DR. BABASAHEB AMBEDKAR MARATHWADA UNIVERSITY

CIRCULAR NO.SU/B.Sc./Bioinformatics/24/2022

It is hereby inform to all concerned that, the syllabi prepared by the Ad-hoc Board and recommended by the Dean, Faculty of Science & Technology, the Hon'ble Vice-Chancellor has accepted **the syllabus of Three Year Degree course of B.Sc. Bioinformatics Ist & IInd semester with Regulation under the scheme of Choice Based Credit & Grading System** in his emergency powers under section 12(7) of the Maharashtra Public Universities Act, 2016 on behalf of the Academic Council as appended herewith.

This is effective from the Academic Year 2022-23 and onwards.

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

University Campus,
Aurangabad-431 004.
REF.NO.SU/2022/ 10548-56
Date:- 15.09.2022.

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Deputy Registrar,
Academic Section

Copy forwarded with compliments to :-

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

Copy to :-

1] The Director, Board of Examinations & Evaluation, Dr.BAMU,A'bad.
2] The Section Officer,[B.Sc.Unit] Examination Branch,Dr.BAMU,A'bad.
3] The Programmer [Computer Unit-1] Examinations, Dr.BAMU,A'bad.
4] The Programmer [Computer Unit-2] Examinations, Dr.BAMU,A'bad.
5] The In-charge,[E-Suvidha Kendra], Rajarshi Shahu Maharaj Pariksha Bhavan, Dr.BAMU,A'bad.
6] The Public Relation Officer, Dr.BAMU,A'bad.
7] The Record Keeper, Dr.BAMU,A'bad.

Dr. Babasaheb Ambedkar Marathwada University

Aurangabad - 431004 (MS) India.

Undergraduate Bachelor Degree Program

in

B.Sc. Bioinformatics

(Integrated)

Course Structure and Curriculum

(Outcome based Curriculum)

Choice Based Credit System

(Effective from Academic Year 2022-23)

Dr. Babasaheb Ambedkar Marathwada University

Aurangabad – 431004 (MS) India

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

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1. Preamble

Bioinformatics is an emerging branch in the field of life science. Bioinformatics is information technology applied to the management and analysis of biological data with the aid of computers. It is the science of using information to understand biology. It is a field in which biological information collected, compared, studied and analyses to find the interrelation between them for solving structural, functional and evolutionary problems using computational technologies. The biological information stored in various databases is available online through internet.

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

Bioinformatics solves the following problems and put more emphasis on understanding the disease related problems at molecular level.

- Protein sequencing, Nucleic acid sequencing and their analysis.
- Find proteins their interaction, activity, modification and function.
- Elucidation of function of a molecule based on its structure.
- Gene expression, analysis, prediction and establish genomic library.
- Find homology for studying evolutionary relationship among different species.
- Molecular modeling and molecular dynamics methods to study structure from sequence.
- Drug designing and discovery from data of functional genomics and proteomics.

In the recent years in this age of Internet and sequenced genome we have more information at our fingertips than ever before. Organizing this entire data and combating information overload is becoming more and more important. The advent of genetic engineering vastly increased size of the information. It is thus necessary for institutes like university evolve a system, which is most accurate and more student friendly. After expert training in the bioinformatics subject students can be accommodated in any national/multinational drug designing pharmaceutical/biotechnology/software/IT industry.

2. Structure and Curriculum for

B.Sc. Bioinformatics (Integrated)

(Choice Based Credit System)

Dr. Babasaheb Ambedkar Marathwada University, Aurangabad

Choice Based Credit System (CBCS) Curriculum
For
Faculty of Science and Technology
Course Structure and Scheme of Examination

(B.Sc. Bioinformatics) Integrated

Semester I

	Course Code	Course Title	Teaching time/week	Credits	Scheme of Examination			
					Max Marks	CIA	UA	Min Marks
Core Courses	BBI-111	Fundamentals of Biology-I	3 hours	3	50	10	40	20
	BBI-112	Basic Chemistry-I	3 hours	3	50	10	40	20
	BBI-113	Basic Mathematics & Statistics-I	3 hours	3	50	10	40	20
	BBI-114	Fundamentals of Computer	3 hours	3	50	10	40	20
	BBI-115	Introduction to Cell Biology	3 hours	3	50	10	40	20
	BBI-121	LC1: Basic Chemistry & Basic Mathematics & Statistics	4 hours	1.5	50	-	50	20
	BBI-122	LC2: Fundamentals of Biology & Cell Biology	4 hours	1.5	50	-	50	20
	BBI-123	LC3: Fundamentals of Computer	4 hours	1.5	50	-	50	20
Ability Enhancement compulsory courses	BBI-116	Basic Biophysics	3 hours	3	50	10	40	20
			30	22.5	450	60	390	180

Total Credits for Semester I : 22.5 (Theory : 18 ; Laboratory : 4.5)

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Semester II								
	Course Code	Course Title	Teaching time/week	Credits	Scheme of Examination			
					Max Marks	CIA	UA	Min Marks
Core Courses	BBI-211	Introduction to Bioinformatics	3 hours	3	50	10	40	20
	BBI-212	Fundamentals of Biology-II	3 hours	3	50	10	40	20
	BBI-213	Basic Chemistry-II	3 hours	3	50	10	40	20
	BBI-214	Basic Mathematics & Statistics-II	3 hours	3	50	10	40	20
	BBI-215	Introduction to Genetics	3 hours	3	50	10	40	20
	BBI-216	Programming in C	3 hours	3	50	10	40	20
	BBI-221	LC4: Basic Chemistry-II & Introduction to Genetics	4 hours	1.5	50	-	50	20
	BBI-222	LC5: Introduction to Bioinformatics	4 hours	1.5	50	-	50	20
	BBI-223	LC6: Programming in C	4 hours	1.5	50	-	50	20
Additional credit		Constitution of India	3 hours	2 *	50	10	40	20
			33	22.5	500	70	430	200
Total Credits for Semester II : 22.5 (Theory : 18 ; Laboratory : 4.5)								

Semester III								
	Course Code	Course Title	Teaching time/week	Credits	Scheme of Examination			
					Max Marks	CIA	UA	Min Marks
Core Courses	BBI-311	Basic Biochemistry	3 hours	3	50	10	40	20
	BBI-312	Molecular Biology	3 hours	3	50	10	40	20
	BBI-313	Basic Instrumentation	3 hours	3	50	10	40	20
	BBI-314	Methods in Bioinformatics	3 hours	3	50	10	40	20
	BBI-315	Database Management System	3 hours	3	50	10	40	20
	BBI-316	OOP's Using JAVA	3 hours	3	50	10	40	20
	BBI-321	LC7: Basic Instrumentation	4 hours	1.5	50	-	50	20
	BBI-322	LC8: Methods in Bioinformatics	4 hours	1.5	50	-	50	20
	BBI-323	LC9: OOP's using JAVA & DBMS	4 hours	1.5		-	50	20
			30	22.5	350	60	390	180
Total Credits for Semester III : 22.5 (Theory : 18 ; Laboratory : 4.5)								

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Semester IV								
	Course Code	Course Title	Teaching time/week	Credits	Scheme of Examination			
					Max Marks	CIA	UA	Min Marks
Core Courses	BBI-411	Structural Bioinformatics & Enzyme Kinetics	3 hours	3	50	10	40	20
	BBI-412	Immunology	3 hours	3	50	10	40	20
	BBI-413	Data structures & Algorithm	3 hours	3	50	10	40	20
	BBI-414	Chemoinformatics	3 hours	3	50	10	40	20
	BBI-415	Advanced JAVA	3 hours	3	50	10	40	20
	BBI-416	Central Dogma	3 hours	3	50	10	40	20
	BBI-421	LC10: Advanced JAVA	4 hours	1.5	50	-	50	20
	BBI-422	LC11: Tech. in Bioinformatics & Structural Bioinformatics	4 hours	1.5	50	-	50	20
	BBI-423	LC12: Chemoinformatics	4 hours	1.5	50	-	50	20
Additional Credit		Environmental Studies	3 hours	2*	50	10	40	20
			33	22.5	500	70	430	200
Total Credits for Semester IV : 22.5 (Theory : 18 ; Laboratory : 4.5)								

Semester V								
	Course Code	Course Title	Teaching time/week	Credits	Scheme of Examination			
					Max Marks	CIA	UA	Min Marks
Specific Elective	BBI-511	Select any one paper from A1: Biodiversity Informatics B1: Parasite Bioinformatics C1: Networking & Data Security D1: Computer Graphics	3 hours	3	50	10	40	20
	BBI-512	Select any one paper from A2: Introduction to PERL B2: Introduction to Julia C2: UNIX D2: Cloud computing	3 hours	3	50	10	40	20
	BBI-513	Recombinant DNA Technology	3 hours	3	50	10	40	20
	BBI-514	Metabolism	3 hours	3	50	10	40	20
	BBI-515	Introduction to Linux	3 hours	3	50	10	40	20
	BBI-516	Programming in R	3 hours	3	50	10	40	20

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	BBI-521	LC13: Based on BBI-511 & BBI-512	4 hours	1.5	50	-	50	20
	BBI-522	LC14: LINUX & R Programing	4 hours	1.5	50	-	50	20
	BBI-523	LC-15:Mini Project based on Wet Lab Techniques	4 hours	1.5	50	-	50	20
Non-Credit Course	BBI-517	Professional Ethics and Moral Values	2 hours					
			32	22.5	450	60	390	180

Total Credits for Semester V : 22.5 (Theory : 18 ; Laboratory : 4.5)

Semester VI

	Course Code	Course Title	Teaching time/week	Credits	Scheme of Examination			
					Max Marks	CIA	UA	Min Marks
Specific Elective	BBI-611	Select any one paper from A1: Web Enabling Technologies B1: Intellectual Property Rights & Commercialization C1: Machine Learning in Bioinformatics D1: Emerging Areas in Bioinformatics	3 hours	3	50	10	40	20
	BBI-612	Select any one paper from A2: Data Science for Bioinformatics B2: Immunoinformatics C2: Glycobiology D2: Internet of Things	3 hours	3	50	10	40	20
	BBI-613	Genome to Drug & Vaccine	3 hours	3	50	10	40	20
	BBI-614	Genomics & Proteomics	3 hours	3	50	10	40	20
	BBI-615	Taxonomy & Phylogeny	3 hours	3	50	10	40	20
	BBI-616	Introduction to Python & R	3 hours	3	50	10	40	20
	BBI-621	LC16: Based on BBI-611 & BBI-612	4 hours	1.5	50	-	50	20
	BBI-622	LC17: Programming in Python & R	4 hours	1.5	50	-	50	20
	BBI-623	LC18: Major Project (In Silico)	4 hours	1.5		-	50	
			30	22.5	450	60	390	180

Total Credits for Semester VI : 22.5 (Theory : 18 ; Laboratory : 4.5)

Total Credits for three years : Sem I (22.5) + Sem II (22.5) + Sem III (22.5) + Sem IV (22.5) + Sem V (22.5) + Sem VI (22.5) = 135 Credits

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3. **Vision**

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

4. **Mission**

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

5. **Program Educational Objectives:**

1. Advance knowledge through quality research in important emerging areas in the discipline and to build strong relationship with industry, academia and society.
2. Able to analyze, design and implement optimized solutions for the real-world problems and become engineering professional, innovator, product developer or entrepreneur.
3. Develop an ability to adapt, work as a team to implement trans-disciplinary and multidisciplinary projects using the cutting edge tools and technologies.
4. Graduates will be ethical and socially responsible and be able to pursue higher education/research in reputed institutions

6. **Programme Outcomes (POs) and Programme Specific Outcomes:**

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

- The ability to design hardware and software through system programming skills based on the knowledge acquired in the system software and hardware courses.
- The ability to interpret relationships among living things and analyze the biological problems, from molecular to ecosystem level, solving those using basic biological concepts, algorithms, and tools available in computer science and to facilitate the biological database system.

7. **Eligibility:** Candidates who have passed 10+2 with Science from recognized board and as per the eligibility criteria lay down by Dr. Babasaheb Ambedkar Marathwada University, Aurangabad will be eligible for admission to B.Sc. Bioinformatics course.
8. **Duration:** The course will be of three years duration and shall be completed in six semesters.
9. **Medium of Instructions:** English
10. **Choice Based Credit System (CBCS) and Credit-to-contact hour mapping:** One Credit would mean equivalent of 15 periods of 60 minutes each for theory lecture. For lab course/ workshops/internship/field work/project, the credit weightage for equivalent hours shall be 50% that for lectures /workshop
11. **Attendance:** A candidate is required to put in a minimum of 75% of attendance in both theory papers practical separately in each subject before admission to the examination. This relaxation in attendance includes for medical & any other reasons approved by the head of the Institution. A candidate lacking in the prescribed attendance and progress in any one of the subjects in theory and practical in the first appearance shall not be permitted for admission to the entire examination.
12. **Evaluation Methods/ Scheme of Examination, Earning Credits, Grading System:**

Theory

a. Each theory paper examination shall be of 2 hours duration and of maximum marks 40.

b. There will be three question papers (03 sets each) for each year and shall be in accordance with the different subjects/area covered during each of the B. Sc. Bioinformatics three years course.

c. The Paper setter shall set the questions within the prescribed course of study of the concerned paper. There will be a set pattern of question papers duly approved by Academic Council, Dr. Babasaheb Ambedkar Marathwada University, Aurangabad.

d. Internal Assessment – Internal assessment shall be of 10 marks for each theory paper.

e. Passing criteria - A candidate will have to obtain at least 40% marks in each Theory paper to pass. This means that he will have to score 20 marks in each

paper. This shall include the marks obtained in Theory paper of 16 marks and internal assessment for that paper of 04 marks. (Marks obtained in Theory paper + marks obtained in internal assessment = the Total Marks obtained in respect of each paper).

f. To conduct 02 internal exams of each theory paper per semester, pattern of internal exam should be objectives.

Practical

- Practical examination will be conducted in presence of internal & external examiner as per university guidelines.
- Practical exam will conducted annually.
- Students shall be required to obtain a minimum of 40% marks in the each paper of practical examination.

The Grading:

At the end of each semester, the teacher will assign grades to each student and will submit it to the department. The department will submit these grades to the university to give official results to students.

The grade will be as follows:

- **O (Outstanding)** will have 9.00-10 points
- **A++ (Excellent)** will have 8.00-8.99 points
- **A+ (Exceptional)** will have 7.00-7.99 points
- **A (Very good)** will have 6.00-6.99 points
- **B+ (Good)** will have 5.50-5.99 point
- **B (Fair)** will have 5.00-5.49 point
- **C+ (Average)** will have 4.50-4.99 point
- **C (Below average)** will have 4.01-4.49 point
- **D (Pass)** will have 4.00 point.
- **F (Fail)** will have 0 point.

Any student with F grade will be considered to be failed in the course. He has to repeat the course in the next semester or in some other semester as instructed by the Head of the department. There will not be any reevaluation or reexamination in the system.

The Grade Point Average (GPA):The student will have GPA between 4 to 10 computed as follows:
GPA= Sum (Course credit * number of points in the course by a student) / Sum (Course Credit) The final grading which will be consistent with the UGC scheme will be awarded as per the GPA .

13. **Curriculum for Semester I**

BBI-111: Fundamentals of Biology-I

Total Credit: 03 Contact Hours: 30 (Clock Hours)

Marks: 50 Periods: 45 (50 Min. each)

Learning Objectives

- To develop the basic understanding about diversity in the living world.
- To understand the hierarchy of plant and animal classification system.
- To understand the structural organization in plants and animals.

Learning outcomes:

After successful completion of course, students will be able to:

- Understand the characteristics of living organisms and diversity among the species.
- Aware with plant and animal kingdoms.
- To study the morphology of plants and animals.

Unit-I (05 Period)

Living world, Diversity in living world, Taxonomic categories, Taxonomical aids.

Unit-II (10 Period)

Biological classification: two kingdom and five kingdom classification system, Viruses, viroids and lichens.

Unit-III (10 Period)

Plant Kingdom: algae, bryophytes, pteridophytes, Gymnosperm, Angiosperm, plant life cycle and alteration of generation.

Unit-IV (10 Period)

Animal Kingdom: Basis of animal classification, Phylum wise classification of animals, Morphology and anatomy of flowering plants.

Unit-V (10 Period)

Structural organization in animals: Animal Tissues, Organ and organ system. Cell division: Cell cycle, Mitosis and meiosis.

References:

1. Brock Biology of Microorganisms - Madigan et al, 9th ed.

2. Biology by Raven and Johnson

3. Biology by Campbell and Reece

4. Exploring creation with Biology – Wiley and Durnell.

5. Biology: NCERT textbook for class IX.

BBI-112: Basic Chemistry-I

Total Credit: 03 | Contact Hours: 30 (Clock Hours)

Marks: 50 | Periods: 45 (50 Min. each)

Learning Objectives:

The purpose of this chemistry subject in undergraduate Bioinformatics program is to provide the basic understanding of atoms, molecules, bonding or interactions towards Chemoinformatics.

Learning outcomes:

After successful completion of course, students will be able to:

- Understand the fundamental properties of atoms, molecules, and the various states of matter with an emphasis on the particulate nature of matter.
- Understand the fundamental atomic structure and the periodicity of elements in the periodic table
- Understand the current bonding models for simple inorganic and organic molecules in order to predict structures and important bonding parameters.

Unit I: (10 Period)

General Introduction: Importance and scope of chemistry. Historical approach to particulate nature of matter, laws of chemical combination, Dalton's atomic theory: concept of elements, atoms and molecules. Atomic and molecular masses. Mole concept and molar mass; percentage composition and empirical and molecular formula; chemical reactions.

Unit II: (10 Period)

Discovery of electron, proton and neutron; atomic number, isotopes and isobars. Thompson's model and its limitations, Rutherford's model and its limitations, Bohr's model and its limitations, concept of shells and subshells, dual nature of matter and light, de Broglie's relationship, Heisenberg uncertainty principle, concept of orbitals, quantum numbers, shapes of s, p and d orbitals.

Unit III: (05 Period)

Significance of classification, brief history of the development of periodic table, modern periodic law and the present form of periodic table, periodic trends in properties of elements –atomic radii, ionic radii, inert gas radii, ionization enthalpy, electron gain enthalpy, electro negativity, valence. Nomenclature of elements with atomic number greater than 100.

Unit IV: (10 Period)

Valence electrons, ionic bond, covalent bond, bond parameters, Lewis structure, polar character of covalent bond, covalent character of ionic bond, valence bond theory, resonance, geometry of covalent molecules, VSEPR theory, concept of hybridization involving s, p and d orbitals and shapes of some simple molecules, molecular orbital theory of homonuclear diatomic molecules, Hydrogen bond.

Unit V: (10 Period)

Three states of matter, intermolecular interactions, types of bonding, melting and boiling points,role of gas laws in elucidating the concept of the molecule, Boyle's law, Charle's law, Gay Lussac's law, Avogadro's law, ideal behaviour, empirical derivation of gas equation, Avogadro number, ideal gas equation. Kinetic energy and molecular speeds, deviation from ideal behaviour, liquefaction of gases, critical temperature. Liquid State – Vapour pressure, viscosity and surface tension.

References:

1. N. N. Greenwood, A. Earnshaw: Chemistry of the Elements

2. D. F. Shriver, P. W. Atkins, C.H. Langford: Inorganic Chemistry

3. A. G. Sharpe: Inorganic Chemistry

4. J. March: Advanced Organic Chemistry

5. I. L. Finar: Organic Chemistry (Vol. I)

6. D. A. Mcquarrie and J. D. Simon: Physical Chemistry – A Molecular Approach

7. I. N. Levine: Physical Chemistry

BBI-113: Basic Mathematics & Statistics-I

Total Credit: 03 Contact Hours: 30 (Clock Hours)

Marks: 50 Periods: 45 (50 Min. each)

Learning Objectives:

To understand the basic concept in mathematics and statistics. To apply mathematical and statistical techniques for analysis and interpretation of biological data.

Learning outcomes:

After successful completion of course, students will be able to:

- Represents data in various graphical formats.
- To calculate measures of central tendency.
- To perform hypothesis testing and its interpretations.
- To apply mathematical model for biological entity.

Unit I (10 Periods)

Biostatistics-definition-statistical methods-basic principles. Variables-Measurements and functions. Limitations and uses of statistics, Data -primary, secondary. Methods of data collection. Merits and limitations. Classification, tabulation and presentation of data.

Unit II (05 Periods)

Measures of Central tendency-Mean, Median, Mode, –merits and limitations. Measures of dispersion –range, standard deviation, mean deviation.

Unit III (10 Periods)

Correlation and regression, similarities and dissimilarities of correlation and regression, Statistical interference –hypothesis: simple hypothesis, Hypothesis testing. Student's t test, Chi-Square test, ANOVA.

Unit IV (10 Periods)

Matrix algebra: Definition, types of matrices, matrix algebra, addition, subtraction & multiplication. Transpose inverse of matrix.

Unit V (10 Periods)

Vector algebra and calculus, Vector Algebra--Addition, subtraction, dot, cross, scalar triple product, divergence, curl of a vector.

References:

1. Introductory Biostatistics: Chap T Le, Wiley interscience publication.

2. Jenny Olive – Maths: - a self study Guide – Cambridge Low prices edition

3. R.G. Bartle and D.R. Sherbert (2nd edition)-John Wiley, New York

4. Daniel, W.W. Biostatistics, John Wiley Sons, New York.

5. Sundarrao, P.S.S. and Richards, An Introduction to Biostatistics, 3rdEdition, CMC, Vellore.

6. Selvin, S. Statistical analysis of epidemiological data, University press, NY.

7. Bishop, O.N. Statistics for biology, Hougtan, Boston.

8. Freedman, P, The principles of scientific research, Pergamon press,NY.

9. Venkateswara Rao, A Textbook of B.Sc. Mathematics - Vol. 1, S. Chand publication.

BBI-114: Fundamentals of Computer

Total Credit: 03 Contact Hours: 30 (Clock Hours)

Marks: 50 Periods: 45 (50 Min. each)

Learning Objectives:

Give students an in-depth understanding of why computers are essential components in business, education and society.

Learning outcomes:

After successful completion of course, students will be able to:

- Analyze, design, implement, and evaluate a computer-based system, process, component, or program to meet desired needs.
- Understand the difference between an operating system and an application program, and what each is used for in a computer.

Unit I (05 Periods)

Computer: Definition, Characteristics of Computers, Basic Applications of Computer, Generations of computers.

Unit II (10 Periods)

Components of Computer System: Central Processing Unit (CPU), input/output Devices, computer Memory: primary and secondary memory, magnetic and optical storage devices, Concepts of Hardware and Software.

Unit III (10 Periods)

Data processing: concepts of data processing, Definition of Information and data, Storage of data/Information as files, Representation of data/Information, Binary number system, Operating Systems: DOS Internal, External commands, Windows OS , Overview of architecture of Windows , tools and system utilities including registry , partioning of hard disk ,

Unit IV (10 Periods)

Overview of Linux architecture, File system, files and permissions, concept of user and group, installation of rpm and deb based packages, Overview of Microsoft office: word, excel, access and powerpoint.

Unit V (10 Periods)

Networking Basics - Uses of a network and Common types of networks, Network topologies and protocols, Network media and hardware.

References:

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

BBI-115: Introduction to Cell Biology

Total Credit: 03 Contact Hours: 30 (Clock Hours)

Marks: 50 Periods: 45 (50 Min. each)

Learning Objectives:

To understand basic structure and organization cell as well as the role of transport system and its function in biosystem.

Learning outcomes:

After successful completion of course, students will be able to:

- Describe the fundamental principles of cell biology.
- Develop a deeper understanding of cell structure and how it relates to cell functions.

Unit I (10 Periods)

Cell as a basic unit, classification of cell types, cell theory, organization of plant and animal cells, comparison of microbial, plant and animal cell. Ultrastructure of cells, Biochemical composition of cells (nucleic acid, carbohydrate, proteinand lipids).

Unit II (10 Periods)

Subcellular organization, cytosol, endoplasmic reticulum, nucleus, cytoskeleton, ribosomes, mitochondria, chloroplast, vacuoles, peroxisomes, lysosomes and cell wall.

Unit III (05 Periods)

Structure and function of cell membranes, Cell division (eukaryotic and prokaryotic), mitosis, meiosis and cell cycle.

Unit IV (10 Periods)

Transport across membranes, Types of membrane transports- active and passive Transport, Passive transport- Simple and facilitated diffusion, transporters- Uniporters , co-transporters and channel proteins. Active transport-Pumps, Group translocations and electrochemical gradients

Unit V (10 Periods)

Specialized cell, motile cells, nerve cells, muscle cells, cell death and apoptosis.

References:

1. Molecular Biology of Cell, (2002), 4th Edition by Albert's et al.
2. Molecular Cell Biology (2004), by Lodish et al.
3. Cell and Molecular Biology; Concepts & Experiments (2004). By Karp, G.
4. The Cell: A molecular Approach (2004), by Cooper, G.M
5. Cell &Molecular biology, by Robertis & Robertis..
6. Biochemistry & Molecular Biology of plants (2004); by Buchananet al.
7. Lehninger Principles of Biochemistry, (2005) by Nelson & Cox.

BBI-116: Basic Biophysics

Total Credit: 03 Contact Hours: 30 (Clock Hours)

Marks: 50 Periods: 45 (50 Min. each)

Learning Objectives:

- Understand the depth knowledge of various subjects of Biophysics.
- Demonstrate skills and competencies to conduct wide range of scientific experiments.
- Identify their area of interest in academic and R&D. Perform job in various fields' viz.
- To provide students a strong foundation education in Biophysics

Learning outcomes:

After successful completion of course, students will be able to:

- The students would be able to have strong foundation knowledge and comprehend the basic concepts and principles in Biophysics.
- The students would be able to progress in their academic performance through structured curricula.
- The students would be able take up competitive exams in life sciences, can be entrepreneur s and succeed in higher education in Biophysics.
- The students would be able to experience a well-resourced environment for learning Biophysics

UNIT I (10 Periods)

Units and Measurements; International Standards of Units; Position, Distance, Displacement; Average Velocity, Average speed; Kinematic Equations; Relative Velocity; Vector representation of Physical quantities; Projectile Motion, Circular Motion

UNIT II (10 Periods)

Law of Intertia; Newton's 1st law, 2nd law and 3rd law of motion; conservation of momentum; equilibrium of a particle, common forces in mechanics

UNIT III (10 Periods)

Notions of work; Force and Work; Kinetic Energy; Potential Energy; Conservation of mechanical energy; Potential energy of a spring; Power ; Collisions

UNIT IV (10 Periods)

Centroid; Center of mass; Linear Momentum; Angular Velocity Vs Linear velocity, interrelationship; Torque, angular momentum; Rigid bodies; Moment of Intertia;

Definition of

perpendicular and parallel axes, Kinematics & Dynamics about an axis;

UNIT V (05 Periods)

Simple Harmonic motion; The force law of SHM; Energy; Angular SHM; Pendulums; Damped Oscillations; Forced Oscillations

References

- Casey E.J. (1967), Biophysics, concepts and mechanisms. Affiliated East west Ackerman E.A. Ellis, L.E.E. & Williams L.E. (1979), Biophysical Science, Prentice-Hall Inc.press
- Physical Chemistry for Life Sciences by Barrow C, MC-Grow Hill
- Biophysical Chemistry by Bloomfield V A and Harrington R E, W A Freeman and Co.
- Biophysical Chemistry by Cantor C R and Schimmel, P R, W A Freeman and Co. Protein, by Hasehemyer R N and Hasehemyer ACBV, John Willy and Sons

BBI-121: LC-1: Basic Chemistry & Basic Mathematics & Statistics

Total Credit: 1.5

Marks: 50

Contact Hours: 30 (Clock Hours)

Periods: 45 (50 Min. each)

Section A: Basic chemistry

- Prepare standard solution oxalic acid ad standardize given NaOH solution.
- Prepare standard solution oxalic acid ad standardize given KMnO4 solution.
- Determine the water of crystallization in given salt – BaCl2, 2H2O
- To determine the specific reaction rate of the hydrolysis of methyl acetate/ ethyl Acetate

  catalyzed by hydrogen ion at room temperature
- To study and perform kinetically the reaction rate of decomposition of iodide by H2O2.
- To determine the percentage composition of a given mixture by viscosity methods.
- To determine the percentage composition of a given binary mixture by surface tension method.

Section B: Basic Mathematics and Statistics

- Graphical representation of data.
- Problems based on measures of central tendency.
- Problems based on measures of dispersion.
- Problems based on combined mean and variance and coefficient of variation.
- Problems based on matrix and vector algebra.
- Problems based on ANOVA.

BBI-122: LC2: Fundamentals of Biology & Cell Biology

Total Credit: 1.5 | Contact Hours: 30 (Clock Hours)

Marks: 50 | Periods: 45 (50 Min. each)

Section A: Fundamentals of Biology

- To study the different parts of a microscope.
- To study various tools and instruments required in the laboratory.
- Preparation and study of mitosis in onion root tips.
- Study of stages of meiosis using permanent slides.
- To cut a T.S. of the given monocot/dicot stems and roots and to make temporary stained mounts to study their structures.
- Isolation and confirmation of mitochondria from plant / animal cells.

Section B: Cell Biology

- Visualization of Chromosomes in mitotic/ meiotic stages in onion root tips / buds.
- Isolation and confirmation of mitochondria from plant / animal cells.
- Lipid solubility of membrane
- Study of osmosis in blood cells
- Isolation of Chloroplasts from Spinach leaves
- Study of hill reaction using isolated chloroplast
- The effect of detergents on the erythrocyte membrane
- Effect of lipid composition on membrane permeability

BBI-123: LC3: Fundamentals of Computer

Total Credit: 1.5 | Contact Hours: 30 (Clock Hours)

Marks: 50 | Periods: 45 (50 Min. each)

- Create a new folder and do the following:
    1. Make a word document in it.
    2. Make an Excel document in it.
    3. Make a new folder in it
    4. Rename the initial folder
    5. Move the initial folder
    6. Copy the initial folder.
    7. Delete the initial folder
- Create a document and
    1. Put Bullets and Numbers
    2. Apply various Font parameters.
    3. Apply Left, Right, and Centre alignments.
    4. Apply hyperlinks
    5. Insert pictures
    6. Insert ClipArt
    7. Show the use of WordArt
    8. Add Borders and Shading
    9. Show the use of Find and Replace.
    10. Apply header/footers
- Make a presentation of College Education System using
    1. Blank Presentation
    2. From Design Template
    3. From Auto Content Wizard
- Make a presentation on "Wild Life" and apply the following:
    1. Add audio and video effects
    2. Apply various Color Schemes

3. Apply various animation schemes.
4. Apply Slide Show

- Connect the Internet; open any website of your choice and save the WebPages.
- Search any topic related to your syllabi using any search engine and download the relevant material.
- Create your E-Mail ID on any free E-Mail Server.
- Compute the division of each and every student of a class.
- To compute mean/median/mode.
- Create a Student database in Design View, by using Wizard, and by entering data.
- Create a query on Student database in design view and by using wizard.

14. Curriculum for Semester II

BBI-211: Introduction to Bioinformatics

Total Credit: 03 Contact Hours: 30 (Clock Hours)

Marks: 50 Periods: 45 (50 Min. each)

Learning Objectives:

The basic objective is to give students an introduction to the basic practical techniques of bioinformatics. Emphasis will be given to the application of bioinformatics and biological databases to problem solving in real research problems. The students will become familiar with the use of a wide variety of internet applications, biological database and will be able to apply these methods to research problems.

Learning outcomes:

After successful completion of course, students will be able to:

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

Unit-I (10 Periods)

Introduction to Bioinformatics, History of Bioinformatics, Scope and applications of Bioinformatics, Generation of large scale molecular biology data: genome sequencing, protein sequencing, NMR, X-ray crystallography, Electron microscopy, Human Genome Project.

Unit-II (10 Periods)

Overview of Bioinformatics resources on the web-NCBI/EBI/SIB, Nature of biological data, Introduction to biological databases, Nucleic acid sequence database-GENBANK/EMBL/DDBJ, Protein sequence database : SWISSPROT, PIR, TrEMBL,: PROSITE, Pfam. PRODOM

Unit-III (10 Periods)

Specialized databases: OMIM, OMIA, Literature database-PUBMED, Structural Databases: PDB, NDB, MMDB, Molecular Visualization tools: Rasmol, Cn3D, SPDBViewer, Biological information search engine: ENTREZ-Concept and Applications.

Unit-IV (10 Periods)

Overview of sequence analysis, Basic concept of pairwise sequence alignment and its methods, Significance of pairwise sequence alignment, Scoring matrix: PAM & BLOSUM, Database searching, Sequence similarity search tool: BLAST & FASTA

. Unit-V (05 Periods)

Overview of multiple sequence alignment, methods of MSA, significance of MSA, CLUSTAL OMEGA, CLUSTALX. Protein secondary and tertiary structure prediction methods.

References:

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

BBI-212: Fundamentals of Biology-II

Total Credit: 03 Contact Hours: 30 (Clock Hours)

Marks: 50 Periods: 45 (50 Min. each)

Learning Objectives:

To study different types micro-organisms at cellular level and its etiology and prevention. It helps to undergraduate bioinformatics students to study morphology and pathogenecity of micro-organisms.

Learning outcomes:

After successful completion of course, students will be able to:

- Understand the basic microbial structure and function and study the comparative characteristics of prokaryotes and eukaryotes and also understand the structural similarities and differences among various physiological groups of bacteria/Achaea.
- Know various Culture media and their applications and also understand various physical and chemical means of sterilization.
- Understand the architecture of viruses.

Unit-I (10 Periods)

Introduction & History of Microbiology, theory of Biogenesis and abiogenesis Scope of Microbiology, Classification of Microbes – Systems of classification, Numerical taxonomy, Identifying characters for classification, General properties and principles of classification of microorganisms, Systematics of bacteria, Nutritional types, Classification of bacteria on the basis of oxygen requirem

Unit-II (10 Periods)

Definition of sterilization, dry and moist heat, pasteurization, tyndalization; radiation, ultrasonication, filtration. Physical and Chemical methods of sterilization; disinfection sanitization, antisepsis sterilants and fumigation. Determination of phenol coefficient of disinfectant.

Unit-III (10 Periods)

Definition of auxochrome , chromophores, dyes, Classification of stains, Theories of staining, Mechanism of gram staining, acid fast staining, negative staining, capsule staining, flagella staining, endospore staining.

Unit-IV (10 Periods)

Nature, special features of the thermophilic, methanogenic andhalophilic; Archaea; photosynthetic bacteria, Cyanobacteria some Archaea who live in extreme conditions like cold, and space. Pathogenic Microorganisms – List of common bacterial, fungal and viral diseases of human beings.

Unit-V (05 Periods)

General Characteristics of viruses, differences between bacteria and viruses. Classification of viruses Physical and chemical Structures of different Viruses.

References:

1. Brock Biology of Microorganisms - Madigan et al, 9th ed.
2. Biology by Raven and Johnson
3. Biology by Campbell and Reece
4. Molecular Biology of the Cell – Bruce Alberts
5. Exploring creation with Biology – Wile and Durnell
6. Prescott's Microbiology Joanne Willey , Linda Sherwood , Chris Woolverton
7. Microbiology, Robert bauman

BBI-213: Basic Chemistry-II

Total Credit: 03 | Contact Hours: 30 (Clock Hours)

Marks: 50 | Periods: 45 (50 Min. each)

Learning Objectives:

To provide a broad foundation in chemistry that stresses scientific reasoning and analytical problem solving with a molecular perspective.

Learning outcomes:

After successful completion of course, students will be able to:

- The student will understand the interdisciplinary nature of chemistry and to integrate knowledge of mathematics, physics, chemoinformatics, bioinformatics and other disciplines to a wide variety of chemical problems.
- The student will acquire a foundation of chemistry of sufficient breadth and depth to enable them to understand and critically interpret the primary chemical literature.

Unit-I (10 Periods)

Classification of stereoisomers, isomer number, enantiomerism, diastereomerism, chiral center, absolute configuration, R & S, conformations in Cycloalkanes and cyclohexanes, geometrical isomerism: E & Z, resolution, stereoselecting and stereospecific reactions.

Unit-II (05 Periods)

Elementary treatment of SN1, SN2, E1 and E2 reactions, Hoffmann and Saytzeff rules, Addition reactions, Markonikoff rule and Kharash effect, Diels-Alder reaction, aromatic electrophilic substitution.

Unit-III (10 Periods)

Alkanes, Alkenes, and Alkynes: definition, general formula, IUPAC nomenclature, general preparation methods and physical and chemical properties; Cycloalkanes, Aromatic compounds: definitions, general formulae, IUPAC nomenclature, general preparation methods and physical and chemical properties.

Unit-IV (10 Periods)

Alcohols, Phenols, Aldehydes, Ketones, Carboxylic Acids in Biology, Its Definition, general formula, IUPAC nomenclature, general preparation methods and bio-physico-chemical properties.

Unit-V (10 Periods)

Hetero-cyclic systems, 5-membered rings: structures of pyrols, furenes and thiophenes, electrophilic substitions; 6-membered rings: structures of pyridines; sources, reactions of pyridines, basicity of pyridines.

References:

1. N. N. Greenwood, A. Earnshaw: Chemistry of the Elements
2. D. F. Shriver, P. W. Atkins, C.H. Langford: Inorganic Chemistry
3. A. G. Sharpe: Inorganic Chemistry
4. J. March: Advanced Organic Chemistry
5. I. L. Finar: Organic Chemistry (Vol. I)
6. D. A. Mcquarrie and J. D. Simon: Physical Chemistry – A Molecular Approach
7. I. N. Levine: Physical Chemistry
8. G. W. Castellan: Physical Chemistry
9. P. W. Atkins: Physical Chemistry
10. Organic Chemistry, R. T. Morrison & R. N. Boyd, 6th Edition, Publishers: Pearson Education.

BBI-214: Basic Mathematics & Statistics-II

Total Credit: 03 | Contact Hours: 30 (Clock Hours)

Marks: 50 | Periods: 45 (50 Min. each)

Learning Objectives:

Fundamental objects, techniques and theorems in the mathematical sciences, including the fields of analysis, algebra, geometry, and discrete mathematics. The overall process and particular steps in designing studies, collecting and analyzing data, interpreting and presenting results .The role of statistics and its applications in other disciplines, e.g. biological sciences.

Learning outcomes:

After successful completion of course, students will be able to:

- Construct, modify and analyze mathematical models of systems encountered in disciplines such as biology, assess the models' accuracy and usefulness, and draw contextual conclusions from them.
- Choose appropriate statistical methods and apply them in various data analysis problems.

Unit-I (10 Periods)

Introduction to probability- definition & types of probability. Probability distribution – binomial, Poisson , normal, Baye's theorem, concept of Random variable, types of Random variable.

Unit-II (05 Periods)

ANOVA, one-way and two-way ANOVA, applications of ANOVA in biological problems, Multivariate ANOVA.

Unit-III (10 Periods)

Functions, types of functions, Limits, standard formulae, limits of logarithmic, exponential, trigonometric ,implicit and explicit functions. Continuity, definition, continuity of functions.

Unit-IV (10 Periods)

Derivatives: laws of derivatives of functions, differentials of all types of functions functions logarithmic, exponential, trignometric, implicit and explicit functions.

Unit-V (10 Periods)

Concept of Integration, applications, types: Definite and Indefinite (Non-definite), basic rules and properties of Integration. Definite Integrals & Non-definite Integrals and its integrals of functions- logarithmic, exponential, trigonometric, implicit and explicit.

References:

1. Introductory Biostatistics: Chap T Le, Wiley interscience publication
2. Jenny Olive – Maths :- a self study Guide – Cambridge Low prices edition
3. Campbell R.C.–Statistics for Biologist, Cambridge University Press, Cambridge
4. Ward Law A.C. (1985)–Practical Statistics for Experimental Biologists
5. Daily N.T.J.–Statistical Methods in Biology, English University Press

BBI-215: Introduction to Genetics

Total Credit: 03 Contact Hours: 30 (Clock Hours)

Marks: 50 Periods: 45 (50 Min. each)

Learning Objectives:

To understand the basic concept of heredity and variation, interaction, linkage and crossing over.

Learning outcomes:

After successful completion of course, students will be able to:

- Describe the fundamental molecular principles of genetics
- To study genetic diseases at molecular basis.
- To study the process of genetic recombination.

Unit-I (10 Periods)

Genetics- Definition, Concept of heredity and variations, Branches and Applications of Genetics, Mendelism: Genetical terminology, Selection of experimental material , Monohybrid cross, Law of dominance, Incomplete dominance, Law of segregation/law of purity of gametes, Dihybrid cross, Law of independent assortment, Back cross and Test cross.

Unit-II (10 Periods)

Interactions of genes: Non-epistatic genetic interactions- complementary genes (9:7), Duplicate Genes (15:1), Epistatic genetic interactions- Masking genes (12:3:1), Supplementary genes (Recessive epistasis) (9:3:4), Inhibitory genes(13:3), Lethal genes (2:1), Inheritance of coat color in mice, Inheritance of sickle cell anemia.

Unit-III (05 Periods)

Multiple alleles: Definition, Concept, Characters of multiple alleles, Examples of multiple alleles – inheritance of blood group in human, eye color in Drosophila.

Unit-IV (10 Periods)

Linkage and Crossing over: Linkage- Definition and Types, Crossing over: Definition and Types, Construction of a linkage map by two point test cross and three point test cross.

Unit-V (10 Periods)

Concept of Sex chromosomes and autosomes, Inheritance of X- linked genes - eye colour in Drosophila, Inheritance of colour blindness in humans, Inheritance of Y linked genes - Holandric genes in humans, Sex influenced genes – baldness in humans.

References:

1. Principles of Genetics by Gardner and Simmons.
2. Concepts of Genetics by Klug/Cummings/Spencer
3. Principles of Genetics by Robert Tamarin
4. Genetics: Analysis of Genes and Genomes by Daniel L Hartl and Maryellen Ruvolo
5. Genetics: A Molecular Approach by Dr Terry Brown
6. Genetics by P S Verma and V K Agarwal

BBI-216: Programming in C

Total Credit: 03 | Contact Hours: 30 (Clock Hours)

Marks: 50 | Periods: 45 (50 Min. each)

Learning Objectives:

The course aims to provide exposure to problem-solving through programming. It aims to train the UG bioinformatics student to the basic concepts of the C-programming language. This course involves a lab component which is designed to give the student hands-on experience with the concepts.

Learning outcomes:

After successful completion of course, students will be able to:

- Develop applications or Bio-tools required for molecular data analysis.
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Unit-I (10 Periods)

Introduction to C: Introduction – Structure of C Program – Writing the first C Program - Compiling and Executing C Programs - Using Comments – Keywords – Identifiers – Basic Data Types in C – Variables – Constants – I/O Statements in C - Operators in C - Programming Examples – Type Conversion and Type Casting.

Unit-II (10 Periods)

Decision Control and Looping Statements: Introduction to Decision Control Statements – Conditional Branching Statements – Iterative Statements – Nested Loops – Break and Continue Statement – Goto Statement.

Functions: Introduction – using functions – Function declaration/ prototype – Function definition – function call – return statement – Passing parameters – Scope of variables – Storage Classes – Recursive functions – Recursion vs Iteration.

Unit-III (10 Periods)

Arrays: Introduction – Declaration of Arrays – Accessing elements of the Array – Storing Values in Array – Calculating the length of the Array – Operations on Array — Two dimensional Arrays –Operations on Two Dimensional Arrays Strings: Introduction – Reading Strings – Writing Strings – String Manipulation functions -Array of Strings

Unit-IV (10 Periods)

Pointers: Introduction to Pointers – declaring Pointer Variables – Pointer Expressions and Pointer Arithmetic – Null Pointers – Passing Arguments to Functions using Pointer, Dynamic Memory Allocation.

Structure, Union, and Enumerated Data Types: Introduction – Nested Structures – Arrays of Structures – Structures and Functions – Self-referential Structures – Union – Enumerated Data Types.

Unit-V (05 Periods)

Files: Introduction to Files – Using Files in C – Reading Data from Files – Writing Data To Files – Detecting the End-of-file – Error Handling during File Operations – Accepting Command Line Arguments – Functions for Selecting a Record Randomly - Remove() – Renaming a File – Creating a Temporary File.

References:

1. Programming with C by Brian W. Kernighan and Dennis Ritchie
2. C: The Complete Reference by Herbert Schildt
3. Let Us C by Yashavant Kanetkar
4. Mastering C by Venugopal, Prasad – TMH
5. Complete reference with C Tata McGraw Hill
6. C – Programming E.Balagurusamy Tata McGray Hill
7. Schaums outline of Theory and Problems of programming with C: Gottfried

BBI-221: LC4: Basic Chemistry-II & Introduction to Genetics

Total Credit: 1.5 Contact Hours: 30 (Clock Hours)

Marks: 50 Periods: 45 (50 Min. each)

Section A: Basic Chemistry-II

- Systematic qualitative analysis of organic compounds (Single compound:

  i. Benzoic Acid

  ii. Pthalic acid

  iii. Cinnamic acid

  iv. 2 -naphthol

  vi. p-nitroaniline

  vii. Acetanilide

  viii. Naphthalene)

  for nature, functional group, elements, derivatives and physical constant.

- Purification of given organic compound by crystallization method.
- Purification of given organic compound by sublimation method.
- Purification of given organic compound by distillation method.

Section B: Introduction to Genetics

- Problems based on Monohybrid and dihybrid crosses.
- Problems based on sex inheritance.
- Bacterial transformation
- Bacterial conjugation
- Bacterial transduction
- Mutation by UV rays.
- UV survival curve and photo/dark repair.

BBI-222: LC5: Introduction to Bioinformatics

Total Credit: 1.5 | Contact Hours: 30 (Clock Hours)

Marks: 50 | Periods: 45 (50 Min. each)

- Exploring and accessing of resources-NCBI/EBI/SIB.
- Exploring of biological information search engine: Entrez.
- Exploring and accessing of biological information from Genbank/EMBL and DDBJ.
- Exploring and querying Uniprot database.
- Exploring and querying PIR database.
- Exploring and querying PROSITE, PFAM and PRODOM database.

BBI-223: LC6: Programing in C

Total Credit: 1.5

Marks: 50

Contact Hours: 30 (Clock Hours)

Periods: 45 (50 Min. each)

- Find out the given number is perfect number or not using C program.
- Write a C program to find the sum of individual digits of a positive integer.
- Write a C program to print the Fibonacci series
- Write a C program to generate all the prime numbers between 1 and n, where n is a value supplied by the user.
- Write a C program to find both the largest and smallest number in a list of integers.
- Write a C program that uses functions to perform the following: a. Addition of Two Matrices b. Multiplication of Two Matrices
- Write a program to perform various string operations (using molecular data).
- Write C program that implements searching of given item in a given list.
- Write a C program to sort a given list of integers in ascending order.

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