DR. BABASAHEB AMBEDKAR MARATHWADA UNIVERSITY,
CHHATRAPATI SAMBHAJINAGAR.

CIRCULAR NO.SU/Revised B.Sc./NEP/98/2024

It is hereby inform to all concerned that, the Revised syllabi prepared by Ad-hoc Board and recommended by the Dean, Faculty of Science & Technology, **Academic Council at its meeting held on 08 April 2024 has accepted** the following **Revised syllabi of Bachelor of Science** as per direction by the State Government dated on 13 March 2024 under the Faculty of Science & Technology **as per National Education Policy-2020** run at the Affiliated Colleges, Dr.Babasaheb Ambedkar Marathwada University as appended herewith.

Sr.No.	Courses	Semester
1.	**B.Sc.Biotchnology (Single Major)**	**Ist and IInd semester**
2.	**B.Sc.Bioinformatics (Single Major)**	**Ist and IInd semester**

This is effective from the Academic Year 2024-25 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/2024/ 26920-28
Date:- 24.05.2024.

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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.Babasaheb Ambedkar Marathwada University, Chhatrapati Sambhajinagar.
2] The Section Officer,[B.Sc.Unit] Examination Branch, Dr.Babasaheb Ambedkar Marathwada University, Chhatrapati Sambhajinagar.
3] The Programmer [Computer Unit 1] Examinations, Dr.Babasaheb Ambedkar Marathwada University, Chhatrapati Sambhajinagar.
4] The Programmer [Computer Unit 2] Examinations, Dr.Babasaheb Ambedkar Marathwada University, Chhatrapati Sambhajinagar.
5] The In-charge,[E-Suvidha Kendra], Rajarshi Shahu Maharaj Pariksha Bhavan, Dr.Babasaheb Ambedkar Marathwada University, Chhatrapati Sambhajinagar.
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Dr. Babasaheb Ambedkar Marathwada University, Chhatrapati Sambhajinagar

B.Sc. Degree Programme

(Three Year / Four Years (Hons) /Four Years (Hons with Research)

Course Structure and Curriculum

for B.Sc. First Year

(AS PER NEP-2020)

Subject (Major): Bioinformatics (Single Major)

Effective from 2024-25

PREFACE

As we stand on the threshold of a new era in education, the dawn of the National Education Policy 2020 illuminates our path toward a holistic, inclusive, and progressive educational landscape. The Bachelor of Science (B. Sc.) curriculum outlined herein reflects the ethos and aspirations of this transformative policy, aiming to equip learners with the knowledge, skills, and values necessary to thrive in the dynamic world of the 21st century.

At its core, the National Education Policy 2020 envisions an educational framework that is learner-centric, multidisciplinary, and geared towards fostering creativity, critical thinking, and innovation. It emphasizes the integration of knowledge across disciplines, breaking down traditional silos to encourage holistic understanding and application of concepts. The Bachelor of Science (B. Sc.) curriculum embodies these principles by offering a diverse array of courses spanning various scientific domains, while also incorporating interdisciplinary studies to nurture well-rounded graduates capable of addressing complex challenges with agility and insight.

Furthermore, the curriculum is designed to promote experiential learning, research, and hands-on exploration, recognizing the importance of practical engagement in deepening understanding and cultivating real-world skills. Through laboratory work, field experiences, internships, and project-based learning opportunities, students will have the chance to apply theoretical knowledge in practical settings, develop problem-solving abilities, and cultivate a spirit of inquiry and discovery.

Integral to the National Education Policy 2020 is the commitment to inclusivity, equity, and access to quality education for all. The Bachelor of Science (B. Sc.) curriculum reflects this commitment by embracing diversity in perspectives, backgrounds, and experiences, and by fostering an inclusive learning environment where every student feels valued, supported, and empowered to succeed.

Moreover, the curriculum emphasizes the cultivation of ethical values, social responsibility, and global citizenship, instilling in students a sense of accountability towards society and the environment. By integrating courses

on ethics, sustainability, and social sciences, the Bachelor of Science (B. Sc.) program aims to produce graduates who are not only proficient in their respective fields but also compassionate, ethical leaders committed to making a positive impact on the world.

As we embark on this journey of educational transformation guided by the National Education Policy 2020, the Bachelor of Science (B. Sc.) curriculum stands as a testament to our collective vision of a more equitable, inclusive, and enlightened society. It is our hope that through rigorous academics, innovative pedagogy, and unwavering dedication to excellence, we can inspire the next generation of scientists, scholars, and change-makers to realize their full potential and contribute meaningfully to the advancement of knowledge and the betterment of humanity.

Introduction to Undergraduate Degree course in Bioinformatics:

As per the recommendations of the NEP-2020, the undergraduate degree course in Bioinformatics is a six/ eight semester course spread over three/ four academic years. The teaching – learning process is student-centric and it involves both theory and practical components. It offers a flexibility of programme structure while ensuring that the student gets a strong foundation in the subject and gains in-depth knowledge. Besides the Discipline Specific Core (DSC) courses, a student can opt courses from the syllabus comprising of Discipline Specific Electives (DSEs), Generic Electives (GEs), Skill Enhancement Courses (SECs), Ability Enhancement courses (AECs) and Value Addition Courses (VACs). Thereby, bringing out the multidisciplinary approach and adherence to innovative ways within the curriculum framework. Moreover, it allows a student maximum flexibility in pursuing his/her studies at the undergraduate level to the extent of having the liberty to eventually design the degree with multiple exit options depending upon the needs and aspirations of the student in terms of his/her goals of life, without compromising on the teaching learning, both in qualitative and quantitative terms. This will suit the present day needs of students in terms of securing their paths towards higher studies or employment.

Courses of Study: Courses of the study indicate pursuance of study in a particular discipline. Every discipline shall offer four categories of courses of study, viz. Discipline Specific Core (DSC) courses, Discipline Specific Electives (DSEs), Skill Enhancement Courses (SECs) and Generic Electives (GEs). Besides these four courses, a student will select Ability Enhancement Courses (AECs) and Value-Added Courses (VACs) from the respective pool of courses offered by the University.

A. **Discipline Specific Core (DSC):** Discipline Specific Core is a course of study, which should be pursued by a student as a mandatory requirement of his/ her programme of study. In Bachelor of Science (Hons.) Bioinformatics programme, DSCs are

the core credit courses of Bioinformatics which will be appropriately graded and arranged across the semesters of study, being undertaken by the student, with multiple exit options as per NEP 2020.

B. Discipline Specific Elective (DSE): The Discipline Specific Electives (DSEs) are a pool of credit courses of Bioinformatics from which a student will choose to study based on his/ her interest.

C. Generic Elective (GE): Generic Electives is a pool of courses offered by various disciplines of study (excluding the GEs offered by the parent discipline) which is meant to provide multidisciplinary or interdisciplinary education to students. In case a student opts for DSEs beyond his/ her discipline specific course(s) of study, such DSEs shall be treated as GEs for that student.

Ability Enhancement course (AEC), Skill Enhancement Course (SEC) and Value Addition Course (VAC):

These three courses are a pool of courses offered by all the Departments in groups of odd and even semesters from which a studentcan choose.

i. **AEC:** AEC courses are the courses based upon the content that leads to knowledgeenhancement through various areas of study. They are based on Language and Literature, and Environmental Science which are mandatory for all disciplines.

ii. **SEC:** SECs are skill-based courses in all disciplines and are aimed at providing hands-on training, competencies, proficiency and skills to students. SEC courses may be chosen from a pool of courses designed to provide skill- based instruction.

iii. **VAC:** VACs are common pool of courses offered by different disciplines and aimed towards personality building, embedding ethical, cultural and constitutional values; promote critical thinking, Indian knowledge systems, scientific temperament, communication skills, creative writing, presentation skills, sports and physical education and team work which willhelp in all round development of students.

Structure of B. Sc. (Three / Four Years Honours / Honours with Research Degree Programme with Multiple Entry and Exit Options

Subject (Major): Bioinformatics

B.Sc First Year: 1st Semester

Course Type	Course Code	Course Name	Teaching Scheme(Hrs / Week)		Credits Assigned		Total Credits
			Theory	Practical	Theory	Practical	
Major (Core) M1 Mandatory **Biotechnology**	DSC-1	**Introduction to Computer**	2		2		2+2 = 4
	DSC-2	Practical based on DSC-1		4		2	
Major (Core) M2 Mandatory	DSC-3	**Chemistry-I**	2		2		2+2 = 4
	DSC-4	Practical based on DSC-3		4		2	
Major (Core) M3 Mandatory	DSC-5	**Numericals for Bioinformatics**	2		2		2+2 = 4
	DSC-6	Practical based on DSC-5		4		2	
Generic / Open Elective (GE/OE) (Choose any two from pool of courses) **It should be chosen compulsorily from the faculty other than that of Major**	GE/OE-1	To be chosen from other faculty	2		2		2
SEC (Skill Enhancement Courses) (Choose any one from pool of courses)	**SEC-1**	**A. Animal Informatics B. Biophysics**	1		1		2
	SEC-2	**Practical based on SEC-1 A Practical based on SEC-1 B**		2		1	
AEC, VEC, IKS	AEC-1	English (Common for all the faculty)	2		2		2+2 =4
	IKS-1	Choose any one from pool of courses	2		2		
OJT/ FP/CEP/CC/RP	CC-1	Health and Wellness(Common for all the faculty)		4		2	2
			13	**18**	**13**	**09**	**22**

GE/OE-1: **Overview of Bioinformatics** (This course will be available for the students from other faculty

B.Sc. First Year: 2nd Semester

Course Type	Course Code	Course Name	Teaching Scheme(Hrs / Week)		Credits Assigned		Total Credits
			Theory	Practical	Theory	Practical	
Major (Core) M1 Mandatory	DSC-7	**Introduction to Bioinformatics**	2		2		2+2 = 4
	DSC-8	Practical based on DSC-7		4		2	
Major (Core) M2 Mandatory	DSC-9	**Chemistry-II**	2		2		2+2 = 4
	DSC-10	Practical based on DSC-9		4		2	
Major (Core) M3 Mandatory	DSC-11	**Scripting Language for Bioinformatics**	2		2		2+2 = 4
	DSC-12	Practical based on DSC-11		4		2	
Generic / Open Elective (GE/OE) (Choose any two from pool of courses) **It should be chosen compulsorily from the faculty other than that of Major**	GE/OE-2	To be chosen from other faculty	2		2		2
VSC (Vocational Skill Courses) (Choose any one from pool of courses)	VSC-1	**A. Plant Informatics B. Programming in C**	1		1		2
	VSC-2	**Practical based on VSC-1 A** **Practical based on VSC-1 B**		2		1	
AEC, VEC, IKS	AEC-1	English (Common for all the faculty)	2		2		2+2 =4
	VEC-1	Constitution of India (Common for all the faculty)	2		2		
OJT/ FP/CEP/CC/RP	CC-2	Yoga Education / Sports and Fitness (Common for all the faculty)		4		2	2
			13	**18**	**13**	**09**	**22**
Exit Option : Award of UG Certificate in 3 Majors with 44 credits and an additional 4 credits of core NSQF course/ Internship OR continue with Major and Minor							

GE/OE-2: **Introduction to Bioinformatics Software** (This course will be available for the students from other faculty)

Students will have to choose COMPULSORY three subjects as a **Major 1, Major 2, Major 3,** under the Faculty of Science and Technology.

Detailed Illustration of Courses included in 1st and 2nd semester:

1) **Major** (Core) subject are mandatory.
   - **DSC-1:** This is a 2 credit theory course corresponding to Major (core) subject
   - **DSC-2:** This is a 2 credit practical course based on **DSC-1**
   - **DSC-3:** This is a 2 credit theory course corresponding to Major (core) subject
   - **DSC-4**: This is a 2 credit practical course based on **DSC-3**
   - **DSC-5:** This is a 2 credit theory course corresponding to Major (core) subject
   - **DSC-6:** This is a 2 credit practical course based on **DSC-5**
   - **DSC-7:** This is a 2 credit theory course corresponding to Major (core) subject
   - **DSC-8**: This is a 2 credit practical course based on **DSC-7**
   - **DSC-9:** This is a 2 credit theory course corresponding to Major (core) subject
   - **DSC-10:** This is a 2 credit practical course based on **DSC-9**
   - **DSC-11:** This is a 2 credit theory course corresponding to Major (core) subject
   - **DSC-12:** This is a 2 credit practical course based on **DSC-11**

2) **Generic / Open Elective (GE/OE)**: (Needs to be chosen (any two) from pool of courses available at respective college). **These courses should be chosen compulsorily from faculty other than that of Major.**

   GE/OE -1: This is a 2 credit theory course should be chosen compulsorily fromfaculty other than that of Major.
   GE/OE -2: This is a 2 credit theory course should be chosen compulsorily fromfaculty other than that of Major.

3) **SEC** (Skill Enhancement Courses): Choose any one from pool of courses. These courses needs to be designed to enhance the technical skills of the students in specific area.

SEC-1: This is a 1 credit theory course to enhance the technical skills of the studentsin specific area.
SEC-2: This is a 1 credit practical course based on SEC-1.

4) **VSC** (Vocational Skill Courses): Choose any one from pool of courses. Thesecourses should be based on Hands on Training corresponding to Major (core) subject.

VSC-1: This is a 1 credit theory course based Hands on Training corresponding toMajor (core) subject.
VSC-2: This is a 1 credit practical course based on VSC-1

5) **AEC** (Ability Enhancement courses): The focus of these courses should be based on linguistic and communication skills.

AEC-1: English
This is a 2 credit theory course based on linguistic proficiency. It will be common forall the faculty.

AEC-2: English
This is a 2 credit theory course based on linguistic proficiency. It will be common forall the faculty.

6) **IKS** (Indian Knowledge System): The courses related to traditional and ancient culture of India will be included in this section. The respective college will have to choose one of the courses from the pool of courses designed by the University.

IKS-1: To be chosen from the pool of courses designed by the University
This is a 2 credit theory course based on Indian Knowledge System. It will becommon for all the faculty

7) **VEC** (Value Education Courses): The courses such as understanding India, Environmental Science / Education, Digital and Technological solutions etc will be part of Value Education Courses.

VEC-1: Constitution of India
This is a 2 credit theory course based on value education. It will be common for allthe faculty

8) **CC** (Curricular Courses): The courses such as Health and wellness, Yoga education, Sports and Fitness, Cultural activities, NSS/NCC, Preforming Arts.

CC-1: Health and Wellness
This is a 2 credit practical course based on Co-curricular activities. It will be commonfor all the faculty

CC-2: Yoga education / Sports and Fitness
This is a 2 credit practical course based on Co-curricular activities. It will be commonfor all the faculty.

Programme Educational Objectives (PEOs):

Programme Educational Objectives (PEOs) for the Bachelor of Science in Bioinformatics Curriculum under the National Education Policy 2020:

1. **Mastery of Discipline-Specific Knowledge**: Graduates of the Bachelor of Science in Bioinformatics program will demonstrate a deep understanding of fundamentalprinciples, theories, and methodologies in their chosen scientific discipline, enabling them to analyze complex problems, propose innovative solutions, and contribute to advancements in their field.
2. **Interdisciplinary Proficiency**: Graduates will possess the ability to integrate knowledge and skills from multiple scientific disciplines, fostering a holistic approach to problem- solving and innovation. They will be equipped to address multifaceted challenges by drawing upon diverse perspectives and methodologies.
3. **Critical Thinking and Analytical Skills:** Graduates will develop strong critical thinking abilities, enabling them to evaluate information rigorously, analyze data effectively, and make informed decisions based on evidence. They will demonstrate proficiency in applying logical reasoning and scientific methods to solve problems and generate new knowledge.
4. **Leadership and Innovation:** Graduates will demonstrate leadership qualities and entrepreneurial mindset, capable of initiating and driving positive change in their organizations and communities. They will exhibit creativity, resilience, and adaptability, harnessing innovation to address complex challenges and seize opportunities for growth and advancement.
5. **Global Citizenship and Cultural Sensitivity**: Graduates will possess a global perspective and cultural sensitivity, recognizing the inter connectedness of diverse communities and the importance of collaboration across borders. They will engage in cross-cultural dialogue, embrace diversity, and contribute to the advancement of knowledge and understanding on a global scale.

These Programme Educational Objectives serve as guiding principles for the Bachelor of Science curriculum, reflecting our commitment to nurturing well-rounded graduates who are prepared to excel in their careers, contribute to society, and lead meaningful lives in a rapidly changing world.

Programme Outcomes (POs):

The National Education Policy (NEP) 2020 for India emphasizes several key aspects for Bachelor of Science (B.Sc.) programs, aiming to produce graduates who are not only well- versed in their respective disciplines but also equipped with skills necessary for holistic development and employability. While specific program outcomes may vary between institutions and disciplines within B.Sc. programs, here are some common outcomes alignedwith NEP 2020:

- **PO1. The citizenship and society:** Apply broad understanding of ethical and professional skill in science subjects in the context of global, economic, environmental and societal realities while encompassing relevant contemporary issues.
- **PO2. Environment and sustainability**: Apply broad understanding of impact of science subjects in a global, economic, environmental and societal context and demonstrate the knowledge of, and need for sustainable development.
- **PO3. Ethics:** Apply ability to develop sustainable practical solutions for science subject related problems within positive professional and ethical boundaries.
- **PO4. Individual and team work:** Function effectively as a leader and as well as team member in diverse/ multidisciplinary environments.
- **PO5. Communication:** Communicate effectively on complex science subject related activities with the scientific community in particular and with the society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
- **PO6. Project management and finance**: Demonstrate knowledge and understanding of the first principles of science and apply these to one's own work as a member and leader in a team, to complete project in any environment.

- **PO7. Life-long learning**: Recognize the need for lifelong learning and have theability to engage in independent and life-long learning in the broadest context of technological change.

These program outcomes align with the broader goals of NEP 2020 to transform higher education in India and prepare students for the challenges and opportunities of the 21st century. Board of Studies designing B.Sc. curricula are encouraged to incorporate these outcomes into their program objectives and learning outcomes.

Programme Specific Outcomes (PSOs)

PSO No.	Program Specific Outcomes(PSOs) On completion of the 03/04 years Degree in B.Sc. Bioinformatics, student will be able to:
PSO1	**Academic competence** (i) Demonstrate comprehensive knowledge, imparted by highly qualified andcompetent faculty, and develop interdisciplinary skills in the fields of bioinformatics. (ii) Acquire good experimental and laboratory skills applied in bioinformatics andallied subjects in well-equipped and state-of- the-art laboratories. (iii) Understand the scope and applications of bioinformatics and acquire competence in the domain of life sciences to enable bright future prospects.
PSO2	**Personal and Professional Competence** (i) Demonstrate conceptual learning through systematic thinking and self-study and lifelong learning that helps to solve scientific problems in the field of bioinformatics. (ii) Apply appropriate tools and techniques in bioinformatics, to design and perform in silico experiments proficiently and become competent to pursue higher studies or join the industry sector. (iii) Acquire good oral and written communication skills. (iv) Discuss the upcoming fields in bioinformatics. (v) Experience opportunity to participate in/manage/curate many co and extra-curricular activities for overall development of students.
PSO3	**Research Competence** (i) Acquire an ability to identify, formulate, analyze and solve scientific problems in various areas of bioinformatics and allied fields. (ii) Demonstrate appropriate skills in design of experiments with proper scientific approach. (iii) Develop ability to apply scientific research methodology and achieve ethicalresearch aptitude.
PSO4	**Entrepreneurial and Social competence** (i) Employ skills and knowledge acquired in skill imparting and Entrepreneurial courses in upcoming fields of bioinformatics (ii) Develop a sense of environmental, social, ethical and professional responsibility.

Semester – I

M1 : DSC-1 : Introduction to Computer

Total Credits : 02 Total Contact Hours : 30 Hrs

Maximum Marks : 50

Learning Objectives of the Course:

i. To familiar with Computer System

ii. To Handle Windows operating System

iii. To Handle LINUX operating System

iv. To Handle Microsoft Office Suite

Course Outcomes (COs) :

After completion of the course, students will be able to -

i. Understand various components of computers & their working

ii. Understand & handling of Windows operating system

iii. Understand & handling of LINUX operating system

iv. Handle Microsoft Office applications

Module No.	Topics / actual contents of the syllabus	Contact Hours
I	Computer: Definition, Characteristics of Computers, Basic Applications of Computer, Generations of computers, 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.	**10 Hrs**
II	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 , partition of hard disk.	**10 Hrs**

III	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.	**10 Hrs**

Text Books:

- Computer Fundamentals by P. K. Sinha.

Reference Books:

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

DSC-2 : Practical based on DSC-1 (M1 Introduction to Computer)	
Total Credits : 02 Total Contact Hours : 60 Hrs Maximum Marks : 50	
Course Objectives	• Efficiently handle computer system • To handle MS WORD • To handle MS EXCEL • To handle MS ACCESS • To handle MS POWERPOINT • To handle LINUX operating system
Course Outcome	**After successful completion of this course, students are expected to:** • Handle computer system • Perform various operations on MS WORD • Perform various operations on MS EXCEL • Perform various operations on MS ACCESS • Perform various operations on MS POWERPOINT • Perform various operations on LINUX OS
1.	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
2.	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
3.	Make a presentation of College Education System using 1. Blank Presentation 2. From Design Template 3. From Auto Content Wizard
4.	Connect the Internet; open any website of your choice and save 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
5.	Webpages Search any topic related to your syllabi using any search engine and download the relevant material.
6.	Create your E-Mail ID on any free E-Mail Server.
7.	Compute the division of each and every student of a class using MS EXCEL
8.	To compute mean/median/mode using MS EXCEL
9.	Create a Student database in Design View, by using Wizard, and by entering data using MS ACCESS.
10.	Create a query on Student database in design view and by using wizard.
11.	File handling using LINUX

Text Books:

- *Computer Fundamentals by P. K. Sinha.*

Reference Books:

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

M2 : DSC-3 : Chemistry-I

Total Credits : 02 Total Contact Hours : 30 Hrs

Maximum Marks : 50

Learning Objectives of the Course:

i. To familiar with fundamentals of chemistry

ii. To understand atomic structures of elements

iii. To understand the chemical bonding

Course Outcomes (COs) :

After completion of the course, students will be able to -

i. Understand the fundamental properties of atoms, molecules, and the various states of matter with an emphasis on the particulate nature of matter.

ii. Understand the fundamental atomic structure and the periodicity of elements in the periodic table.

iii. Understand the current bonding models for simple inorganic and organic molecules in order to predict structures and important bonding parameters.

Module No.	Topics / actual contents of the syllabus	Contact Hours
I	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.	**10 Hrs**
II	Discovery of electron, proton and neutron; atomic number, isotopes and isobars. Thompson's model and its limitations, Rutherford's model and its limitations,	**10 Hrs**

	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. 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	
III	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. 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.	**10 Hrs**

Text Books:

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

Reference Books:

- D. F. Shriver, P. W. Atkins, C.H. Langford: Inorganic Chemistry
- A. G. Sharpe: Inorganic Chemistry
- J. March: Advanced Organic Chemistry
- I. L. Finar: Organic Chemistry (Vol. I)
- D. A. Mcquarrie and J. D. Simon: Physical Chemistry – A Molecular Approach
- I. N. Levine: Physical Chemistry

DSC-4 : Practical based on DSC-3 (M2 : Chemistry-I)	
Total Credits : 02 Total Contact Hours : 60 Hrs Maximum Marks : 50	
Course Objectives	i. To familiar with fundamentals of chemistry ii. To understand atomic structures of elements iii. To understand the chemical bonding
Course Outcome	**After successful completion of this course, students are expected to:** i. Understand the fundamental properties of atoms, molecules, and the various states of matter with an emphasis on the particulate nature of matter. ii. Understand the fundamental atomic structure and the periodicity of elements in the periodic table. iii. Understand the current bonding models for simple inorganic and organic molecules in order to predict structures and important bonding parameters.
1.	Prepare standard solution oxalic acid ad standardize given NaOH solution.
2.	Prepare standard solution oxalic acid ad standardize given KMnO4 solution.
3.	Determine the water of crystallization in given salt – BaCl2, 2H2O
4.	To determine the specific reaction rate of the hydrolysis of methyl acetate/ ethyl Acetate catalysed by hydrogen ion at room temperature
5.	To study and perform kinetically the reaction rate of decomposition of iodide by H2O2.
6.	To determine the percentage composition of a given mixture by viscosity methods.
7.	To determine the percentage composition of a given binary mixture by surface tension method.

Text Books:

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

Reference Books:

- D. F. Shriver, P. W. Atkins, C.H. Langford: Inorganic Chemistry
- A. G. Sharpe: Inorganic Chemistry
- J. March: Advanced Organic Chemistry
- I. L. Finar: Organic Chemistry (Vol. I)
- D. A. Mcquarrie and J. D. Simon: Physical Chemistry – A Molecular Approach
- I. N. Levine: Physical Chemistry

M3: DSC-5 : Numericals for Bioinformatics

Total Credits : 02 Total Contact Hours : 30 Hrs

Maximum Marks : 50

Learning Objectives of the Course:

i. To understand the concept of statistical analysis and their use in life sciences

ii. To understand the theoretical concept of measures of central tendency

iii. To understand the basics of algebra

Course Outcomes (COs) :

After completion of the course, students will be able to -

i. Applications of various statistical techniques in life sciences

ii. Understand correlation, regression, statistical inferences & ANOVA

iii. Understand matrix & vector algebra

Module No.	Topics / actual contents of the syllabus	Contact Hours
I	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. Measures of Central tendency-Mean, Median, Mode, –merits and limitations. Measures of dispersion –range, standard deviation, mean deviation.	**10 Hrs**
II	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.	**10 Hrs**
III	Matrix algebra: Definition, types of matrices, matrix algebra, addition, subtraction & multiplication. Transpose inverse of matrix. Vector algebra and calculus,	**10 Hrs**

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

Text Books:

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

Reference Books:

- Introductory Biostatistics: Chap T Le, Wiley interscience publication.
- Jenny Olive – Maths: - a self-study Guide – Cambridge Low prices edition
- R.G. Bartle and D.R. Sherbert (2nd edition)-John Wiley, New York
- Daniel, W.W. Biostatistics, John Wiley Sons, New York.
- Sundarrao, P.S.S. and Richards, An Introduction to Biostatistics, 3rd Edition, CMC, Vellore.
- Selvin, S. Statistical analysis of epidemiological data, University press, NY.
- Bishop, O.N. Statistics for biology, Hougtan, Boston.
- Freedman, P, The principles of scientific research, Pergamon press, NY.

DSC-6 : Practical based on DSC-5 **(M3 : Numericals for Bioinformatics)** Total Credits : 02 Total Contact Hours : 60 Hrs Maximum Marks : 50	
Course Objectives	• To understand the concept of statistical analysis and their use in life sciences • To understand the theoretical concept of measures of central tendency • To understand the basics of algebra
Course Outcome	**After successful completion of this course, students are expected to:** • Applications of various statistical techniques in life sciences • Understand correlation, regression, statistical inferences & ANOVA • Understand matrix & vector algebra
1.	Graphical representation of data.
2.	Problems based on measures of central tendency.
3.	Problems based on measures of dispersion.
4.	Problems based on combined mean and variance and coefficient of variation.
5.	Problems based on matrix and vector algebra.
6.	Problems based on ANOVA.
7.	Graphical representation of data.
8.	Problems based on correlation and regressions
Text Books: • Venkateswara Rao, A Textbook of B.Sc. Mathematics - Vol. 1, S. Chand publication.	

Reference Books:

- Introductory Biostatistics: Chap T Le, Wiley interscience publication.
- Jenny Olive – Maths: - a self-study Guide – Cambridge Low prices edition
- R.G. Bartle and D.R. Sherbert (2nd edition)-John Wiley, New York
- Daniel, W.W. Biostatistics, John Wiley Sons, New York.
- Sundarrao, P.S.S. and Richards, An Introduction to Biostatistics, 3rd Edition, CMC, Vellore.
- Selvin, S. Statistical analysis of epidemiological data, University press, NY.
- Bishop, O.N. Statistics for biology, Hougtan, Boston.
- Freedman, P, The principles of scientific research, Pergamon press, NY.

SEC-1 : A. Animal Informatics

Total Credits : 01 Total Contact Hours : 15 Hrs

Maximum Marks : 25

Learning Objectives of the Course:

i. To understand the outline of kingdom Animalia
ii. To understand the morphology of Honey bees
iii. To understand the life cycles of parasite
iv. To understand the economic importance of zoology

Course Outcomes (COs) :

After completion of the course, students will be able to -

i. Classify chordates & non-chordates
ii. Identify different body parts of honey bee
iii. Study the life cycles of endo- parasites
iv. Study economic importance of vermin-culture, aquaculture etc.

Module No.	Topics / actual contents of the syllabus	Contact Hours
I	**Introduction to Kingdom Animalia:** Outline of classification and characterization of non-chordates and chordates with examples. Adaptations in animal kingdom (with respect to environment in which they live)., **Type Study: Honey bee** Morphology, Structure of Head , Mouthparts , Legs, wings, Sting Apparatus and Pollen Basket., Social Organization of Honey Bee and Bee Products (apiculture).	**07 Hrs**
II	**Parasitology:** Study of Plasmodium sp., *Entamoeba histolytica, Fasciola hepatica, Taenia solium* on lifecycle, adaptations and evolution of host-parasite interactions, infectivity, control and treatment measures. Model System: Drosophila as a model system Zebra fish as a Model system Chick embryo as a model system,	**08 Hrs**

	Economic Zoology: Vermiculture, aquaculture, sericulture, pearl culture, lac culture.	

Text Books:

- Jordan, E.L. and Verma P.S., (i) Chordate Zoology S. Chand & Company Ltd. Ram Nagar. New Delhi.

Reference Books:

- Jordan, E.L. and Verma P.S. (ii) Invertebrate Zoology. S. Chand & Company Ltd. Ram Nagar. New Delhi.
- Modern Text Book of Zoology: Invertebrates. R.L.Kotpal. Publisher, Rastogi Publishers.

SEC-1 : B. Biophysics

Total Credits : 01 Total Contact Hours : 15 Hrs

Maximum Marks : 25

Learning Objectives of the Course:

i. To understand the radiations and their properties

ii. To understand the term homeostasis

iii. To understand the term photomorphogenesis

Course Outcomes (COs) :

After completion of the course, students will be able to -

i. Classify radiations & study their effect on cells

ii. Study respiration & homeostasis

iii. Study the biophysics of light

Module No.	Topics / actual contents of the syllabus	Contact Hours
I	Nuclear radiations and their properties - alpha, beta and gamma. Introduction, classification of radiations in radiobiology, irradiation of cells, type of radiation damage, Tissue Specific metabolism: Kidney, Brain, Liver, Muscles, Blood: use of energy for their function Role of ATP, ADP and Phosphocreatine for energy generation.	**07 Hrs**
II	Homeostasis: human as an example. Gaseous exchange: respiration, cellular and intracellular respiration. Thermoregulation: role of hormones, heat production by mitochondria. Osmoregulation: role of kidney Biophysics of light: Properties of light, Photosynthesis, Photomorphogenesis, Visual processing, Circadian rhythms, Bioluminescence, and UV radiation effects	**08 Hrs**

Text Books:

- Biophysics, an introduction. 1st edition. Cotteril R. John Willey and Sons Ltd., USA.

Reference Books:

- Biophysics. 1st edition Pattabhi V and Gautham N. Kluwer Academic Publisher, USA.
- Lehninger, Principles of Biochemistry. 5th Edition David Nelson and Michael Cox, W.H. Freeman and company, NY.
- Biophysical Chemistry: Principles and Techniques by Upadhyay, Upadhyay, Nath.

SEC-2 : Practical Based on SEC-1 A

(Animal Informatics)

Total Credits : 01 Total Contact Hours : 30 Hrs

Maximum Marks : 25

Learning Objectives of the Course:

i. To identify animal species by observing their external features
ii. To acquire dissection skills
iii. To study life cycles of animals
iv. To understand life cycles of parasites

Course Outcomes (COs) :

After completion of the course, students will be able to -

i. Identify the animals of invertebrate and vertebrate phyla and recognize their distinguishing features.
ii. Explain theoretical basis and dissection Skills.
iii. Discuss, distinguish and understand the life cycle of important Invertebrate model organisms
iv. Identify, recall and demonstrate life cycle of various parasites.

Practical No./ Module No.	Topics / actual contents of the syllabus
1.	Study of Paramecium: Morphology & Reproduction
2.	Study of Hydra: Morphology, Reproduction & Regeneration
3.	Dissection of Honey Bee, Mounting of Mouth parts, pollen basket, Sting Apparatus, legs and wings.
4.	Study of Fasciola, Plasmodium and Taenia: Morphology & Life cycle

5.	Study of ecto-parasites

Text Books:

- Jordan, E.L. and Verma P.S., (i) Chordate Zoology S. Chand & Company Ltd. Ram Nagar. New Delhi.

Reference Books:

- Jordan, E.L. and Verma P.S. (ii) Invertebrate Zoology. S. Chand & Company Ltd. Ram Nagar. New Delhi.
- Modern Text Book of Zoology: Invertebrates. R.L.Kotpal. Publisher, Rastogi Publishers.

SEC-2 : Practical Based on SEC-1 B

(Biophysics)

Total Credits : 01 Total Contact Hours : 30 Hrs

Maximum Marks : 25

Learning Objectives of the Course:

i. To study calibrations of different laboratory instruments
ii. To determine hemolysis in solution
iii. To study effect of light on pigment production
iv. To study problems on normality, molarity etc.

Course Outcomes (COs) :

After completion of the course, students will be able to -

i. Identify and compare the instruments required to carry out the experiments in the laboratory. Tell whether the instruments they use are calibrated
ii. Solve mathematical problems for preparation of chemicals in the laboratory and radiation biology.
iii. Design experiments to study the effect of light for photosynthesis and concept of osmosis.

Practical No./ Module No.	Topics / actual contents of the syllabus
1	Calibration and use of micropipettes and glass pipettes
2	Problems on radioactivity
3	To determine hemolysis in solutions of different osmolarity
4	To study the effect of light on pigment production.
5	Mathematical Calculations, problems based on normality, molarity, stock and working standard preparation
6	Problems on measurement unit conversions

Text Books:

- Biophysics, an introduction. 1st edition. Cotteril R. John Willey and Sons Ltd., USA.

Reference Books:

- Biophysics. 1st edition Pattabhi V and Gautham N. Kluwer Academic Publisher, USA.
- Lehninger, Principles of Biochemistry. 5th Edition David Nelson and Michael Cox, W.H. Freeman and company, NY.
- Biophysical Chemistry: Principles and Techniques by Upadhyay, Upadhyay, Nath.

This course will be available for the students from other faculty

GE/OE-1 : Overview of Bioinformatics

Total Credits : 02 Total Contact Hours : 30 Hrs

Maximum Marks : 50

Learning Objectives of the Course:

i. To understand the field of bioinformatics & its applications

ii. To understand the need, nature & contents of biological databases

iii. To understand the concept of data analysis

Course Outcomes (COs) :

After completion of the course, students will be able to -

i. Study genome sequencing strategies & nature of biological data

ii. Access the contents of various biological databases

iii. Handle & process biological data

Module No.	Topics / actual contents of the syllabus	Contact Hours
I	Bioinformatics-History, Concept and Applications, Genome Sequencing strategies-NGS: Concept and Application, Nature of Biological data, Format vs Content, Human Genome Project-Aim, Objectives and Outcomes, Draft vs Finished Human Genome Data.	**10 Hrs**
II	General Introduction of Biological Databases; Nucleic acid databases (NCBI, DDBJ, and EMBL). Protein databases (Primary, Composite, and Secondary). Specialized Genome databases: (SGD, TIGR, and ACeDB). Structure databases (CATH, SCOP, and PDB)	**10 Hrs**

III	Concept of Biological Data Analysis, Basics of biological Data Analysis tools(FASTA, BLAST, BLAT, RASMOL), RASMOL, Cn3D.	**10 Hrs**

Text Books:

- Introduction to Bioinformatics Author(s): Teresa Attwood, David Parry-Smith

Reference Books:

- Ontologies for Bioinformatics Author(s): Kenneth Baclawski and Tianhua Niu
- Bioinformatics: The Machine Learning Approach Author(s): P.Baldi and S. Brunak
- DNA Microarrays and Gene Expression: From Experiments to Data Analysis and Modeling Author(s): Pierre Baldi, G. Wesley Hatfield
- Bioinformatics for Geneticists Author(s): Michael Barnes, Ian C Gray
- Bioinformatics: A Practical Guide to the Analysis of Genes and Proteins, Second Edition Author(s): Andreas D. Baxevanis and B. F. Francis Ouellette (Eds)
- Bioinformatics Computing Author(s): Bryan P. Bergeron

Semester – II

M1 : DSC-7 : Introduction to Bioinformatics

Total Credits : 02 Total Contact Hours : 30 Hrs
Maximum Marks : 50

Learning Objectives of the Course:

i. To understand the concept of bioinformatics, their scope & applications
ii. To understand the design and contents of biological databases
iii. To understand the algorithmic approach of data analysis techniques

Course Outcomes (COs) :

After completion of the course, students will be able to -

i. Understand 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
ii. Explain the major steps in pairwise and multiple sequence alignment, Explains the principle for, and executes pairwise sequence alignment by dynamic programming.
iii. Predict the secondary and tertiary structures of protein sequences.

Module No.	Topics / actual contents of the syllabus	Contact Hours
I	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.	**10 Hrs**
II	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, Specialized databases: OMIM, OMIA, Literature	**10 Hrs**

	database-PUBMED, Structural Databases: PDB, NDB, MMDB, Molecular Visualization tools: Rasmol, Cn3D, SPDBViewer, Biological information search engine: ENTREZ-Concept and Applications.	
III	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, Overview of multiple sequence alignment, methods of MSA, significance of MSA, CLUSTAL OMEGA, and CLUSTALX. Protein secondary and tertiary structure prediction methods.	**10 Hrs**

Text Books:

- Introduction to Bioinformatics: by Arthur Lesk, Oxford University press.

Reference Books:

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

DSC-8 : Practical based on DSC-7 (M1 : Introduction to Bioinformatics)

Total Credits : 02 Total Contact Hours : 60 Hrs

Maximum Marks : 50

Course Objectives	i. To understand the concept of bioinformatics, their scope & applications ii. To understand the design and contents of biological databases iii. To understand the algorithmic approach of data analysis techniques
Course Outcome	**After successful completion of this course, students are expected to:** i. Explore & access bioinformatics resources ii. Explore & access Biological databases iii. Handle Bioinformatics Tools
1.	Exploring and accessing of resources-NCBI/EBI/SIB.
2.	Exploring of biological information search engine: Entrez.
3.	Exploring and accessing of biological information from Genbank/EMBL and DDBJ.
4.	Exploring and querying Uniprot database.
5.	Exploring and querying PIR database
6.	Exploring and querying PROSITE, PFAM and PRODOM database.
7.	BLAST & FASTA analysis
8.	Biomolecular Structure Visualization using Rasmol, Cn3D & SPDBViewer
9.	Protein secondary & tertiary structure prediction

Text Books:

- Introduction to Bioinformatics: by Arthur Lesk, Oxford University press.

Reference Books:

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

M2 : DSC-9 : Chemistry-II

Total Credits : 02 Total Contact Hours : 30 Hrs

Maximum Marks : 50

Learning Objectives of the Course:

i. To understand the classification interdisciplinary nature of chemistry

ii. To understand the nomenclature and classification of chemical compounds

Course Outcomes (COs) :

After completion of the course, students will be able to -

i. 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.

ii. Acquire a foundation of chemistry of sufficient breadth and depth to enable them to understand and critically interpret the primary chemical literature.

Module No.	Topics / actual contents of the syllabus	Contact Hours
I	Classification of stereoisomers, isomer number, enantiomerism, diastereomerism, chiral center, absolute configuration, R & S, conformations in Cycloalkanes and cyclohexanes, geometrical isomerism: E & Z, resolution, stereo selecting and stereospecific reactions. 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.	**10 Hrs**
II	Alkanes, Alkenes, and Alkynes: definition, general formula, IUPAC nomenclature, general preparation methods and physical and chemical properties; Cycloalkanes, Aromatic compounds: definitions, general	**10 Hrs**

	formulae, IUPAC nomenclature, general preparation methods and physical and chemical properties.	
III	Alcohols, Phenols, Aldehydes, Ketones, Carboxylic Acids in Biology, Its Definition, general formula, IUPAC nomenclature, general preparation methods and bio-physico-chemical properties. 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.	**10 Hrs**

Text Books:

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

Reference Books:

- N. N. Greenwood, A. Earnshaw: Chemistry of the Elements
- D. F. Shriver, P. W. Atkins, C.H. Langford: Inorganic Chemistry
- A. G. Sharpe: Inorganic Chemistry
- J. March: Advanced Organic Chemistry
- I. L. Finar: Organic Chemistry (Vol. I)
- D. A. Mcquarrie and J. D. Simon: Physical Chemistry – A Molecular Approach
- I. N. Levine: Physical Chemistry

DSC-10 : Practical based on DSC-9 (M2 : Chemistry-II)	
Total Credits : 02 Maximum Marks : 50	Total Contact Hours : 60 Hrs
Course Objectives	• To understand the classification interdisciplinary nature of chemistry • To understand the nomenclature and classification of chemical compounds
Course Outcome	**After successful completion of this course, students are expected to:** • 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. • Acquire a foundation of chemistry of sufficient breadth and depth to enable them to understand and critically interpret the primary chemical literature.
1.	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.

2.	Purification of given organic compound by crystallization method.
3.	Purification of given organic compound by sublimation method.
4.	Purification of given organic compound by distillation method.

Text Books:

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

Reference Books:

- N. N. Greenwood, A. Earnshaw: Chemistry of the Elements
- D. F. Shriver, P. W. Atkins, C.H. Langford: Inorganic Chemistry
- A. G. Sharpe: Inorganic Chemistry
- J. March: Advanced Organic Chemistry

M3 : DSC-11 : Scripting Language for Bioinformatics

Total Credits : 02 Total Contact Hours : 30 Hrs

Maximum Marks : 50

Learning Objectives of the Course:

i. To develop web based applications especially for biological data analysis

ii. To understand working on World Wide Web through implementations

iii. To understand various methods from computational biology to implement their programmatic versions

Course Outcomes (COs) :

After completion of the course, students will be able to -

i. Apply design principles to develop web based applications especially for biological data analysis

ii. Understand working on World Wide Web through implementations

iii. Use various methods from computational biology to implement their programmatic versions

Module No.	Topics / actual contents of the syllabus	Contact Hours
I	Introduction to Internet and World Wide Web. An overview of scripting languages, with applications towards biological data and sequence analysis. Complexity of DNA problems and their computational implications and applications. Introduction to HTML, DHTML, XML. Accessing different objects of the HTML page, Dynamic page generation, Cascading Style Sheets (CSS).	**10 Hrs**
II	JAVASCRIPT: Document object model, Elements of the document object model, basic principles of JS, object based programming using JavaScript; data types and structures, array and string handling, function implementations, XML: DTD, XML schemas, XML	**10 Hrs**

	document structure, retrieving data from database in XML format; various bio based versions of XML.	
III	PHP: PHP beginning to advanced level, data types, array and string handling, mathematical expressions and functions in PHP, PHP programming (implementation of object model), Database connectivity using PHP. Implementation of programming skills for solving problems in biology. Development of bioinformatics based small applications and web based applications.	**10 Hrs**

Text Books:

- HTML the complete reference, TMH

Reference Books:

- HTML the complete reference, TMH.
- Beginning PHP and Professional PHP, Wrox, Wiley Dreamtech.
- JavaScript: The complete Reference, TMH.

DSC-12 : Practical based on DSC-11

(M3 : Scripting Language for Bioinformatics)

Total Credits : 02 Total Contact Hours : 60 Hrs

Maximum Marks : 50

Course Objectives	• To develop web based applications especially for biological data analysis • To understand working on World Wide Web through implementations • To understand various methods from computational biology to implement their programmatic versions
Course Outcome	**After successful completion of this course, students are expected to:** • Apply design principles to develop web based applications especially for biological data analysis • Understand working on World Wide Web through implementations • Use various methods from computational biology to implement their programmatic versions
1.	Introduction to HTML, DHTML, XML and accessing different objects of the HTML page and dynamic page generations
2.	HTML code for basic understanding of the syntax including the use of nesting of lists
3.	HTML code for creating a webpage including hyperlinks and images.
4.	Construction of DTD schema, a sample xml document to represent Evolutionary tree.
5.	Create a MySql/ MS accesses database tables and execute all SQL queries.
6.	Development of a PHP program to take set of sequences and find out conserved sequences
7.	Write a PHP program to connect mysql database and execute all SQL commands

8.	Write a PHP program to find out ORFs existing in a given genomic sequence

Text Books:

- HTML the complete reference, TMH

Reference Books:

- HTML the complete reference, TMH.
- Beginning PHP and Professional PHP, Wrox, Wiley Dreamtech.
- JavaScript: The complete Reference, TMH.

VSC-1 : A. Plant Informatics

Total Credits : 01
Maximum Marks : 25

Total Contact Hours : 15 Hrs

Learning Objectives of the Course:

i. To understand nature of plant cell & tissues
ii. To understand habit & habitat of plant species
iii. To understand binomial nomenclature system of plant

Course Outcomes (COs) :

After completion of the course, students will be able to –

i. Describe these plant specimens morphologically. Identify in which group of kingdom Plantae they belong to.
ii. Demonstrate their anatomical features. Apply Taxonomic criteria and Classify, identify and find out scientific name
iii. Analyze the relationship between different groups of plant Kingdom

Module No.	Topics / actual contents of the syllabus	Contact Hours
I	Unique features of plants, Plant Cell, Cell wall, plasmodesmata, Chloroplasts, Growth and Development Plant Tissue Systems Epidermal, Ground, Vascular, Mechanical tissue systems. Conquest of land: Cryptogams- General characters (Habit, habitat, Reproduction, Alternation of generations) and Economic Importance of Algae, Fungi, Bryophytes and Pteridophytes,	**07 Hrs**
II	Phanerogams- General characters (Habit, habitat, Reproduction, Alternation of generations) and Economic Importance of Gymnosperms and Angiosperms. Major Aspects of plant sciences Structural Morphology- Vegetative and reproductive plant parts Anatomy- Vegetative and reproductive plant parts	**08 Hrs**

	Taxonomy-Binomial nomenclature, Systems of Classification, ICBN, Study of some plant families.	

Text Books:

- *Botany for Degree Students-Algae by B. R. Vashishta*

Reference Books:

- *Class book of Botany- by A.C. Dutta*
- *College Botany Vol.I, II, III by Ganguli, Das Dutta.*
- *Taxonomy of Vascular Plants by G H. Lawrence*

VSC-1 : B. Programming in C

Total Credits : 01 Total Contact Hours : 15 Hrs

Maximum Marks : 25

Learning Objectives of the Course:

i. Understand data types, variables & operators in C Language.

ii. Understand decision making & looping statement

iii. Understand Array & Pointers in C

Course Outcomes (COs) :

After completion of the course, students will be able to –

i. Study data types, variables, decision making statement in C

ii. Study functions in C

iii. Study array in C

Module No.	Topics / actual contents of the syllabus	Contact Hours
I	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. Decision Control and Looping Statements: Introduction to Decision Control Statements – Conditional Branching Statements – Iterative Statements – Nested Loops – Break and Continue Statement – Goto Statement.	**07 Hrs**
II	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. Arrays: Introduction – Declaration	**08 Hrs**

	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.	

Text Books:

- *Let Us C by Yashavant Kanetkar*

Reference Books:

- Programming with C by Brian W. Kernighan and Dennis Ritchie
- C: The Complete Reference by Herbert Schildt
- Mastering C by Venugopal, Prasad – TMH Complete reference with C Tata McGraw Hill
- C – Programming E. Balagurusamy Tata McGray Hill
- Schaums outline of Theory and Problems of programming with C: Gottfried

VSC-2 : Practical based on VSC-1 A (Plant Informatics)	
Total Credits : 01 Total Contact Hours : 30 Hrs Maximum Marks : 25	
Course Objectives	i. To study distinguishing features of plant species ii. To study anatomical features of plant species iii. To study morphological features of plant species
Course Outcome	**After successful completion of this course, students are expected to:** i. State and describe distinguishing features Algae, Fungi, lichens, Bryophytes, Pteridophytes, Gymnosperms and Angiosperms with the help of available suitable material. ii. Apply different morphological terms and describe the specimens to study plant families. Classify and identify the plant and find out the family in which it belongs. iii. Discuss Anatomical features of different plant parts- Root, Stem, leaf of Dicotyledonous and Monocotyledonous plants.
1.	Study of one example each of the following- • Algae • Fungi • Bryophytes • Pteridophytes • Gymnosperms • Angiosperms
2.	Study of anatomical features of root, stem and leaves of Dicotyledons and Monocotyledons
3.	Study of plant tissues by sectioning, staining , maceration
4.	Study of Morphological features of plants and plant families.
5.	Study of plant diseases
Text Books: • Botany for Degree Students-Algae by B. R. Vashishta	

Reference Books:

- Class book of Botany- by A.C. Dutta
- College Botany Vol.I, II, III by Ganguli, Das Dutta.
- Taxonomy of Vascular Plants by G H. Lawrence

VSC-2 : Practical based on VSC-1 B (Programming in C)	
Total Credits : 01 Maximum Marks : 25	Total Contact Hours : 30 Hrs
Course Objectives	i. To construct logic for C Programming ii. To design application specific logic iii. To understand the concept of error handling
Course Outcome	**After successful completion of this course, students are expected to:** i. Write a code for C program ii. Execute C program iii. Resolve errors in C program
1.	Find out the given number is perfect number or not using C program.
2.	Write a C program to find the sum of individual digits of a positive integer.
3.	Write a C program to print the Fibonacci series
4.	Write a C program to generate all the prime numbers between 1 and n, where n is a value supplied by the user.
5.	Write a C program to find both the largest and smallest number in a list of integers.
6.	Write a C program that uses functions to perform the following: a. Addition of Two Matrices b. Multiplication of Two Matrices
7.	Write a program to perform various string operations (using molecular data).
8.	Write C program that implements searching of given item in a given list.
9.	Write a C program to sort a given list of integers in ascending order.

Text Books:

- *Let Us C by Yashavant Kanetkar*

Reference Books:

- Programming with C by Brian W. Kernighan and Dennis Ritchie
- C: The Complete Reference by Herbert Schildt
- Mastering C by Venugopal, Prasad – TMH Complete reference with C Tata McGraw Hill
- C – Programming E.Balagurusamy Tata McGray Hill
- Schaums outline of Theory and Problems of programming with C: Gottfried

This course will be available for the students from other faculty

GE/OE-2 : Introduction to Bioinformatics Software

Total Credits : 02 Total Contact Hours : 30 Hrs

Maximum Marks : 50

Learning Objectives of the Course:

i. To study bioinformatics resources

ii. To study software maintained by NCBI

iii. To study software maintained by EBI & SIB

Course Outcomes (COs) :

After completion of the course, students will be able to -

i. Understand types of Bioinformatics Software

ii. Understand handling of Software

iii. Study interpretation of outcomes

Module No.	Topics / actual contents of the syllabus	Contact Hours
I	Basic concept of Bio computing, Need of Bioinformatics Software, Software Development, Software compatible Biological Data and their types. Major Bioinformatics Resources: NCBI, EBI, SIB.	**10 Hrs**
II	NCBI Bioinformatics Software: BLAST, CDTree, COBALT, Cn3D, Genome Data Viewer, OSIRIS, ORF Finder, SPlign, Tree Viewer, VecScreen, VAST.	**10 Hrs**
III	EBI & SBI Bioinformatics Software: FASTA, BinChe, Clustal Omega, EMBOSS NEEDLE, EMBOSS WATER, ENSEMBL VEP, SWISSMODEL, SWISSDRUGDESIGN, V-PIPE.	**10 Hrs**

Text Books:

- Introduction to Bioinformatics Author(s): Teresa Attwood, David Parry-Smith

Reference Books:

- Ontologies for Bioinformatics Author(s): Kenneth Baclawski and Tianhua Niu
- Bioinformatics: The Machine Learning Approach Author(s): P.Baldi and S. Brunak
- DNA Microarrays and Gene Expression: From Experiments to Data Analysis and Modeling Author(s): Pierre Baldi, G. Wesley Hatfield
- Bioinformatics for Geneticists Author(s): Michael Barnes, Ian C Gray
- Bioinformatics: A Practical Guide to the Analysis of Genes and Proteins, Second Edition Author(s): Andreas D. Baxevanis and B. F. Francis Ouellette (Eds)
- Bioinformatics Computing Author(s): Bryan P. Bergeron

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