॥ सा विद्या या विमुक्तये ॥

स्वामी रामानंद तीर्थ मराठवाडा विद्यापीठ, नांदेड

'ज्ञानतीर्थ', विष्णुपुरी, नांदेड – ४३१ ६०६ (महाराष्ट्र राज्य) भारत

SWAMI RAMANAND TEERTH MARATHWADA UNIVERSITY, NANDED

'Dnyanteerth', Vishnupuri, Nanded - 431 606 (Maharashtra State) INDIA

स्वामी रामानंद तीर्थ मराठवाडा विद्यापीठ, नांदेड

Established on 17th September, 1994, Recognized By the UGC U/s 2(f) and 12(B), NAAC Re-accredited with 'B++' grade

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विज्ञान व तंत्रज्ञान विद्याशाखे अंतर्गत राष्ट्रीय शैक्षणिक धोरण २०२० नुसार पदव्यूत्तर द्वितीय वर्षाचे अभ्यासक्रम (Syllabus) शैक्षणिक वर्ष २०२४–२५ पासून लागू करण्याबाबत.

प रि प त्र क

या परिपत्रकान्वये सर्व संबंधितांना कळविण्यात येते की, या विद्यापीठा अंतर्गत येणा–या सर्व संलग्नित महाविद्यालयामध्ये शैक्षणिक वर्ष २०२४–२५ पासून राष्ट्रीय शैक्षणिक धोरणानुसार पदव्यूत्तर द्वितीय वर्षाचे अभ्यासक्रम लागू करण्याच्या दृष्टीकोनातून विज्ञान व तंत्रज्ञान विद्याशाखे अंतर्गत येणा–या अभ्यासमंडळांनी तयार केलेल्या पदव्यूत्तर द्वितीय वर्षाच्या अभ्यासक्रमांना मा. विद्यापरिषदेने दिनांक १५ मे २०२४ रोजी संपन्न झालेल्या बैठकीतील विषय क्रमांक १५/५९–२०२४ च्या ठरावाअन्वये मान्यता प्रदान केली आहे. त्यानुसार विज्ञान व तंत्रज्ञान विद्याशाखेतील खालील एम. एस्सी द्वितीय वर्षाचे अभ्यासक्रम (Syllabus) लागू करण्यात येत आहेत.

1) M. Sc. II year Biotechnology (Affiliated College)
2) M. Sc. II year Biotechnology (Campus)
3) M. Sc. II year Bioinformatics (Sub Campus Latur)
4) M. Sc. II year Bioinformatics (Affiliated College)
5) M. Sc. II year Clinical Research (Affiliated College)
6) M. Sc. II year Botany (Campus)
7) M. Sc. II year Herbal Medicine
8) M. Sc. II year Boany (Affiliated College)
9) M. Sc. II year Geology (Campus)
10) M. Sc. II year Dairy Science
11) M. Sc. II year Electronics
12) M. Sc. II year Environmental Science
13) M. Sc. II year Environmental Science (Campus)
14) M. Sc. II year Geography (Campus)
15) M. Sc. II year Applied Mathematics
16) M. Sc. II year Mathematics
17) M. Sc. II year Mathematics (Campus)
18) M. Sc. II year Microbiology
19) M. Sc. II year Microbiology (Campus)
20) M. Sc. II year Statistics
21) M. Sc. II year Statistics (Campus)

सदरील परिपत्रक व अभ्यासक्रम प्रस्तुत विद्यापीठाच्या **www.srtmun.ac.in** या संकेतस्थळावर उपलब्ध आहेत. तरी सदरील बाब ही सर्व संबंधितांच्या निदर्शनास आणून द्यावी, ही विनंती.

'ज्ञानतीर्थ' परिसर,
विष्णुपुरी, नांदेड – ४३१ ६०६.
जा.क्र.:शै–१/एनइपी/विवत्रंविपदवी/२०२४–२५/१०९
दिनांक १२.०६.२०२४

डॉ. सरिता लोसरवार
सहा.कुलसचिव
शैक्षणिक (१–अभ्यासमंडळ) विभाग

प्रत : १) मा. आधिष्ठाता, विज्ञान व तंत्रज्ञान विद्याशाखा, प्रस्तुत विद्यापीठ.
२) मा. संचालक, परीक्षा व मुंल्यमापन मंडळ, प्रस्तुत विद्यापीठ.
३) मा. प्राचार्य, सर्व संबधित संलग्नित महाविद्यालये, प्रस्तुत विद्यापीठ.
४) मा. संचालक, सर्व संकुले परिसर व उपपरिसर, प्रस्तुत विद्यापीठ
५) सिस्टीम एक्सपर्ट, शैक्षणिक विभाग, प्रस्तुत विद्यापीठ. याना देवून कळविण्यात येते की, सदर परिपत्रक संकेतस्थळावर प्रसिध्द करण्यात यावे.

SWAMI RAMANAND TEERTH MARATHWADA UNIVERSITY, NANDED

STRUCTURE AND SYLLABUS OF TWO YEAR MASTERS PROGRAM IN SCIENCE

UNDER

NATIONAL EDUCATION POLICY (NEP 2020)

In

SUBJECT: BIOINFORMATICS

FACULTY OF SCIENCE AND TECHNOLOGY

M. Sc. Second Year

(Sub-Centre, Latur)

SCHOOL OF TECHNOLOGY

SWAMI RAMANAND TEERTH MARATHWADA UNIVERSITY, SUB-CENTRE, LATUR

With Effect From June 2024.

From the Desk of the Dean, Faculty of Science and Technology:

Swami Ramanand Teerth Marathwada University, Nanded, enduring to its vision statement "***Enlightened Student: A Source of Immense Power***", is trying hard consistently to enrich the quality of science education in its jurisdiction by implementing several quality initiatives. Revision and updating curriculum to meet the standard of the courses at national and international level, implementing innovative methods of teaching-learning, improvisation in the examination and evaluation processes are some of the important measures that enabled the University to achieve ***the 3Es, the equity, the efficiency*** and ***the excellence*** in higher education of this region. To overcome the difficulty of comparing the performances of the graduating students and also to provide mobility to them to join other institutions the University has adopted the cumulative grade point average (CGPA) system in the year 2014-2015. Further, following the suggestions by the UGC and looking at the better employability, entrepreneurship possibilities and to enhance the latent skills of the stakeholders the University has adopted the Choice Based Credit System (CBCS) in the year 2018-2019 at graduate and post-graduate level. This provided flexibility to the students to choose courses of their own interests. To encourage the students to opt the world-class courses offered on the online platforms like, NPTEL, SWAYM, and other MOOCS platforms the University has implemented the credit transfer policy approved by its Academic Council and also has made a provision of reimbursing registration fees of the successful students completing such courses.

SRTM University has been producing a good number of high calibre graduates; however, it is necessary to ensure that our aspiring students are able to pursue the right education. Like the engineering students, the youngsters pursuing science education need to be equipped and trained as per the requirements of the R&D institutes and industries. This would become possible only when the students undergo studies with an updated and evolving curriculum to match global scenario.

Higher education is a dynamic process and in the present era the stakeholders need to be educated and trained in view of the self-employment and self-sustaining skills like start-ups. Revision of the curriculum alone is not the measure for bringing reforms in the higher education, but invite several other initiatives. Establishing industry-institute linkages and initiating internship, on job training for the graduates in reputed industries are some of the important steps that the University would like to take in the coming time. As a result, revision of the curriculum was the need of the hour and such an opportunity was provided by the New Education Policy 2020. National Education Policy 2020 (NEP 2020) aims at equipping students with knowledge, skills, values, leadership qualities and initiates them for lifelong learning. As a result the students will acquire expertise in

specialized areas of interest, kindle their intellectual curiosity and scientific temper, and create imaginative individuals.

The curriculum given in this document has been developed following the guidelines of NEP-2020 and is crucial as well as challenging due to the reason that it is a transition from general science based to the discipline-specific-based curriculum. All the recommendations of the ***Sukanu Samiti*** given in the **NEP Curriculum Framework-2023** have been followed, keeping the disciplinary approach with rigor and depth, appropriate to the comprehension level of learners. All the Board of Studies (BoS) under the Faculty of Science and Technology of this university have put in their tremendous efforts in making this curriculum of international standard. They have taken care of maintaining logical sequencing of the subject matter with proper placement of concepts with their linkages for better understanding of the students. We take this opportunity to congratulate the Chairman(s) and all the members of various Boards of Studies for their immense contributions in preparing the revised curriculum for the benefits of the stakeholders in line with the guidelines of the **Government of Maharashtra regarding NEP-2020**. We also acknowledge the suggestions and contributions of the academic and industry experts of various disciplines.

We are sure that the adoption of the revised curriculum will be advantageous for the students to enhance their skills and employability. Introduction of the mandatory ***On Job Training, Internship program*** for science background students is praise worthy and certainly help the students to imbibe first hand work experience, team work management. These initiatives will also help the students to inculcate the workmanship spirit and explore the possibilities of setting up of their own enterprises.

Dr. M. K. Patil
Dean
Faculty of Science and Technology

Preamble: The National Education Policy 2020 (NEP 2020) is formulated to revamp education system and lay down road map for new India. This policy is framed based on the fundamental pillars of access, equity, quality, affordability, and accountability and seeks to transform India into a thriving knowledge society and a global knowledge superpower.

Some of the important features of National Education Policy are increasing gross enrolment ratio in higher education, holistic and multidisciplinary education with multiple entry/exit options, establishment of academic bank of credit, setting up of multidisciplinary education and research Universities and National Research Foundation, expansion of open and distance learning to increase gross enrolment ratio, internationalization of education, motivated / energized and capable faculty, online and digital education and effective governance and leadership.

As per the National Education Policy, the Government of Maharashtra has proposed a model curriculum framework and an implementation plan for the State of Maharashtra. It is to suggest and facilitate the implementation of schemes and programs, which improve not only the level of academic excellence but also improve the academic and research environment in the state. The proposed curriculum framework endeavours to empower the students and help them in their pursuit for achieving overall excellence.

In view of NEP priority and in-keeping with its vision and mission, process of updating the curriculum is initiated and implemented in SRTM University at UG and PG level from the academic year 2023-2024.

Bioinformatics is the use of computational approach to analyse, manage and store biological data. The research in Biotechnology especially that involving sequence data management and drug design occurred at a speedy rate due to development of Bioinformatics. A number of tools and softwares are developed for analysis and interpretation of biological complexity. There are number of applications of Bioinformatics viz. sequence analysis and alignment, molecular modelling, docking, annotation and dynamic simulation to accelerate the Biotechnological research. It is expected that many future Bioinformatics innovations are likely to stimulate analysis of vast biological data. Bioinformatics also has the importance in various fields of Biotechnology viz. genomics, proteomics, transcriptomics, chemo-informatics, climate change studies, drug discovery and development, waste clean-up, bioenergy, crop improvement, veterinary sciences, forensic sciences and biodefense.

Keeping in mind, BOS in Biotechnology and Bioinformatics prepared the curriculum to ensure up-to-date level of understanding of Bioinformatics. Studying Bioinformatics prepares the students for their career working either in educational institutions or industries in which they can

be directly involved in the teaching, research and development. Also, to ensure uniform curriculum and its quality at UG/PG level, curriculum of different Indian Universities, syllabus of NET, SET, MPSC, UPSC and the UGC model curriculum are referred to serve as a base in updating the same.

The comments or suggestions from all teachers, students and other stakeholders are welcome for upbringing this curriculum.

Salient Features:

The syllabus of M Sc Bioinformatics has been framed to meet the requirement of Choice Based Credit System under NEP 2020. The courses offered here in will train and orient the students in the specific fields of Bioinformatics.

The Core Courses deals with Genetic Information Flow and Processing, Biochemistry, Cell and Molecular Biology, Genomics and Proteomics, Chemoinformatics, Programming in Java, Microarray, Computer Aided-Drug Design, Proteomics, Plant Genomics and Comparative Genomics.

Apart from the core courses, the Department Specific Elective Courses deal with Statistics, Mathematics, Structural Bioinformatics, Immunology, Molecular Modelling, Virology, Drug Designing and Applications of Bioinformatics. These courses offered during this program are designed with the aim of imparting specific skills to the students which will lead to their employability. There are also two Research Projects in third and fourth semester respectively. This would help students to lay a strong foundation in the field of Bioinformatics.

Overall after completion of this course, students will acquire fundamental knowledge of applications of Bioinformatics.

Program Educational Objectives:

The Objectives of this program are:

PEO1: To offer postgraduate program in Bioinformatics based on the needs of industries, academic and research institutions worldwide.

PEO2: To expose the students to the different emerging fields of Bioinformatics.

PEO3: To update curriculum by introducing recent advances in the subject that enable the students to successfully face NET, SET, MPSC, UPSC and other competitive examinations.

PEO4: To train and orient the students so as to develop human resource for the educational institutes and other organizations.

PEO5: To inculcate analytical and application-oriented abilities to create active and frontline researchers and human resource for the industries.

PEO6: To develop specific skills amongst students for their employability and for the development of their own enterprises.

Program Outcomes:

The Outcomes of this program are:

PO1: This program will expose the students to the different emerging fields of Bioinformatics.

PO2: This will provide an updated curriculum with recent advances in the subject that enable the students to face NET, SET, MPSC, UPSC and other competitive examinations successfully.

PO3: This program shall train and orient the students so as to develop human resources for educational institutes and other organizations.

PO4: This program shall train and orient the students so as to develop active and frontline researchers and human resources for the industries.

PO5: This will also develop specific skills amongst students for their employability and for the development of their own enterprises.

Prerequisite:

The students seeking admission to this program should have knowledge of B Sc in Life Sciences, Bioinformatics, Biotechnology, Genetics, Computer Science, or a related discipline. The optional courses are offered to the students registered for post-graduate programs. Such students should have a basic knowledge of Bioinformatics and willing to gain additional knowledge in the field of Bioinformatics.

The students seeking admission to this program should have cleared B Sc or B Pharm or B Sc Agri from any statutory University.

Dr. Sunita D. Lohare
Chairman, BOS in Biotechnology and Bioinformatics,
Swami Ramanand Teerth Marathwada University,
Nanded 431606.

Details of the Board of Studies Members in the subject Biotechnology and Bioinformatics under the Faculty of Science & Technology, S.R.T.M. University, Nanded.

Sr No	Name of the Member	Designation	Sr No	Name of the Member	Designation
1	Dr Sunita Dhundiraj Lohare, Shri Havgiswami Mahavidyalaya, Udgir, Dist -Latur Mob 9284161504	Chairman	2	Dr Babasaheb S Surwase School of Life Sciences SRTM University, Nanded 431606. Mob 9075829767	Member
3	Dr Pratap V. Deshmukh Nagnath Arts, Commerce and Science College, Aundha Nagnath, Dist. Hingoli Mob 9637202024	Member	4	Dr Komal S. Gomare Dept of Biotechnology, Dayanand Science College, Latur Mob 9284238413	Member
5	Dr Vaibhav D. Deshpande, General Manager, Quality Corporate Office, Wockhardt, Mumbai Mob 9100988260	Member		--	
	Invitee Members				
6	Dr Laxmikant Kamble School of Life Sciences, SRTM University, Nanded 431606. Mob: 8669695555	Member	7	Dr M M V Baig Dept of Biotechnology, Yeshwant Mahavidyalaya, Nanded. Mob 9422170641	Member
8	Dr A B Gulwe School of Technology SRTM University Sub Campus, Latur. Mob 7387120874	Member	9	Dr Prashant Thakare Department of Biotechnology, SGB Amravati University, Amravati. Mob: 9822222822	Member
10	Dr Sanjog T. Thul Environmental Biotechnology and Genomics Division, National Environmental and Engineering Research Institute (CSIR-NEERI). Nagpur. Mob 9881877072	Member	11	Dr Arun Ingale School of Life Sciences, North Maharashtra University, Umavinagar, Jalgaon. Mob: 9822708707	Member
12	Dr Shivraj Hariram Nile Department of Food Science and Agriculture, National Agri-Food Biotechnology Institute (NABI), Mohali, Punjab. Mob 9561740707	Member	13	Dr Sunil Hajare Department of Biotechnology, New Model Degree College, Hingoli . Mob 8378878817	Member

Swami Ramanand Teerth Marathwada University, Nanded

Faculty of Science & Technology

Credit Framework and Structure of Two Year PG Program (NEP 2020)

Subject: M Sc Bioinformatics (Sub-Centre, Latur)(R-2023)

Year & Level	Sem	Major Subject		RM	OJT / FP/CS (3-Cr)	Research Project	Practicals (1-Cr)	Credits	Total Credits
		(DSC- 4 Cr)	(DSE- 3 Cr)						
1	1	SBIOC-401 Genetic Information Flow and Processing SBIOC-402 Biochemistry SBIOC-403 Cell and Molecular Biology	SBIOE-401 Statistics **OR** SBIOE-403 Mathematics	SVECR 401 Research Methodology (3-Cr)	--		SBIOP-401 Lab Course in Genetic Information Flow and Processing SBIOP-402 Lab Course in Biochemistry SBIOP-403 Lab Course in Cell and Molecular Biology SBIOE-402 Lab Course in Statistics **OR** SBIOE-404 Lab Course in Mathematics	22	44
	2	SBIOC-451 Genomics and Proteomics SBIOC-452 Chemoinformatics SBIOC-453 Programming in Java	SBIOE-451 Structural Bioinformatics **OR** SBIOE-453 Immunology	---	SBIOX-451 (O/F/C)	--	SBIOP-451 Lab Course in Genomics and Proteomics SBIOP-452 Lab Course in Chemoinformatics SBIOP-453 Lab Course in Programming in Java SBIOE-452 Lab Course in Structural Bioinformatics **OR** SBIOE-454 Lab Course in Immunology	22	
Exit option: Exit Option with PG Diploma in Basic Bioinformatics (After 2024-25)									
2	3	SBIOC-501 Microarray SBIOC-502 Computer Aided-Drug Design (CADD) SBIOC-503 Proteomics	SBIOE-501 Molecular Modelling **OR** SBIOE-503 Virology	--	--	Research Project SBIOR-501 (4-Cr)	SBIOP-501 Lab Course in Microarray and Computer Aided-Drug Design SBIOP 502 Lab course in Proteomics SBIOE-502 Lab Course in Molecular Modelling **OR** SBIOE-504 Lab Course in Virology	22	44
	4	SBIOC-551 Plant Genomics SBIOC-552 Comparative Genomics	SBIOE-551 Drug Designing **OR** SBIOE-553 Applications of Bioinformatics	SVECP-551 Publication Ethics (2-Cr)	--	Research Project SBIOR-551 (6-Cr)	SBIOP-551 Lab Course in Plant Genomics SBIOP-552 Lab Course in Comparative Genomics SBIOE-552 Lab Course in Drug Designing **OR** SBIOE-554 Lab Course in Applications of Bioinformatics	22	
Total Credits		44	12	05	03	10	14	**88**	

DSE indicates Department Specific Elective Course. Bioinformatics student, in a particular semester, can opt either of these courses **OR** a course offered by other programs of the School. DSC- Department Specific Core, OJT- On Job Training, FP- Field Project, CS- Case Study, RM- Research Methodology, Cr- Credit, VEC- Value Education Course, R- Revision, Credits of four semesters = 88, Total Marks of all four Semesters = 2200

M. Sc. First Year Semester III (Level 7.0)

Teaching Scheme

Subject	Course Code	Course Name	Credits Assigned			Teaching Scheme (Hrs/ week)	
			Theory	Practical	Total	Theory (Hrs/ Week)	Practical (Hrs/ Week/Batch)
Major (DSC)	SBIOC-501	Microarray	04	--	04	04	--
	SBIOC-502	Computer aided drug design	04	--	04	04	--
	SBIOC-503	Proteomics	04	--	04	04	--
Elective (DSE)	SBIOE-501 SBIOE-503	Molecular Modelling **OR** Virology	03	--	03	03	--
Research Project	SBIOR-501	Research Project	--	04	04	--	08
DSC Practical	SBIOP-501	Lab Course in Microarray and Computer aided drug design	--	01	01	--	02
	SBIOP-502	Lab Course in Proteomics	--	01	01	--	02
DSE Practical	SBIOE-502 SBIOE-504	Lab Course in Molecular Modelling **OR** Lab course in Virology	--	01	01	--	02
Total Credits			**15**	**07**	**22**	**15**	**14**

M. Sc. First Year Semester III (Level 7.0)

Examination Scheme

[20% Continuous Assessment (*CA)* and 80% End Semester Assessment (*ESA*)]

Subject	Course Code	Course Name	Theory				Practical		Total
			Continuous Assessment (CA)			ESA			
			Test I	Test II	Avg of (T1+T2)/2	Total	CA	ESA	
Major (DSC)	SBIOC-501	Microarray	20	20	20	80	--	--	100
	SBIOC-502	Computer aided drug design	20	20	20	80	--	--	100
	SBIOC-503	Proteomics	20	20	20	80	--	--	100
Elective (DSE)	SBIOE-501 **OR** SBIOE-503	Molecular Modelling **OR** Virology	15	15	15	60	--	--	75
Research Project	SBIOR-501	Research Project	--	--	--	--	20	80	100
DSC Practical	SBIOP-501	Lab Course in Microarray and Computer aided Drug design	--	--	--	--	05	20	25
	SBIOP-502	Lab Course in Proteomics	--	--	--	--	05	20	25
DSE Practical	SBIOE-502 **OR** SBIOE-504	Lab Course in Molecular Modelling **OR** Lab course in Virology	--	--	--	--	05	20	25

M. Sc. First Year Semester IV (Level 7.0)

Teaching Scheme

Subject	Course Code	Course Name	Credits Assigned			Teaching Scheme	
			Theory	Practical	Total	Theory (Hrs/ Week)	Practical (Hrs/ Week/Batch)
Major (DSC)	SBIOC-551	Plant Genomics	04	--	04	04	--
	SBIOC-552	Comparative Genomics	04	--	04	04	--
Elective (DSE)	SBIOE-551 SBIOE-553	Drug Designing **OR** Applications of Bioinformatics	03	--	03	03	--
Value Education Course (VEC)	SVECP-551	Publication Ethics	02	--	02	02	--
Research Project	SBIOR-551	Research Project	--	06	06	--	12
DSC Practical	SBIOP-551	Lab Course in Plant Genomics	--	01	01	--	02
	SBIOP-552	Lab Course in Comparative Genomics	--	01	01	--	02
DSE Practical	SBIOE-552 SBIOE-554	Lab Course in Drug Designing **OR** Lab Course in Applications of Bioinformatics	--	01	01	--	02
Total Credits			**13**	**09**	**22**	**13**	**18**

M. Sc. First Year Semester IV (Level 7.0)

Examination Scheme

[20% Continuous Assessment (*CA)* and 80% End Semester Assessment (*ESA*)]

Subject	Course Code	Course Name	Theory				Practical		Total
			Continuous Assessment (CA)			ESA			
			Test I	Test II	Avg of (T1+T2)/2	Total	CA	ESA	
Major (DSC)	SBIOC-551	Plant Genomics	20	20	20	80	--	--	100
	SBIOC-552	Comparative Genomics	20	20	20	80	--	--	100
Elective (DSE)	SBIOE-551 SBIOE-553	Drug Designing **OR** Applications of Bioinformatics	15	15	15	60	--	--	75
Value Education Course (VEC)	SVECP-551	Publication Ethics	10	10	10	40	--	--	50
Research Project	SBIOR-551	Research Project	--	--	--	--	30	120	150
DSC Practical	SBIOP-551	Lab Course in Plant Genomics	--	--	--	--	05	20	25
	SBIOP-552	Lab Course in Comparative Genomics	--	--	--	--	05	20	25
DSE Practical	SBIOE-552 SBIOE-554	Lab Course in Drug Designing **OR** Lab Course in Applications of Bioinformatics	--	--	--	--	05	20	25

SBIOC-501 Microarray

Teaching Scheme

Course Code	Course Name	Teaching Scheme (Hrs.)		Credits Assigned		
		Theory	Practical	Theory	Practical	Total
SBIOC-501	Microarray	04	--	04	--	04

Assessment Scheme

Course Code	Course Name	Theory				Practical		Total
		CA			ESA			
		Test I	Test II	Avg of (T1+T2)/2		CA	ESA	
SBIOC-501	Microarray	20	20	20	80	--	--	100

Course pre-requisite:

- Students should have basics of molecular biology
- Familiarity with bioinformatics tools
- Should have strong background in Statistics and softwares related to data analysis

Course objectives:

- To understand the gene expression patterns
- To get the epigenetics factors responsible for gene expression
- To gain knowledge of different types of micro array experiments

Course outcomes:

- Students will learn the hybridization of DNA
- Students will critically understand the basics of statistical tools for analysis of gene expression data
- Students will come to know the different types of microarray experiments

Curriculum Details:

Module No.	Unit No.	Topic	Hrs.
1.0		Array Formats	15
	1.1	Biomolecules and Cells on Surfaces — Fundamental Concepts	
	1.2	Surfaces and Substrates	
	1.3	Nanoarrays	
	1.4	Manufacturing of 2-D Arrays by Pin-printing Technologies	
2.0		DNA microarray for microbiologist	15
	2.1	Protein Microarrays	

	2.2	Biological Membrane Microarrays	
	2.3	Microarray in glycomic research	
	2.4	Microarray applications in plant genetics and crop improvement	
3.0		The Technical Foundations, Importance and Definition Designing a Microarray Experiment: The Basic Steps	15
	3.1	Types of Microarray, NCBI and Microarray Data Management, GEO (Gene Expression Omnibus),	
	3.2	MAML 4.3 The Promise of Microarray Technology in Treating Disease.	
	3.3	Microarray Data, Preprocessing the Data, Measuring Dissimilarity of Expression Pattern, Distance Motifs and Dissimilarity measures, Visualizing Microarray Data	
	3.4	DNA Microarray: The Technical Foundations, Importance and Definition Designing a Microarray Experiment: The Basic Steps	
4.0		Concept of Gene Expression, Types of Microarrays; Making Microarrays; Spotted Microarrays	15
	4.1	Sample Preparation and Labeling, Hybridization, Washing, Image Acquisition	
	4.2	Concept of Gene Expression,GEO Database. Application of Microarrays	
	4.3	Types of Microarrays; Making Microarrays; Spotted Microarrays	
	4.4	NCBI and Microarray Data Management	
		Total	60

References

1. David W. Mount Bioinformatics- A Practical Guide to the Analysis of Genes and Proteins. USA: John Wiley, 2001. INDIA: CBS Publishers, 2003
2. Pevsner and Jonathan Bioinformatics Sequence and Genome Analysis... Bioinformatics and Genomics Functional. USA: John Wiley, 2003.
3. Chen, Yi-Ping Phoebe. Bioinformatics: Machine Learning Approach. USA: MIT Press, 2003. Bioinformatics Technologies. Germany: Springer, 2005.
4. Durbin R, S. Eddy, A. Krogh and G. Mitchison. Biological Sequence Analysis: Probabilistic Proteins and Nucleic Acids. USA: Cambridge University Press, 2005.
5. Higgins, Des and Willie Taylor. Bioinformatics –Sequence, Structure and Databanks – Practical Approach. UK: Oxford University Press, 2001.
6. Lesk Arthur M. Introduction to Bioinformatics. UK: Oxford University Press, 2005.

SBIOP-501 Lab Course in Microarray

Part A

1. Aggregation and normalization
2. Identification of significant differential expression
3. Clustering
4. K-means clustering
5. Pattern recognition
6. Significance analysis of microarrays (SAM)Algorithm
7. Fold changes

Data bases and Data Analysis

Sr No	Databases	Sr No	Software
1.	ArrayExpress at EBI	1.	WebArray(DB)
2.	ArrayTrack	2.	ArrayExpress +
3.	caArray at NCI	3.	ArrayTrack
4.	Gene Expression Omnibus - NCBI	4.	BASE
5.	GeneNetwork system	5.	Chipster
6.	Genevestigator	6.	dChip
7.	ImmGen database	7.	EMMA2
8.	MUSC database	8.	EzArray
9.	NCI mAdb	9.	FGDP
10.	Stanford Microarray database	10.	Gecko

SBIOC-502 Computer Aided-Drug Design (CADD)

Teaching Scheme

Course Code	Course Name	Teaching Scheme (Hrs.)		Credits Assigned		
		Theory	Practical	Theory	Practical	Total
SBIOC-502	Computer Aided Drug Design	04	--	04	--	04

Assessment Scheme

Course Code	Course Name	Theory				Practical		Total
		CA			ESA			
		Test I	Test II	Avg of (T1+T2)/2		CA	ESA	
SBIOC-502	Computer Aided Drug Design	20	20	20	80	--	--	100

Course pre-requisite:

- Students should have a solid foundation in drug molecules
- Should have basic informatics tools and software used for drug molecules and its mechanism of action

Course objectives:

- To understand the structure of Drug molecules
- To explore the ADMET of drug molecules
- To gain knowledge of drug reactions and toxicity effects

Course outcomes:

- Students will be able to understand the .molecular descriptors
- Students will critically evaluate the block buster drugs .
- Student will gain knowledge about different antibiotics and process of drug development

Curriculum Details:

Module No.	Unit No.	Topic	Hrs.
1.0	1	Introduction	15
	1.1	Antibacterial antibiotics; narrow spectrum and Broad spectrum antibiotics.	
	1.2	Mechanism of action of antibiotic, antifungal antibiotics,	
	1.3	antiviral agents, antitumor agents.	
	1.4	Chemical disinfectants, antiseptics, preservatives. Sulfa drugs.	
2.0		Introduction drug design and discovery	15
	2.1	Introduction: - Natural product, Drugs;	

	2.2	Principles of drug Development.	
	2.3	Bioinformatics in drug development,	
	2.4	Chemoinformatics and Pharmacoinformatics.	
3.0		Structure-based drug designing	15
	3.1	Introduction, Structure-based drug designing approaches: Target	
	3.2	Identification and Validation, homology modeling and protein	
	3.3	folding, receptor mapping, active site analysis and pharmacophore	
	3.4	Grid maps	
4.0		Ligand-based drug designing and docking	15
	4.1	Introduction, Ligand-based drug designing approaches: Lead	
	4.2	HTS, QSAR, Database generation and Chemical libraries, ADME	
	4.3	IPR	
	4.4	Introduction to docking methods to generate new structure;	
		Total	60

References

1. Brown, D.G., Troy, L., and Tricia, New natural products as new leads for antibacterial drug discovery.. Bioorgan. Med. Chem. Lett. 24:413–418. L.M. 2013
2. Fair, R.J. and Tor, Y. Antibiotics and bacterial resistance in the 21st century. Perspect. Med. Chem. 2014.
3. Kohanski, M.A., Dwyer, D.J., and Collins, J.J. How antibiotics kill bacteria: From targets to networks.Nat. Rev. Microbiol. 2010.
4. Marinelli, F. and Genilloud, O. (eds.). Antimicrobials: New and Old Molecules in the Fight AgainstMulti-Resistant Bacteria. Berlin, Germany: Springer-Verlag. 2014.
5. Pucci, M.J., Bush, K., and Page, M.G.P. Cautious optimism for the antibacterial pipeline. Microbe2014.
6. Sánchez, S. and Demain, A.L. (eds.). Antibiotics: Current Innovations and Future Trends. Norfolk,U.K.: Caister Academic Press.Walsh, C.T. and Wencewicz, T.A. 2014.
7. J.Antibiot Wright, P.M., Ian, B.S., and Andrew, Prospects for new antibiotics: A molecule-centered perspective. G.M. 2014.
8. Angew.The evolving role of chemical synthesis in antibacterial drugdiscovery. Chem. Int. Ed. 53(34):8840–8869Twyman, R. M. Advanced Molecular Biology. 1st ed., 2003.
9. Turner, P. C. Instant Notes on Molecular Biology. 2nd ed., 2002.

SBIOP-501 Lab Course in Computer Aided-Drug Design

Part B

1. Identification of Drug Targets
2. Metabolic diseases and Pathogenic diseases
3. Gene Expression Analysis
4. Structural Genomics
5. Functional Genomics
6. Pharmacokinetics (4)
7. Classification
8. Case study
9. Comparative screening

10. ADMET: Drug metabolism; Role of cytochromes P450; Elimination half-life
11. Toxicity screening
12. Pharmacogenetics (2)
13. The genetics of drug metabolism
14. The genetics of therapeutic targets
15. Interactions of small molecules and gene-based drug targets (1)
16. Proteome analysis and Prediction of epitopes on Genomic scale

SBIOC-503 Proteomics

Teaching Scheme

Course Code	Course Name	Teaching Scheme (Hrs.)		Credits Assigned		
		Theory	Practical	Theory	Practical	Total
SBIOC-503	Proteomics	04	--	04	--	04

Assessment Scheme

Course Code	Course Name	Theory				Practical		Total
		CA			ESA			
		Test I	Test II	Avg of (T1+T2)/2		CA	ESA	
SBIOC-503	Proteomics	20	20	20	80	--	--	100

Course pre-requisite:

- Students should have a solid foundation in Proteins
- Familiarity with bioinformatics tools and software used for proteomics study

Course objectives:

1. To locate proteomics as a research field by mapping the locations and identities of key actants (people, artifacts, organizations), and monitoring their relations over time
2. To compare and contrast different visions of what proteomics is – its origins, boundaries and future trajectories - in particular in relation to protein biochemistry, genomics and systems biology
3. To analyze the production of knowledge in proteomics
4. To identify, experiment with and critically evaluate new research methods
5. To learn the pathways simulation
6. To learn the rate of reaction of kinases in cancer pathways

Course outcomes: The students will learn

1. The role of Proteomics in Drug discovery
2. The identification and annotation of novel Onco genes and Proteins by this study
3. To identify the role of of Proteomics in Leukemia
4. Making awareness about the role of Proteins in different cancer proteomes
5. The role of PTM of proteins in disease progression
6. Understanding the mechanism of action of different protein-protein interactions
7. To simulate the interaction of kinases in cancer disease progression
8. The Insilco study of relationship between gene –protein interaction
9. Students will learn the Simulation of metabolic pathways
10. Will learn the metabolic flux and metabolites concentration by pathway simulators

Curriculum Details:

Module No.	Unit No.	Topic	Hrs.
1.0		UNIT I	15
	1.1	Introduction to Proteomics- What is Proteomics. One genome many proteome, Overview of proteomics tools	
	1.2	Structural proteomics- four levels of protein structure	
	1.3	Analytical proteomics-Protein extraction methods from biological samples, IEF	
	1.4	Analytical proteomics-Protein extraction methods from biological samples	
2.0		UNIT II	15
	2.1	Protein and Peptide analysis using Mass spectrometers – MALDI-TOF. Peptide sequence analysis by tandom mass spectrometry (TMS). SALSA algorithm.	
	2.2	Applications of Proteomics: Proteomining, Expression profiling, Comparative proteomics with 2D gel	
	2.3	Comparative proteomics with LCMS and isotope tagging,	
	2.4	Immunoprecipitation, mapping protein modifications	
3.0		UNIT III	15
	3.1	Protein structural analysis-X ray crystallography and NMR spectroscopy. Protein identification – Peptide mass fingerprinting (Algorithm and Software tools)	
	3.2	ESI Tandem MS instruments	
	3.3	Capillary electrophoresis	
	3.4	Protein separation techniques-ID and 2D SDS PAGE, HPLC, IEF	
4.0		UNIT IV	15
	4.1	Protein separation techniques-ID and 2D SDS PAGE, HPLC	
	4.2	Protein digestion techniques- Proteases and Cleavage reagents	
	4.3	Identifying protein-protein interactions and protein complex	
	4.4	Capillary electrophoresis	
		Total	60

References

1. R.M.Twyman, Principles of Proteomics, BIOS Scientific Publishers, 2004.
2. P.Michael Conn, Handbook of Proteomic Method.Humana Press, Totowa, New Jersay, USA, 2003.
3. Stryer, Biochemistry, W. H. Freeman and Co., New York, 2007.
4. R. D. Appel and D.F. Hochstrasser, Proteome Research: New Frontiers in Functional Genomics,Springer, 1997
5. C. Branden and J. Tooze, Introduction to protein structure, Garland Publishing, 1998.
6. Anderson NG, Anderson NL. Behring Inst Mitt;63:169–210. . 1979

SBIOP 502 Lab course in Proteomics

1. Introduction to amino acids.
2. Introduction to proteins
3. Protein folding &misfolding
4. Introduction to proteomics
5. Lab session Ã¢â‚¬â€œ Protein-protein interaction using label-free biosensors
6. Sample preparation and pre-analytical factors
7. Sample preparation: Pre-analytical factors (contd.)
8. Sample preparation: Protein extraction and quantification
9. One-dimensional electrophoresis
10. Introduction to 2-DE
11. Second dimension, staining &destaining
12. Gel analysis
13. DE Applications & Challenges
14. Protein/peptide pre-fractionation using OFFGEL FRACTIONATOR & data analysis
15. 2D-DIGE: Basics
16. 2D-DIGE: Data analysis
17. 2D-DIGE: Applications
18. Systems biology and proteomics – I
19. Systems biology and proteomics – II
20. Fundamentals of mass spectrometry
21. Chromatography technologies
22. Liquid chromatography
23. Mass spectrometry: Ionization sources
24. Mass spectrometry: Mass analyzers
25. ALDI sample preparation and analysis
26. Hybrid mass spectrometry configurations
27. n-gel & in-solution digestion
28. Sample preparation: tissue sample preservation tech

SBIOE-501 Molecular Modelling

Teaching Scheme

Course Code	Course Name	Teaching Scheme (Hrs.)		Credits Assigned		
		Theory	Practical	Theory	Practical	Total
SBIOE-501	Molecular Modelling	03	--	03	--	03

Assessment Scheme

Course Code	Course Name	Theory				Practical		Total
		CA			ESA			
		Test I	Test II	Avg of (T1+T2)/2		CA	ESA	
SBIOE-501	Molecular Modelling	15	15	15	60	--	--	75

Course pre-requisite:

- Students should have a solid foundation in biology, Familiarity with bioinformatics tools and software used structure drawing tools
- Basic understanding of Molecular forces on structures.

Course objectives:

- To understand the molecular geometry information, basic concepts of a molecule.
- To explore the molecular geometry information to determine the stability of small molecule interactions with the proteins.
- To perceive the knowledge on the activities of a molecule inside the biological system through simulation studies.
- To understand the algorithms used to develop software to predict the molecular activities through computational approach.
- To get knowledge on pharmacophore, its features, applications and to get access to the sources exist at present
- To determine a significant pharmacophore model in order to identify the most promising candidates.

Course outcomes: Students will be able to

- Understand the algorithms used in the molecular docking concepts and its types.
- Get exposure to the existing docking software and to observe the result.
- Get aware of molecular databases available at present to explore the biological molecules.
- Get understanding of the basic steps in querying structure database and to interpret information from the data sets available.

Curriculum Details:

Module No.	Unit No.	Topic	Hrs.
1.0	1	Quantum mechanics & concepts in molecular 23odelling :	15
	1.1	Introduction – coordinate systems – potential energy surfaces – introduction to quantum mechanics – postulates – Schrodinger wave equation – hydrogen molecule – Born-Oppenheimer approximation, introduction to computer hardware and software.	
	1.2	Molecular mechanics and energy minimization:	
	1.3	Empirical force field models – Bond stretching – angle bending – torsional term – nonbonding interactions — simplex – sequential univariate method – steepest descent method – conjugate gradient method- Newton-Rapsonmethod.	
	1.4	thermodynamics properties using a forcefield – derived and non derived energy minimization method	
2.0		Molecular Dynamics and Monte Carlo simulation :	15
	2.1	Introduction – Using single Model – time steps – Multiple steps – Setting up MD	
	2.2	energy conservation in MD	
	2.3	Simulation Examples – Monte Carlo – Random number generation	
	2.4	— Difference in MD & MC.	
3.0		Homology 23odelling:	15
	3.1	Comparative 23odelling of proteins .	
	3.2	Homology – steps in homology 23odelling – tools	
	3.3	Side chain 23odelling – loop modeling	
	3.4	comparison of 3D structure — databases	
4.0		General approach to discovery of new drugs	15
	4.1	Lead discovery – lead modification — drug stereo chemistry –drug action– structure based drug design – pharmacophores	
	4.2	physiochemical principles of drug action	
	4.3	3D database search – computer aided drug design	
	4.4	Docking – molecular 23odelling in drug design QSAR	
		Total	60

References

1. A. R.Leach – Molecular Modeling Principles and Application, 2nd edition, Longman Publications, 1996.
2. D. Baxivanis and Foulette – Bioinformatics: A Practical Guide to the Analysis of Genes and Proteins, Wiely Indian Edition, 2001.
3. T K Attwood, D J parry-Smith, Introduction to Bioinformatics, Pearson Education, 1st Edition, 11th Reprint 2005

SBIOE-502 Lab Course in Molecular Modelling

Introduction to Biological Data Mining

- Data Mining in Genomics
- Gene Expression Data Mining
- Data Mining in Proteomics
- Data Mining Preparatory Activities
- Data cleaning, data preprocessing, and semantic integration of heterogeneous, distributed biomedical databases
- RNA Data Mining

Optimization Techniques

- Steepest descent
- Conjugate gradient
- Newton Raphson
- Simulated annealing and biomolecular structure optimization
- Genetic algorithms

Machine Learning Techniques

- Neural Network based biological applications
- HMM based biological applications
- Dynamic programming and biological applications
- Sequences alignments
- Structure alignments

Monte Carlo and Bayesian approaches in data mining

- Data mining models and data streams
- Bayesian techniques and current biological research
- Statistical alignment MCMC workbench
- Models of computational analysis
- Markov Chain Monte Carlo
- Bayesian phylogenetics
- RNA substitution model and early mammalian evolution
- Advantages of Bayesian applications

Clustering algorithms and applications

SBIOE-503 Virology

Teaching Scheme

Course Code	Course Name	Teaching Scheme (Hrs.)		Credits Assigned		
		Theory	Practical	Theory	Practical	Total
SBIOE-503	Virology	03	--	03	--	03

Assessment Scheme

Course Code	Course Name	Theory				Practical		Total
		CA			ESA			
		Test I	Test II	Avg of (T1+T2)/2		CA	ESA	
SBIOE-503	Virology	15	15	15	60	--	--	75

Course pre-requisite:

- Basic knowledge of mathematicsVirus
- Understanding of structure of Virusa
- Proficiency in bioinformatics tools

Course objectives:

- The course aims to provide a basic and advanced level understanding about viruses and functioning of the immune system,
- To get acquainted with various techniques to study immunological and serological event and isolation and characterization of viruses with special emphasis on the different virus mediated pathogens of human, animal and plant origin.
- To get the knowledge about the importance of immune system in terms of homeostasis, defence against infectious disease, autoimmunity, and tolerance and for the overall exposure of the students towards various aspects of immunology and virology and to come up with a more rational and skilled approach in the field of biomedical research and academics

Course outcomes:

- The students should gain fundamental knowledge on various aspects of virology and immunology and should get acquainted with the infrastructure required for working with viruses and to also acquire knowledge about various safety measures. The overall exposure of students to modern bioinformatics tools, epidemiological characterization of infection and immunity will help the students pursue career in public health and related areas along with biomedical research, academics, and industries.

Curriculum Details

Module No.	Unit No.	Topic	Hrs.
1.0		UNIT I	11
	1.1	History, origin and evolution of viruses, pioneer workers in Virology	
	1.2	Nomenclature and classification of viruses: Criteria used for naming and classification, Current ICTV classification of viruses of bacteria	
	1.3	Morphology and properties of viruses: Physical- morphology and structure, sedimentation, electrophoretic mobility, buoyant density; virus stability	
	1.4	Transmission of viruses: Non-vector and vector mode of transmission of viruses	
2.0		UNIT II	12
	2.1	Isolation, cultivation and maintenance of viruses: Isolation and cultivation of plant and animal viruses (experimental plants and tissue culture, experimental animals, embryonated eggs, organ cultures, primary and secondary cell cultures	
	2.2	Purification of viruses: Extraction of viruses from tissues, clarification, and concentration of viruses in clarified extracts by physical and chemical methods	
	2.3	Introduction to Viral Assay Techniques: Overview of viruses and their significance in human health and disease, Basic principles underlying viral assay techniques	
	2.4	Bacteriophages: Biology of major RNA and DNA bacteriophages and cyanophages, replication of M13, T4 and lambda phages	
3.0		UNIT III	11
	3.1	Algal and fungal viruses: Biology of viruses of Phycodnaviridae, Partitiviridae and Totiviridae, Biology of sub-viral agents, sat-RNAs, DI particles, viroids, virusoids and prions	
	3.2	Cell Culture-Based Assays, Molecular Assays, Serological Assays: HA, HI, immunofluorescence, and molecular (viral protein and nucleic acid based) approaches	
	3.3	Quantitation and preservation of purified virus preparations	
	3.4	Purification of viruses by rate zonal / equilibrium density gradient centrifugation, Criteria of virus purity	
4.0		UNIT IV	11
	4.1	Biochemical- chemical composition, nucleic acids, proteins, enzymes, lipids, carbohydrates, polyamines	
	4.2	Biological- Host range, inclusion bodies and transmission	
	4.3	Satellite viruses	
	4.4	Suspension and monolayer cell cultures, cell strains lines	
		Total	45

References

1. Thomas B. Newman, Michael A. Kohn Evidence-Based Diagnosis: An Introduction to Clinical Epidemiology Publisher: CambridgeUniversity Press 2nd Edition,by (2020).2,.
2. Frank Ryan (Author), Virusphere: From Common Colds to Ebola Epidemics--Why We Need the Viruses That Plague Us 1st edition, Publisher: Prometheus (2020)..
3. ReetiKhare P. Saravanan Guide to Clinical and Diagnostic Virology (2019), (ASM Books) 1st Edition, by, Publisher: ASM Press. Virology (2019),.
4. YashpalSingh Malik, Raj Kumar Singh, Mahendra Pal Yadav Recent Advances in Animal Virology 1st Edition, Kindle Edition, by, 471 pages, Publisher: Springer. 2019
5. RenWarom, Virology Titan Books. 2017
6. Marilyn J. Roossinck, Carl Zimmer,Publisher Virus: An Illustrated Guide to 101 Incredible Microbes1st Edition (ASMBooks) Fourth Edition, by: Princeton University Press 2016.
7. Carl Zimmer A Planet of Viruses University of Chicago Press.2015: 2nd ed, by (2015)
8. N. Cary Engleberg MD, Terence Dermody , Victor DiRita Schaechter's Mechanisms of Microbial Disease .Fifth, North American Edition,by Publisher: LWW; Fifth,North American edition 2012
9. Dimmock et al, Introduction to Modern Virology. 5th ed.., Blackwell Sci.2001

SBIOE 504 Lab course in Virology

1. Pairwise sequence alignments.
2. Phylogeny & tree building
3. Secondary structure prediction.
7. Secondary databases – Motif, family searches, Epitope prediction(B-cell).
8. Epitope predictions (T-cell).
9. Biomolecular Structure visualization
10. Primer designing.
4. Classification and General properties of plant, animal and bacterial viruses, Bacteriophages – lytic cycle &lysogeny.
5. Structure of viruses, assembly of viral membrane.
6. Life cycle and replication of viruses: RNA-negative strand (VSV), positive strand (Polio),
7. segmented [Influenza], Retrovirus- RSV and HIV, DNA- adenovirus and SV-40.
8. Persistent chronic and acute viral infections.
9. Mechanism of interferon and antiviral therapy.
10. Host virus interactions; plant and animal.

SEMESTER IV

SBIOC-551 Plant Genomics

Teaching Scheme

Course Code	Course Name	Teaching Scheme (Hrs.)		Credits Assigned		
		Theory	Practical	Theory	Practical	Total
SBIOC-551	Plant Genomics	04	--	04	--	04

Assessment Scheme

Course Code	Course Name	Theory				Practical		Total
		CA			ESA			
		Test I	Test II	Avg of (T1+T2)/2		CA	ESA	
SBIOC-551	Plant Genomics	20	20	20	80	--	--	100

Course pre-requisite:

- Students should have basics of plant biology
- Familiarity with bioinformatics tools
- Should have strong background in NCBI and crop plant database

Course objectives:

- To understand the gene structures of plants
- To get the understanding of crop plants genomes

Course outcomes: Students will be able to

- Students will learn the importance of crop genomes
- students will critically understands the Gene deserts
- Students will come to know the draught resistance and defence genes

Curriculum Details:

Module No.	Unit No.	Topic	Hrs.
1.0	1	Plant Nuclear Genome	15
	1.1	Genome organization in plant nucleus, plant epigenome	
	1.2	Plant organellar genomes- plastid and mitochondrial genomes	
	1.3	Plant genome sequencing strategies for plant genome sequencing, high-throughput sequencing technologies, single molecule and real time sequencing, assembly.	
	1.4	Alignment programs, genome browsers	
2.0	2	Plant Proteomics	15
	2.1	High throughput approaches– mass spectrometry based	

		proteomics .	
	2.2	Plant metabolomics	
	2.3	Plant genome editing and genome engineering- ZFN, TALENs, CRISPR-Cas9 and ODM	
	2.3	Plant genome editing and genome engineering- ZFN, TALENs, CRISPR-Cas9 and ODM	
	2.4	Analytical platforms– GC-MS, NMR, MALDI	
3.0		Plant Secondary Metabolism & Metabolic Engineering	15
	3.1	Secondary metabolites- ecological functions & uses	
	3.2	Terpenoids- synthesis of IPP, phenyltransferase and terpene synthase reactions, modification of terpenoid skeletons	
	3.3	Alkaloids- biosynthesis	
	3.4	Phenolic compounds- phenylpropanoid, phenylpropanoid-acetate pathways – biosynthesis	
4.0		Biosynthesis	15
	4.1	Lignans and flavonoids biosynthesis	
	4.2	Coumarins, stilbenes, styrylpyrones and arylpyrones	
	4.3	Plant metabolic engineering- approaches to metabolic engineering- biotechnological application of alkaloid biosynthesis, phenolics metabolic engineering, terpenoids metabolic engineering.	
	4.4	Introduction to plant cell culture- different plant tissue culture media, role of plant growth regulators in tissue culture	
		Total	60

References

1. PalmiroPoltronieri, NatalijaBurbulis, CorradoFogher, From Plant Genomics to Plant Biotechnology edited by Woodhead Publishing Limited, New Delh (2013)
2. Isabelle Nickel Plant Genomics and Biotechnology Syrawood Publishing House (2016),
3. Arie Altman, Paul M. Hasegawa, Plant Biotechnology and Agriculture: edited by Elsevier Prospects for the 21st Century (2012)
4. Rudolf Endress Plant Cell Biotechnology by, Springer-Verlag Berlin
5. Amita Sarkar Molecular farming , Discovery Publishing House Pvt. Ltd. (2009)
6. Bob B. Buchanan, Wilhelm Gruissem, Russell L. Jones Metabolic Engineering of Plant Secondary Metabolism (2000) edited by Robert Verpoorte, A.Wilhelm Alfermann, Springer 7. Biochemistry and Molecular Biology of Plants , Wiley Blackwell (2015)

SBIOP-551 Lab Course in Plant Genomics

1. Browsing and viewing genome data -Ensembl, Gramene,UCSC,.
2. Genome annotation using integrated genome annotations servers GLIMMER, Grail, GENSCAN.
3. Plant promoter analysis by using plantpanresourse
4. Plant SNP analysis by using Sniplay, planetsnp pipeline
5. To retieve 3D structures of active ingredients in plants from small chemical databases.

SBIOC-552 Comparative Genomics
Teaching Scheme

Course Code	Course Name	Teaching Scheme (Hrs.)		Credits Assigned		
		Theory	Practical	Theory	Practical	Total
SBIOC-552	Comparative Genomics	04	--	04	--	04

Assessment Scheme

Course Code	Course Name	Theory				Practical		Total
		CA			ESA			
		Test I	Test II	Avg of (T1+T2)/2		CA	ESA	
SBIOC-552	Comparative Genomics	20	20	20	80	--	--	100

Course pre-requisite:
- Students should have a solid foundation in softwares handling
- Should have basic binformatics tools and software used for comparative study

Course objectives:
- To understand the concept of comparative genomes
- To explore the Novel genes in the new genomes
- To gain knowledge of Model organisms

Course outcomes: Students will be able to
- Students will be able to understand the to find out new genes
- Students will critically evaluate the annotation of the new genomes
- Student will gain knowledge about Genome annotation and new methods of genome annotation pipelines

Curriculum Details:

Module No.	Unit No.	Topic	Hrs.
1.0	1	Objectives and Overview of Genome Comparisons	15
	1.1	Genome Alignment Genomic and Pairwise.	
	1.2	BLAST	
	1.3	MUMmer	
	1.4	PipMaker, LAST, Mauve	
2.0		Comparison of Gene Order analysis	15
	2.1	Synteny analysis	
	2.2	Recombination methods analysis, RDP.	
	2.3	Analysis of Population structure- Prokaryotic	
	2.4	Analysis of Population structure- Eukaryotic	

3.0		Population diversification	15
	3.1	Population diversification: dN/dS ratio and selection pressure analysis.	
	3.2	SingalNucleotide Polymorphism, dbSNP and other SNP-related databases	
	3.3	GWAS resources	
	3.4	analysis of polymorphism in populations	
4.0		Comparative Genomics	15
	4.1	Viruses	
	4.2	Microbes genomes comparison and annotation	
	4.3	Pathogens genomes annotation	
	4.4	Eukaryotes genome annotation	
		Total	60

References

1. Xia, Xuhua, Comparative Genomics,Springer-Verlag Berlin Heidelber 2013
2. Mount, David. Bioinformatics: sequence and genome analysis. Publisher: Cold Spring Harbor Laboratory Press, 2004.
3. Arcady R. Mushegian, Foundations of Comparative Genomics, Publisher:Academic Press 2007

SBIOP-552 Lab Course in Comparative Genomic

1. Comparative genomics resources and NCBI and EBI
2. Comparison of full / partial genomic sequences using following methods to identify conserved genes and map/compare the annotations of the two sequences BLAST2, MegaBLAST and Discontiguous Mega BLAST, MUMmer, PipMaker, LAST, Mauve & Artemis
3. Gene order comparison & Synteny analysis RDP
4. Structure using case studies of - virus, microbes, model organisms
5. Calculating dN/dS ratio and selection pressure analysis
6. Explore and query SNP and SNP-related databases
7. GWAS resources and analysis of polymorphism
8. Workout any one comparative genomics case study based on publication & reproduce the output

SBIOE-551 Drug Designing

Teaching Scheme

Course Code	Course Name	Teaching Scheme (Hrs.)		Credits Assigned		
		Theory	Practical	Theory	Practical	Total
SBIOE-551	Drug Designing	03	--	03	--	03

Assessment scheme

Course Code	Course Name	Theory				Practical		Total
		CA			ESA			
		Test I	Test II	Avg of (T1+T2)/2		CA	ESA	
SBIOE-551	Drug Designing	15	15	15	60	--	--	75

Course Pre-requisite

1. Students should have basic knowledge of Biomolecules
2. He should have familiar with pharmacy terminologies
3. He should have the basic knowledge of Chemistry related software's
4. Should have the clear understanding of Central dogma of Molecular Biology

Course Objectives:-

1. To learn the Lipinski's rule of Five
2. To predict the ADMET properties of Drug molecules
3. To identify the new drug targets
4. To design the most valence compounds
5. To understand the Drug designing Process (Phases)

Course Outcomes:-

1. Students will learn the different Insilco software tools to predict the ADMET Properties of drug molecules
2. Students will become confident in designing novel drug molecules
3. The students will identify the new drug targets
4. Will also minimizes the cost time entity in novel bioactive molecules
5. It will boost the new paradigms shift from in Vitro to In silico process

Curriculum Details:

Module No.	Unit No.	Topic	Hrs.
1.0	1	Pharmaceutical Biotechnology	15
	1.1	Introduction: - Antibacterial antibiotics;	

	1.2	Narrow spectrum and broad-spectrum antibiotics.	
	1.3	Mechanism of action of antibiotic, antifungal antibiotics, antiviral agents, antitumor agents. Chemical disinfectants, antiseptics, preservatives. Sulfa drugs.	
	1.4	Recent advances in pharmaceutical Biotechnology: synthetic vaccines, DNA vaccines, edible vaccines. Policies in drug designing: - Quality assurance: ISO, WHO, certification, Good manufacturing practices, GMP, GLP, Government regulations, policies, Food and drug administration.IPR	
2.0		Introduction drug design and discovery	15
	2.1	Introduction: - Natural product, Drugs; principles of drug Development..	
	2.2	Bioinformatics in drug development, Chemoinformatics and Pharmacoinformatics.	
	2.3	Applications of Drug Discovery and In-Silico Drug Designing,Area influencing drug discovery;	
	2.4	Molecular Biology, pharmacogenomics and pharmacoproteomics	
3.0		Structure-based drug designing	15
	3.1	Introduction, Structure-based drug designing approaches:	
	3.2	Target Identification and Validation	
	3.3	Side chain modeling – loop modeling	
	3.4	homology modeling and protein folding, receptor mapping, active site analysis and pharmacophore mapping, Grid maps.	
4.0		Ligand-based drug designing and docking	15
	4.1	Introduction, Ligand-based drug designing approaches: Lead Designing.	
	4.2	combinatorial chemistry, High Throughput Screening (HTS), QSAR.	
	4.3	Database generation and Chemical libraries, ADME property.	
	4.4	Introduction to docking methods to generate new structure; Tools and Molecular docking programs: Auto Dock, Dock, HEX.	
		Total	60

References

1. Alan Hinchliffe Molecular Modelling for Beginners, (2nd Edition) ., John Wiley & Sons Ltd.2008
2. Tamar Schlick Molecular Modelling and Simulation – An Interdisciplinary Guide ., Springer Verlag 2000
3. Patrick Bultinck., Marcel Dekker Computational Medicinal Chemistry for Drug Discovery, edited by Inc. 2004

SBIOE-552 Lab Course in Drug Designing

1. Binding Site Identification
2. Different approaches for binding site identification
3. Tools - Cast-P, POCASA, 3D ligand site, Metapocket, Ghecom
4. Structure based Drug design
5. Molecular docking using AutoDock

6. Virtual Screening using AutoDock Vina
7. Molecular Dynamics Simulation
8. Protein dynamics using Gromacs
9. Protein-ligand complex MD simulation
10. Ligand Based drug design
11. QSAR

SBIOE-553 Applications of Bioinformatics

Teaching Scheme

Course Code	Course Name	Teaching Scheme (Hrs.)		Credits Assigned		
		Theory	Practical	Theory	Practical	Total
SBIOE-553	Application of Bioinformatics	03	--	03	--	03

Assessment Scheme

Course Code	Course Name	Theory				Practical		Total
		CA			ESA			
		Test I	Test II	Avg of (T1+T2)/2		CA	ESA	
SBIOE-553	Application of Bioinformatics	15	15	15	60	--	--	75

Course pre-requisite:

- Students should have a solid foundation in biology, Familiarity with bioinformatics tools and software used structure drawing tools
- Basic understanding of Molecular forces on structures. new force fields

Course objectives:

- To understand the importance in new era of genomics
- To explore the alogorithms in computational biology

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Course outcomes: Students

- will understand the algorithms used in the field of computational molecular biolions sequencing technologies
- will get an exposure to the new microarray techniques
- will aware of molecular evolution in new Omic sciences
- will get understanding of the need of new Agriculture bioinformatics technologies and pharma industry demands

Curriculum Details:

Module No.	Unit No.	Topic	Hrs.
1.0	1	Environment biotechnology	15

	1.1	Microbial genomics	
	1.2	Pathogenic organisms	
	1.3	Economical useful organisms	
	1.4	Industrial importance	
2.0		Molecular biology, Neurobiology,CNS	15
	2.1	Role in Horticulture	
	2.2	Involvement in floriculture	
	2.3	Computational algorithms in drug molecules screening	
	2.4	Food biotechnology	
3.0		agriculture, drug designing	15
	3.1	Draught resistance genes databases	
	3.2	Defense genes in plants	
	3.3	Transgenic technology	
	3.4	Crop improvement	
4.0		biomedical genome medicines, medical microbiology	15
	4.1	Vaccine designing	
	4.2	Antibiotic designing	
	4.3	Role of bioinformatics in veterinary sciences	
	4.4	Role of Bioinformatics in Bioterrorism	
		Total	60

Reference

1. S. Ignacimuthu and M. Gnanamani Bioinformatics: Methods and Applicationsby
2. Rastogi Shilpi Bioinformatics: Concepts, Skills, Applications
3. David W. Mount Bioinformatics: Sequence and Genome Analysisby
4. P. K. Srimani Computational Biology and Bioinformatics: Gene Regulation
5. Zhumur Ghosh and Bibekanand Mallick Bioinformatics: Principles and Applications
6. Phillip Compeau and Pavel Pevzner Bioinformatics Algorithms: An Active Learning Approach
7. David W. Mount and Zhong Wang Bioinformatics: Databases and Systemsby
8. Arthur M. Lesk Introduction to Bioinformatics
9. Pierre Baldi and SørenBrunak Bioinformatics: The Machine Learning Approach

SBIOE-554 Lab course in Applications of Bioinformatics

1. In silico primer design
2. In silico analysis of molecular data-transeq ,emboss water, emboss needle
3. To retrieve carbohydrate related data by using GlycomeDB (glytoucan), GlycosutDB, Glyco3D
4. Computer added drug discovery and development using click2drug
5. To study plant cis actin regulatory elements by using plantcare database

SVECP-551: Publication Ethics
Teaching Scheme

Course Code	Course Name	Teaching Scheme (Hrs.)		Credits Assigned		
		Theory	Practical	Theory	Practical	Total
SVECP-551	Publication Ethics	02	--	02	--	02

Assessment Scheme

Course Code	Course Name	Theory				Practical		Total
		CA			ESA			
		Test I	Test II	Avg of (T1+T2)/2		CA	ESA	
SVECP-551	Publication Ethics	10	10	10	40	--	--	50

Course pre-requisite: General awareness regarding publication basics

Course objectives:

- To know rules, issues, options, and resources for research ethics.
- To familiarize with various institutional ethics review boards/academic integrity guidelines.
- To understand the purpose and value of ethical decision-making.
- To have a positive disposition towards continued learning about research ethics

Course outcomes:

- To have a positive disposition towards continued learning about research philosophy & ethics.
- To know Rules, Regulations, Issues, Options, and Scientific Resources of Research Ethics.
- To learn the culture of fairness, honesty and integrity in academic communications and to understand the purpose and value of ethical decision-making.
- Avoid wasteful and duplicate publications & encourage original contributions to advance Academic Research and Scholarship.
- Acquiring knowledge & professional competence and expertise about Patents, Copyrights, and other forms of Intellectual Property Rights.
- To promote social good and prevent or mitigate societal hazards through innovative ideas, creativity and research advocacy

Curriculum Details:

Module No.	Unit No.	Topic	Hrs.
1.0	**I**	**Publication ethics**	**08**
	1.1	Publication ethics: definition, introduction and importance, Best practices/standards setting initiatives and guidelines: COPE, WAME, etc. Conflicts of interest	
	1.2	Publication misconduct: definition, concept, problems that lead to unethical behavior and vice verse, types	
	1.3	Violation of publication ethics, authorship and contributor ship	
	1.4	Identification of publication misconduct, complaints and appeals. Predatory publishers and journals	
2.0	**II**	**Open access publishing**	**07**
	2.1	Open access publications and initiatives.	
	2.2	SHERPA/RoMEO online resource to check publisher copyright and self-archiving policies	
	2.3	Software tool to identify predatory publications developed by SPPU	
	2.4	Journal finder/ journal suggestion tools viz. JANE	
3.0	**III**	**Publication misconduct**	**07**
	3.1	Subject specific ethical issues, FFP, authorship	
	3.2	Conflicts of interest	
	3.3	Complaints and appeals: examples and fraud from India and abroad	
	3.4	Use of plagiarism software like Turnitin, Urkund and other open source software tools.	
4.0	**IV**	**Databases and research metrics**	**08**
	4.1	Databases: Indexing databases	
	4.2	Citation databases: Web of Science, Scopus, etc.	
	4.3	Research Metrics: Impact Factor of journal as per journal citation report, SNIP, SJR, IPP, Cite Score.	
	4.4	Metrics: h-index, g index, i10 index, altmetrics	
		Total	**30**

References:

1. Donna M. Mertens, Pauline E. Ginsberg The Handbook of Social Research Ethics, SAGE (2009).
2. Rose Wiles, Bloomsbury What are Qualitative Research Ethics? (2013).
3. Robin Levin Penslar, eds, Research Ethics: Cases and Materials, Indiana University Press (1995).
4. Gary Comstock, Research Ethics: A Philosophical Guide to the Responsible Conduct of Research, Cambridge University Press (2013)
5. Bird, A. Philosophy of Science. Routledge, 2006.
6. MacIntyre, Alasdair A Short History of Ethics London, 1967
7. P. Chaddah Ethics in Competitive Research: Do not get scooped; do not get plagiarized, 2018
8. National Academy of Sciences, National Academy of Engineering and Institute of Medicine,2009.

9. On being a Scientist: A Guide to Responsible Conduct in Research. Third Edition. National Academies Press.
10. Resnik, D. B. What is ethics in research & why is it important. National Institute of Environmental Health Sciences, 2018. Retrieved from https www.nichs.nih.gov/research/resources/bioethics/whatis/index.cfm
11. Beall, J. Predatory publishers are corrupting open access. Nature, 2012. https://doi.org/10.1038/489179a
12. Indian National Science Academy (INSA), Ethics in Science Education, Research and Governance,2019. http://www.insaindia.res.in/pdf/Ethics Book.pdf

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