	Industrial Automation	Economics	Fashion Technology	Accounting	Library Sciences	Pottery

IKS (As per the UGC guidelines. Visit Link:https://iksindia.org/English-BGSamposhan-Kendram-1-updated.pdf) * **	**Faculty of**		**AEC (to be discussed and developed by committee of Dean)***			**OE(Provide 4-8 courses of your department to be approved by the BOS)**	**Faculty of**
Holistic medicine and wellness			Communicative English			MATLAB	Dr. G. Y.P College
Indian psychology and yoga	***Courses For reference purpose only		Communication and Soft Skills	*Courses For reference purpose only		Web Application using HTML	Dr. G. Y.P College
Indian sports and martial arts			German			Artificial Intelligence	Dr. G. Y.P College
Architectural engineering, town planning, civil engineering, Vaastu and Shilpa Shastra			French			Deep Learning	Dr. G. Y.P College
Sustainable agriculture and food preservation methods			Spanish			Data Science	Dr. G. Y.P College

VSEC (Respective departments will prepare the list)	**Faculty of**		**CC(Two courses to be finalized for I & II Semester)*** **		**VEC (to be discussed and developed by committee of Dean) *** **
			NSS	*****Courses For reference purpose only**	Universal Human Values
			Digital Awareness		
			Personality Development		Gandhian Studies
			Yoga		
			NCC		Value Education

Level	First Year (Semester I)																					
4.5	Course Type	Course code	Course Title	Type	Teaching period per week (Hrs /week)			Credits	Duration of exam	Evaluation Scheme (Marks)							Minimum Passing (Marks)			
										Internal				External		Total	Internal	External		Total
					L	T	P			CA-I	MSE	CA-II	TW	ESE	PR		CA/MSE/TW	ESE	PR	
	Core	BTMML101	Physics I-Mechanics and Relativity	Theory	2			2		10	10	10	-	20	-	50		08		20
	Core	BTMML102	C Programming & computer organization	Theory	3		-	3		20	20	20	-	40	-	100		16		40
	IKS		Annexure I	Theory	2		-	2		10	10	10	-	20	-	50		08	-	20
	AEC		Ability Enhancement course	Theory	2	-	-	2		10	10	10	-	20	-	50		08		20
	OE**	BTOEL103	Open Elective I	Theory	2		-	2		10	10	10	-	20	-	50		08		20
	OE	BTOEL104	Open Elective II	Theory	2		-	2		10	10	10	-	20	-	50		08		20
	VSC*	BTVSP105	Bioinformatics Lab	Practical			4	2					30		20	50			08	20
	SEC*	BTSEP106	Programming Lab	Practical			4	2					30		20	50			08	20
	VEC		Value Education Course	Theory	2	-	-	2		10	10	10	-	20	-	50		08		20
	Core	BT MMP107	Foundations of Bioinformatics-I	Practical	-	-	2	1			-		30	-	20	50			08	20
	CC		Co-curricular Course	Practical		-	4	2			-		30	-	20	50			08	20
		Total (L-T-P) Hrs / week = 29			**15**		**14**	**22**								600				

Level	First Year (Semester II)																						
4.5	Course	Course code	Course Title	Type	Teaching period per week			Credit	Duration of exam	Evaluation Scheme								Minimum Passing				
										Internal					External		Total	Internal		External		Total
					L	T	P			CA-I	MSE	CA-II	TW		ESE	PR		CA/MSE/TW		ESE	PR	
	Core	BTMML108	C++ Programming	Theory	2			2		10	10	10	-		20	-	50			08		20
	Core	BTMML109	Data structures and Algorithms	Theory	3		-	3		20	20	20	-		40	-	100			16		40
	MIN	BTMIL110	Annexure I	Theory	2		-	2		10	10	10	-		20	-	50			08		20
	AEC		Ability Enhancement course	Theory	2	-	-	2		10	10	10	-		20	-	50			08		20
	OE**	BTOEL111	Open Elective I	Theory	2		-	2		10	10	10	-		20	-	50			08		20
	OE	BTOEL112	Open Elective II	Theory	2		-	2		10	10	10	-		20	-	50			08		20
	VSC*	BTVSP113	Bioinformatic Lab II	Practical			4	2					30			20	50				8	20
	SEC*	BTSEP114	Bioinformatics Exploration I	Practical			4	2					30			20	50				8	20
	VEC		Annexure I	Theory	2	-	-	2		10	10	10	-		20	-	50			08		20
	Core	BT MMP115	Foundations of Bioinformatics-II	Practical	-	-	2	1			-		30		-	20	50				08	20
	CC		Annexure I	Practical	-	-	4	2			-		30		-	20	50				08	20
		Total (L-T-P) Hrs / week = 29			**15**		**14**	**22**									600					

*As per the requirement VSC / SEC can be used for Theory or Practical of core subject **As per the requirement, Department/Institute can offer OE practical

Level 4.5 Award of UG certificate with 44 credits and an additional 4-credits core NSQF course / internship OR continue with major and minor

Level	Second Year (Semester III)																						
5.0	Course Type	Course code	Course Title	Type	Teaching period per week			Credits	Duration of exam	Evaluation Scheme (Marks)						Minimum Passing (Marks)						
										Internal			External		Total	Internal			External		Total
					L	T	P			CA	MSE	TW	ESE	PR		CA	MSE	TW	ESE	PR	
	Core	BTMML201	Molecular Biology of cell	Theory	2	-	-	2		20	10	-	20	-	50				08		20
	Core	BTMML202	Mathematical Techniques for Bioinformatics-III	Theory	3	-	-	3		40	20	-	40	-	100				16		40
	Core	BTMML203	Introduction to Bioinformatics	Theory	2	-	-	2		20	10	-	20	-	50				08		20
	OE	BTOEL204	Annexture I	Theory	2	-	-	2		20	10	-	20	-	50				08		20
	MIN	BTMIL205	Annexture I	Theory	3	-	-	3		40	20	-	40	-	100				16		40
	AEC		Ability Enhancement course	Theory	2	-	-	2		20	10	-	20	-	50				08		20
	VSC	BTVSJ206	Mini Project	Practical		-	4	2			-	30	-	20	50					08	20
	MIN	BTMIP207	Annexture I	Practical	-	-	2	1		20	10	-	20	-	50				08		20
	Core	BTMMP208	Bioinformatics Labs.	Practical	-	-	2	1			-	30	-	20	50					08	20
	FP	BTFPJ209	Field Project	Practical		-	4	2				30	-	20	50					08	20
	CC		Annexture I	Practical		-	4	2			-	30	-	20	50					08	20
		Total (L-T-P) Hrs / week = 30			**14**		**16**	**22**							600						

Level	Second Year (Semester IV)																					
5.0	Course	Course code	Course Title	Type	Teaching period per week			Credit	Duration of exam	Evaluation Scheme						Minimum Passing						
										Internal			External		Total	Internal			External		Total
					L	T	P			CA	MSE	TW	ESE	PR		CA	MSE	TW	ESE	PR	
	Core	BTMML210	Genetics of Life	Theory	2	-	-	2		20	10	-	20	-	50				08		20
	Core	BTMML211	Computational Molecular Biology	Theory	3	-	-	3		40	20	-	40	-	100				16		40
	Core	BTMML212	Structural Bioinformatics	Theory	2	-	-	2		20	10	-	20	-	50				08		20
	OE	BTOEL213	Annexture I	Theory	2	-	-	2		20	10	-	20	-	50				08		20
	MIN	BTMIL214	Annexture I	Theory	3	-	-	3		40	20	-	40	-	100				16		40
	AEC		Annexture I	Theory	2	-	-	2		20	10	-	20	-	50				08		20
	SEC	BTSEP215	Mini Project	Practical		-	4	2			-	30	-	20	50					08	20
	MIN	BTMIL216	Annexture I	Practical	-	-	2	1			-	30	-	20	50					08	20
	Core	BTMMP217	Python and Structural Bioinformatics Lab.	Practical	-	-	2	1			-	30	-	20	50					08	20
	CEP		Community Engagement and Service (Mini project)	Practical		-	4	2				30	-	20	50					08	20
	CC		Co-curricular Course	Practical		-	4	2			-	30	-	20	50					08	20
		Total (L-T-P) Hrs / week = 30			**14**		**16**	**22**							650						

Level 5.0Award of UG Diploma in major and minor with (44+44)= 88 credits and an additional 4-credits core NSQF course / internship OR continue with major and minor

Level	Third Year (Semester V)																							
5.5	Course Type	Course code	Course Title	Type	Teaching period per week			Credits	Duration of exam	Evaluation Scheme (Marks)						Minimum Passing (Marks)								
										Internal			External		Total	Internal			External		Total			
					L	T	P			CA	MSE	TW	ESE	PR		CA	MSE	TW	ESE	PR				
	Core	BTMML301	System Biology	Theory	2	-	-	2		20	10	-	20	-	50				08		20			
	Core	BTMML302	Algorithms in Bioinformatics	Theory	3	-	-	3		40	20	-	40	-	100				16		40			
	Core	BTMML303	Database Management System	Theory	2	-	-	2		20	10	-	20	-	50				08		20			
	Core elective	BTMEL304	Foundations of Machine learning and AI	Theory	3		-	3		40	20	-	40	-	100				16		40			
	MIN	BTMIL305	Annexture I	Theory	3		-	3		40	20	-	40	-	100				16		40			
	VSC	BTVSL306	Vocational Skill Course	Theory	2	-		2		20	10	-	20	-	50				08		20			
	VSC	BTVSJ307	Mini Project	Practical		-	4	2			-	30	-	20	50					08	20			
	MIN	BTMIL308	Annexture I	Practical	-	-	2	1			-	30	-	20	50					08	20			
	Core	BTMMP309	DBMS Labs and Machine Learning Lab.	Practical	-	-	2	1			-	30	-	20	50					08	20			
	FP/CEP	BTFPJ310	Field Project/Community Engagement and Service	Practical		-	4	2				30	-	20	50					08	20			
	Core elective	BTMEP311	Seminar (Research Paper based)	Practical	-	-	2	1				30	-	20	50					08	20			
		Total (L-T-P) Hrs / week = 29			**15**		**14**	**22**							700									

Level	Third Year (Semester VI)																					
5.5	Course	Course code	Course Title	Type	Teaching period per week			Credit	Duration of exam	Evaluation Scheme						Minimum Passing						
										Internal			External		Total	Internal			External		Total
					L	T	P			CA	MSE	TW	ESE	PR		CA	MSE	TW	ESE	PR	
	Core	BTMML312	Biological Data analysis-I	Theory	2	-	-	2		20	10	-	20	-	50				08		20
	Core	BTMML313	Genomics and Proteomics	Theory	3	-	-	3		40	20	-	40	-	100				16		40
	Core	BTMML314	Statistical methods in Bioinformatics and Statistical Inference	Theory	3	-	-	3		40	20	-	40	-	100				16		40
	Core elective	BTMEL315	Metabolomics	Theory	3	-	-	3		40	20	-	40	-	100				16		40
	MIN	BTMIL316	Annexture I	Theory	3	-	-	3		40	20	-	40	-	100				16		40
	OJT	BTJTI317	On Job Training/Internship/Apprenticeship	Practical		-	4	2			-	30	-	20	50					08	20
	OJT	BTJTI318	On Job Training/Internship/Apprenticeship	Practical		-	4	2			-	30	-	20	50					08	20
	MIN	BTMIP319	Annexture I	Practical	-	-	2	1			-	30	-	20	50					08	20
	Core	BTMMP320	Genomics, Proteomics and Metabolomics Lab.	Practical	-	-	2	1			-	30	-	20	50					08	20
	Core	BTMMJ321	Mini project	Practical	-	-	2	1			-	30	-	20	50					08	20
	Core elective	BTMEP322	Data analysis and statistics	Practical	-	-	2	1				30	-	20	50					08	20
			Total=30		14		16	**22**							750						

Level 5.5 Award of UG degree in major and minor (44+44+44)=132 credits OR continue with major and minor

Level	Four Year (Semester VII)																					
6.0	Course Type	Course code	Course Title	Type	Teaching period per week			Credits	Duration of exam	Evaluation Scheme (Marks)						Minimum Passing (Marks)						
										Internal			External		Total	Internal			External		Total
					L	T	P			CA	MSE	TW	ESE	PR		CA	MSE	TW	ESE	PR	
	Core	BTMML401	Biological Data analysis-II	Theory	3	-	-	3		40	20	-	40	-	100				16		40
	Core	BTMML402	Medical Informatics	Theory	3	-	-	3		40	20	-	40	-	100				16		40
	Core	BTMML403	Agriculture Informatics	Theory	3	-	-	3		40	20	-	40	-	100				16		40
	Core	BTMML404	Biosafety, IPR and Bioethics	Theory	2		-	2		20	10	-	20	-	50				08		20
	Core elective	BTMEL405	Agriculture & Medical Informatics	Theory	3	-	-	3		40	20	-	40	-	100				16		40
	RM		Research Methodology	Theory	3	-	-	3		40	20	-	40	-	100				16		40
	RM		Research Methodology	Practical	-	-	2	1			-	30	-	20	50					08	20
	Core elective	BTMEP406	R Programming	Practical	-	-	2	1				30	-	20	50					08	20
	Core	BTMMP407	Biological Data analysis Lab.	Practical	-	-	2	1			-	30	-	20	50					08	20
	Core	BTMMJ408	Major Project	Practical	-	-	2	1			-	30	-	20	50					08	20
	Core	BTMMP409	Deep Learning with Python	Practical	-	-	2	1			-	30	-	20	50					08	20
			Total = 27		17		10	**22**							800						

Level	Four Year (Semester VIII)																					
6.0	Course	Course code	Course Title	Type	Teaching period per week			Credit	Duration of exam	Evaluation Scheme					Total	Minimum Passing						
										Internal			External			Internal			External		Total
					L	T	P			CA	MSE	TW	ESE	PR		CA	MSE	TW	ESE	PR	
	Core	BTMML410	Chemistry-II	Theory	3	-	-	3		40	20	-	40	-	100				16		40
	Core	BTMML411	Biology: Concept, Connections, Investigation and applications	Theory	3	-	-	3		40	20	-	40	-	100				16		40
	Core	BTMML412	Physics II-Electricity and Magnetism	Theory	3	-	-	3		40	20	-	40	-	100				16		40
	Core	BTMML413	Entrepreneurship Bioinformatics	Theory	2		-	2		20	10	-	20	-	50				08		20
	Core elective	BTMEL414	Science of organisms	Theory	3	-	-	3		40	20	-	40	-	100				16		40
	OJT	BTJTI415	On Job Training/Internship/Apprenticeship	Practical			4	2				30	-	20	50					08	20
	OJT	BTJTI416	On Job Training/Internship/Apprenticeship	practical			4	2				30	-	20	50					08	20
	Core elective	BTMEP417	Software Design Labs.	Practical	-	-	2	1				30	-	20	50					08	20
	Core	BTMMP418	Practical Based on Research Methodology	Practical	-	-	2	1			-	30	-	20	50					08	20
	Core	BTMMP419	Big Idea	Practical	-	-	2	1			-	30	-	20	50					08	20
	Core	BTMMP420	Programming Labs	Practical	-	-	2	1			-	30	-	20	50					08	20
			Total = 30		14		16	**22**							750						

Level 6.0 Four year UG Honours Degree in major and minor (44+44+44+44) = 176 credits

Level			Fourth Year (Semester VII)																						
					Teaching period per week			Credits	Duration of Exam	Evaluation Scheme (Marks							Minimum Passing (Marks)								
	Course Type	Course code	Course Title	Type	L	T	P			Internal				External		Total	Internal			External		Total
										CA 1	MSE	CA 2	TW	ESE	PR		CA	MSE	TW	ESE	PR	
6.0	Core	BTMML401	Biological Data analysis-II	Theory	3		-	3		20	20	20	-	40	-	100				16		40
	Core	BTMML402	Medical Informatics	Theory	2		-	2		20	20	20	-	40	-	100				16		40
	Core	BTMML403	Agriculture Informatics	Theory	2		-	2		20	20	20	-	40	-	100				16		40
	Core	BTMML404	Biosafety, IPR and Bioethics	Theory	2		-	2		10	10	10	-	20	-	50				8		20
	Core elective	BTMEL405	Agriculture & Medical Informatics	Theory	3		-	3		20	20	20	-	40	-	100				16		40
	RM		Research Methodology I	Theory	3		-	3		20	20	20	-	40	-	100				16		40
	RM		Research Methodology II	Practical	-	-	2	1		-	-	-	30	-	20	50					08	20
	Core elective	BTMEP406	R Programming	Practical	-	-	2	1					30	-	20	50					08	20
	Core	BTMMP407	Biological Data analysis Lab.	Practical	-	-	2	1		-	-	-	30	-	20	50					08	20
	RP		Research Project	Practical	-	-	8	4		-	-	-	30	-	20	50					08	20
			Total = 29		**15**		**14**	**22**														

Level	Fourth Year (Semester VIII)																							
					Teaching period per week			Credits	Duration of Exam	Evaluation Scheme (Marks							Minimum Passing (Marks)							
	Course Type	Course code	Course Title	Type	L	T	P			Internal				External		Total	Internal				External		Total
										CA 1	MSE	CA 2	TW	ESE	PR		CA	MSE	TW		ESE	PR	
6.0	Core	BTMML410	Chemistry-II	Theory	3		-	3		20	20	20	-	40	-	100					16		40
	Core	BTMML411	Biology: Concept, Connections, Investigation and applications	Theory	2		-	2		20	20	20	-	40	-	100					16		40
	Core	BTMML412	Physics II-Electricity and Magnetism	Theory	2		-	2		20	20	20	-	40	-	100					16		40
	Core	BTMML413	Entrepreneurship Bioinformatics	Theory	2		-	2		10	10	10	-	20	-	50					8		20
	Core elective	BTMEL414	Science of organisms	Theory	3		-	3		20	20	20	-	40	-	100					16		40
	Core elective	BTMEP417	Software Design Labs.	Practical	-	-	2	1					30	-	20	50						08	20
	Core	BTMMP418	Practical Based on Research Methodology	Practical	-	-	2	1		-	-	-	30	-	20	50						08	20
	RP		Research Project	Practical	-	-	16	8		-	-	-	30	-	20	50						08	20
			Total = 31		**12**		**20**	**22**															

Level 6.0Four year UG Honours with research Degree in major and minor (44+44+44+44) = 176 credits

*[Students who secure 75% marks and above in the first six semesters and wish to undertake research at the undergraduate level can choose a research stream in the fourth year.]

BTOEL103 Programming in C

University: MGM University, Aurangabad **Faculty:** Basics and Applied Sciences

Institute: Institute of Biosciences and Tech. **Degree:** Bioinformatics (UG)

Course Unit Code: BTOEL103 **Course Unit Title:** Programming in C

Credits allocated: 2 **Level of Study:** UG

Mode of delivery planned learning activities and teaching syllabus method: Lecture 2 hrs / week. (On-site method)

Recommended Year /Semester: Bachelor of Science, Year 1/ Semester I

Objective of the Course:

The course is designed to provide complete knowledge of C language. Students will be able to develop logics which will help them to create programs, applications in C. Also, by learning the basic programming constructs they can easily switch over to any other language in future.

Learning Outcomes:

After the completion of this course, the students will be able to develop applications

Course Content (30 Total Lecture)

Unit – I: (Lecture 8)

Introduction: - Overview of Computer Programming languages, History of C programming, application of C Programming Language, How C language is different from machine and Assembly languages, Structure of C program, Creating, compilation, and executing simple C program

Unit – II:(Lecture 8)

languages, Structure of C program, Creating, compilation, and executing simple C, program,Types of C,instruction (Declaration, Arithmetic and logical, Input and output, and Controlling),keywords, all preprocessors, conditional inclusion; C language concepts (with example of C program)

Unit – III: (Lecture 8)

printf and scanf function and its different formats, header files; C Tokens:- data types, constants, variables, static variable, register variable, scope of variable, Automatic variable, identifiers, operators, operator precedence, comments, format specifiers and literals, escape sequence, and Special characters, storage classes, types casting, ASCII values, file inclusion, macro substitution, order of evaluation, complicated declaration.

Unit – IV: (Lecture 6)

Controlling Statement: - Introduction to controlling statement, Flow charts; Decision Making:- if, if...else, nested if, multiple if, switch and multiple switch statements, The ? : Operator; Looping:- while, for, do-while statement, nested loop, break, continue, and goto keywords, infinite loop,

Scope Rules; Function:-Simple function, call by values, call by variables, call by reference, return keyword

References:

1. Programming With C By Byron Gottfried Second Edition, Tata-Mcgraw-Hill.

2. Let Us C By Yashwant Kanetkar 4th Edition Bpb Publication.

3. Pointers In C By Yashwant Kanetkar 3rd Edition.

4. Programming in Ansi C by E. Balagurusamy.

BTOEL104 **World of Bioinformatics**

University: MGM University, Aurangabad **Faculty:** Basics and Applied Sciences

Institute: Institute of Biosciences and Tech. **Degree:** Bioinformatics (UG)

Course Unit Code: BTOEL104 **Course Unit Title:** World of Bioinformatics

Credits allocated: 2 **Level of Study:** UG

Mode of delivery planned learning activities and teaching syllabus method: Lecture 2 hrs / week. (On-site method)

Recommended Year /Semester: Bachelor of Science, Year 1/ Semester I

Objective of the Course:

- Bioinformatics provides central, globally accessible databases that enable scientists to submit, search and analyze information.
- To make students understand the market and their problems. To explore and aware the students for finding the solution on different problems

Learning Outcomes:

As an outcome of completing the course, students will able to Explain the role bioscience

scientist as a problem solver.

• Identify the multi-disciplinary approach required in solving a biosciences problem.

•Build simple systems using biology and informatics.

• Analyses biosciences solutions from ethical perspectives.

• Analyses biosciences solutions from sustainability perspectives. Use basics of science

project management skills in doing projects.

• Demonstrate data acquisition and analysis skills using a tool

Course Content (30 Total Lecture)

Unit – I: Introduction to Bioinformatics (Lecture 8)

Introduction to Bioinformatics, History of Bioinformatics, Scope and application of bioinformatics, Data generation of large scale data from Molecular biology data(Through NMR Spectroscopy, X- RAY diffraction, Microarray, Genome sequencing , Protein sequencing , Gel electrophoresis) , Internet, www

UNIT II: Databases and Resources(Lecture 8)

Biological data, Nature of Biological data, Bioinformatics Resources – NCBI, EBI, SIB, Biological databases, Types of databases, Protein sequence database- PIR , Uniprot , Swissprot,

Structural database- PDB, NDB , Nucleic acid Sequence database- Genbank, EMBL,DDBJ, Introduction to Biological information Search engine,

Unit – III:: Sequence Alignment (Lecture 8)

Concept of sequence alignment, Types of sequence alignment- Pairwise sequence alignment , multiple sequence alignment , Methods of sequence alignment- LOCAL & GLOBAL alignment , sequence similarity search tool – BLAST , FASTA , Clustal-w , Clustal omega Matrices – PAM & BLOSUM

Unit – IV: Phylogenetics (Lecture 6)

Introduction to Phylogenetics,Evolution, Phylogenetic analysis, Phylogenetic data , substitution model , Tree building methods- tree evaluation method – MEGA , BOOTSTRAP , PHYLIP

References:

1. Bioinformatics and functional genomics by Pevsner J, 2 nd edition , Wiley

2. David W Mount Bioinformatics – Sequence and genome analysis 2 nd edition

3. Introduction to Bioinformatics (Atwood , T.K. and parry smith , D.J)

4. Essential Bioinformatics -Jin Xiong

BTOEL111 Genomics and Proteomics

University: MGM University, Aurangabad **Faculty:** Basics and Applied Sciences

Institute: Institute of Biosciences and Tech. **Degree:** Bioinformatics (UG)

Course Unit Code: BTOEL111 **Course Unit Title:** Genomics and Proteomics

Credits allocated: 2 **Level of Study:** UG

Mode of delivery planned learning activities and teaching syllabus method: Lecture 2 hrs / week. (On-site method)

Recommended Year /Semester: Bachelor of Science, Year 1/ Semester II

Objective of the Course:

To acquaint the student with genome organization, gene identification, expression and applications of genomics analysis. Also about proteomics, analysis and its applications

Learning Outcomes:

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

- Explain the current genomics and proteomics technologies and exploit the same in the growing field of omics.
- Interpret data obtained through high throughput expression studies.
- Apply the computational skills to plan and execute a biomedical 'omics' project.

Course Content (30 Total Lecture)

UNIT I: Introduction to Genomics and Proteomics:

Introduction – Organization and structure of genomes, Genome size, Sequence complexity, Introns and Exons, Genome structure in viruses and prokaryotes, Isolation of Chromosomes, chromosome micro dissection, Retrofitting. Introduction to Proteomics – The Proteome, Mining proteomes, Bridging Genomics and Proteomics. Proteomics and the new biology.

UNIT II: Gene Identification and Expression:

Genome annotation, traditional routes of gene identification, detecting open-reading Frames, software programs for finding genes, Identifying the function of a new gene, gene ontology, overview of comparative genomics, Protein structural genomics, determining gene

function by sequence comparison and through conserved protein structure Global expression profiling – Introduction, traditional approaches to expression profiling, Analysis of RNA expression, applications of genome analysis and genomics.

UNIT III: Analysis of Proteomes I:

Analysis of proteomes - Two-dimensional polyacrylamide gel electrophoresis, Sample Preparation, Solubilization, Reduction, Resolution, Reproducibility of 2-DEDetecting proteins in polyacrylamide gels, Image analysis of 2-DE gels.

UNIT IV: Analysis of Proteomes II:

Mass spectrometry based methods for protein identification- De novo sequencing using mass spectrometric data- Correlative mass spectrometric based identification strategies, 2-DE gel electrophoresis coupled with mass spectrometry, Micro array techniques- Types of micorarrays, Designing a microarray experiment, Microarray Technology in Treating Disease.

UNIT V: Applications of Genomics and Proteomics Analysis:

Analysis of Genomes – Human, Mouse, Plasmodium falsiparum,Saccharomyces cerevisiae, Mycobacterium tuberculosis. Application of proteome analysis- drug development and toxicology, Pharmaceutical Applications, Proteomics in drug Discovery in human, phage antibodies as tools, Glycobiology and Proteomics in plant genetics and breeding.

TEXT BOOKS:

1. S. B. Primrose and R.M. Twyman - Principles of Genome Analysis and Genomics, 7th Edition, Blackwell Publishing, 2006.

2. S. Sahai - Genomics and Proteomics, Functional and Computational Aspects,
Plenum Publication, 1999.

REFERENCE BOOKS:

1. Andrezej K Konopka and James C. Crabbe, Compact Hand Book - Computational
Biology, Marcel Dekker, USA, 2004.

2. Pennington & Dunn - Proteomics from Protein Sequence to Function, 1 st edition,
Academic Press, San Diego, 1996.

BTOEL112 Machine Learning in Bioinformatics

University: MGM University, Aurangabad **Faculty:** Basics and Applied Sciences

Institute: Institute of Biosciences and Tech. **Degree:** Bioinformatics (UG)

Course Unit Code: BTOEL112 **Course Unit Title:** Machine Learning in Bioinformatics

Credits allocated: 2 **Level of Study:** UG

Mode of delivery planned learning activities and teaching syllabus method: Lecture 2 hrs / week. (On-site method)

Recommended Year /Semester: Bachelor of Science, Year 1/ Semester II

Objective of the Course:

This course focuses on machine learning algorithms for analyzing biological data. The course will introduce the main topics in this area, such as analysis of protein/DNA sequences, protein structures, molecular graphs, and so on. The main focus is on the role of deep learning and data mining in computational biology and bioinformatics.

Learning Outcomes:

After taking this course students will be

- knowledgeable about the fundamental bioinformatics tasks like sequence and structure analysis and evolution, biological networks, and machine learning methods in bioinformatics
- able to understand the key algorithms for the main tasks
- able to implement and apply the techniques to real world datasets

Course Content (30 Total Lecture)

Unit 1 Learning from DNA sequences:

○ Gene finding, motif finding (HMM models)

Unit 2 Structure of molecules

○ Protein structure prediction (deep neural networks)

○ RNA structure prediction (a dynamic programming method, Stochastic context-free grammar, deep learning models)

Unit 3 Learning from high dimensional data (eg. single cell gene-expression data)

○ Dimension reduction methods (PCA, MDS, auto-encoders, VAE, visualization in low dimensions, diffusion maps)

○ Clustering cells to find new cell types (k nearest neighbor graphs, graph based clustering

methods, matrix factorization)

Unit 4 Interactions between molecules (biological networks)

- Learning network structure and causality between molecules (Bayesian networks, decision trees, random forests)
- Comparison between multiple networks (probabilistic graphical models)

Unit 5 Deep Learning

- Kernels
- Deep learning
- Genomic privacy

References

1. Textbook: Richard Durbin, Sean R. Eddy, Anders Krogh, and Graeme Mitchison, Biological Sequence Analysis: Probabilistic Models of Proteins and Nucleic Acids , Cambridge University Press, 1999, (BSA) (available at Amazon)
2. Online book: Neural Networks and Deep Learning