॥ 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

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 पदवी प्रथम 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 पदवीस्तरावर राष्ट्रीय शैक्षणिक धोरण –२०२० लागू करण्याच्या दृष्टीकोनातून विज्ञान व तंत्रज्ञान विद्याशाखे अंतर्गत येणा–या अभ्यासमंडळांनी तयार केलेल्या पदवी प्रथम वर्षाचे 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 बी. एस्सी प्रथम वर्षाचे अभ्यासक्रम (Syllabus) लागू करण्यात येत आहेत.

01 B. Sc. I year - Biotechnolgy
02 B. Sc. I year – Bio-informatics
03 B. Sc. I year – Biotechnology (Vocational)
04 B. Sc. I year- Dyes and Druge
05 B. Sc. I year – Industrial Chemistry
06 B. Sc. I year – Agrochemical and Fertilizers
07 B. Sc. I year – Chemistry (General)
08 B. Sc. I year – Analytical Chemisrty
09 B. Sc. I year – Biochemistry
10 B. Sc. I year – Statistics
11 B. Sc. I year – Zoology
12 B. Sc. I year – Biotechnolgy (NMD College Hingoli)

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/२०२४–२५/123
दिनांक २०.०६.२०२४

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. प्राचार्य, न्यू मॉडल डिग्री कॉलेज हिंगोली.
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 FOUR YEAR MULTIDISCIPLINARY

DEGREE PROGRAM WITH MULTIPLE ENTRY AND EXIT OPTION

UNDER

NATIONAL EDUCATION POLICY (NEP 2020)

In

SUBJECT: BIOECHNOLOGY (Single Major)

FACULTY OF SCIENCE AND TECHNOLOGY

B. Sc. First Year
(Affiliated Colleges)

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 caliber 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 firsthand 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 endeavors 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.

Biotechnology is often considered as the technology of hope for meeting future challenges like feeding our increasing population, cleaning dangerously polluted environments and potentiating healthcare sector etc. Establishment of new IISERs, Central Universities and IITs indicate that we are already on the track of developing infrastructure and human resource. Our dream of becoming future 'superpower' will not be possible without Biotechnology and inclusive efforts. Therefore, it is necessary to attract young and bright students and train them in the field of Biotechnology.

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

The Core Courses deals with Basics of Cell Biology, Biochemistry-I, Basics of Microbiology, Biochemistry-II, Genetics-I and Basic Maths, Stats and Computer.

Apart from the core courses, the Generic Elective Courses deal with Biofuel and Bioenergy and Applications of Biotechnology.

The Skill Enhancement Courses like Microbial Cultures and their Maintenance and Techniques in Forensic Biology offered during this program are designed with the aim of imparting specific skills to the students which will lead to the self-employability and development of their own enterprises.

This would help students to lay a strong foundation in the field of Biotechnology.

Overall, after completion of this course, students will also acquire fundamental knowledge and applications of Biotechnology.

Program Educational Objectives:

The Objectives of this program are:

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

PEO2: To promote and popularize Biotechnology at grass root level and attract young and budding talents.

PEO3: To expose the students to the different emerging fields of Biotechnology.

PEO4: To update curriculum by introducing recent advances in the subject that enable the students to face NET, SET, MPSC, UPSC and other competitive examinations successfully.

PEO5: To train and orient the students so as to develop human resource for the educational institutes and other organizations.

PEO6: To inculcate analytical and application-oriented abilities to create active and frontline researchers and human resource for the industries.

PEO7: To develop specific skills amongst students for self-employability and for the development of their own enterprises.

Program Outcomes:

The Outcomes of this program are:

PO1: This Biotechnology program shall promote and popularize biotechnology at grass root level and shall also attract young and budding talents.

PO2: This program will expose the students to the different emerging fields of Biotechnology.

PO3: This will provide updated curriculum with recent advances in the subject that enable the students to face NET, SET, MPSC, UPSC and other competitive examinations successfully.

PO4: This program shall train and orient the students so as to develop human resource for the educational institutes and other organizations.

PO5: This program shall train and orient the students so as to develop active and frontline researchers and human resource for the industries.

PO6: This will also develop specific skills amongst students for self-employability and for the development of their own enterprises.

Prerequisite:

Basic knowledge of science at 12^{th} (HSC) level. The optional courses of this program are offered to the students registered for under-graduate programs. Such students should have the basic knowledge of Biotechnology and willing to gain additional knowledge in the field of Biotechnology.

Admissions to this program are given as per the University rules.

Dr. Sunita Dhudiraj Lohare
Chairman, BOS in Biotechnology and Bioinformatics
Swami Ramanand Teerth Marathwada University, Nanded.
E Mail: loharesd@gmail.com

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	Address	Designation
1	Dr. Sunita Dhundiraj Lohare Shri Havgiswami Mahavidyalaya, Udgir, Dist. -Latur Mob. No. 9284161504	Chairman	2	Dr. Babasaheb S. Surwase School of Life Sciences SRTM University, Nanded Mob. No. 9075829767	Member
3	Dr. Pratap V. Deshmukh Nagnath Arts, Commerce and Science College, Aundha Nagnath, Dist. Hingoli Mob. No. 9637202024	Member	4	Dr. Komal S. Gomare Dept of Biotechnology Dayanand Science College, Latur Mob. No. 9284238413	Member
5	Dr. Vaibhav D. Deshpande General Manager, Quality Corporate Office, Wockhardt, Mumbai Mob. No. 9100988260	Member	-	--	
	Invitee Members				
6	Dr Laxmikant Kamble School of Life Sciences, SRTM University, Nanded 431606. Mob. No.8669695555	Member	7	Dr M M V Baig Dept of Biotechnology, Yeshwant Mahavidyalaya, Nanded. Mob. No. 9422170641	Member
8	Dr. A.B. Gulwe School of Technology, SRTM University Sub Campus, Latur. Mob. No. 7387120874	Member	9	Dr. Prashant Thakare Department of Biotechnology, SGB Amravati University, Amravati. Mob. No. 982222822	Member
10	Dr. Sanjog T. Thul Environmental Biotechnology and Genomics Division, National Environmental and Engineering Research Institute, Nagpur (CSIR-NEERI). Mob. No. 9881877072	Member	11	Dr Arun Ingale School of Life Sciences, North Maharashtra University, PO Box 80, Umavinagar, Jalgaon Mob. No. 9822708707	Member

B. Sc. First Year Semester I (Level 4.5)

Teaching Scheme

	Course Code	Course Name	Credits Assigned			Teaching Scheme	
			Theory	Practical	Total	Theory (Hrs/ Week)	Practical (Hrs/ Week/ Batch)
Major Core 1	SBTTCT-1101	Basics of Cell Biology	02	--	02	02	--
	SBTTCP-1101	Lab Course in Basics of Cell Biology	--	02	02	--	04
Major Core 2	SBTTCT-1102	Biochemistry - I	02	--	02	02	--
	SBTTCP-1102	Lab Course in Biochemistry - I	--	02	02	--	04
Major Core 3	SBTTCT-1103	Basics of Microbiology	02	--	02	02	--
	SBTTCP-1103	Lab Course in Basics of Microbiology	--	02	02	--	04
Generic Elective (GE) (From Other Faculty)	SBTTGE-1101	Biofuels and Bioenergy (Group A of Basket 3)	02	--	02	02	--
Vocational &Skill Enhancement Course (Related to Major)	SBTTSC-1101	Microbial Cultures and their Maintenance	--	02	02	--	04
Ability Enhancement Course (ENG)	AECENG-1101	L1 – Compulsory English	02	--	02	02	--
Ability Enhancement Course (MIL)	AECXXX-1101	L2–Second Language Marathi (MAR), Hindi (HIN), Urdu (URD), Kannada (KAN), Pali (PAL) (Basket 4)	02	--	02	02	--
Indian Knowledge System (IKS)	IKSXXX - 1101	Select from Basket 5	02	--	02	02	--
		Total Credits	**14**	**08**	**22**	**14**	**16**

B. Sc. First Year Semester I (Level 4.5)

Examination Scheme

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

Subject	Course Code	Course Name	Theory				Practical		Total
			Continuous Assessment(CA) Avg. of			ESA			
			Test I	Test II(5)	(T1+T2)/2	Total	CA	ESA	
Major Core 1	SBTTCT-1101	Basics of Cell Biology	10	10	10	40	--	--	50
	SBTTCP-1101	Lab Course in Basics of Cell Biology	--	--	--	--	20	30	50
Major Core 2	SBTTCT-1102	Biochemistry - I	10	10	10	40	--	--	50
	SBTTCP-1102	Lab Course in Biochemistry - I	--	--	--	--	20	30	50
Major Core 3	SBTTCT-1103	Basics of Microbiology	10	10	10	40	--	--	50
	SBTTCP-1103	Lab Course in Basics of Microbiology	--	--	--	--	20	30	50
Generic Elective (GE) (From Other Faculty)	SBTTGE-1101	Biofuels and Bioenergy (Group A of Basket 3)	10	10	10	40	--	--	50
Vocational &Skill Enhancement Course (Related to Major)	SBTTSC-1101	Microbial cultures and their maintenance	--	--	--	--	20	30	50
Ability Enhancement Course (ENG)	AECENG-1101	L1 – Compulsory English	10	10	10	40	--	--	50
Ability Enhancement Course (MIL)	AECXXX-1101	L2–Second Language Marathi (MAR), Hindi (HIN), Urdu (URD), Kannada (KAN), Pali (PAL) (Basket 4)	10	10	10	40	--	--	50
Indian Knowledge System (IKS)	IKSXXX - 1101	Select from Basket 5	10	10	10	40	--	--	50

B. Sc. First Year Semester II (Level 4.5)

Teaching Scheme

	Course Code	Course Name	Credits Assigned			Teaching Scheme	
			Theory	Practical	Total	Theory (Hrs/ Week)	Practical (Hrs/ Week/ Batch)
Major Core 1	SBTTCT-1151	Biochemistry - II	02	--	02	02	--
	SBTTCP-1151	Lab Course in Biochemistry - II	--	02	02	--	04
Major Core 2	SBTTCT-1152	Genetics - I	02	--	02	02	--
	SBTTCP-1152	Lab Course in Genetics - I	--	02	02	--	04
Major Core 3	SBTTCT-1153	Basic Maths, Stats and Computer	02	--	02	02	--
	SBTTCP-1153	Lab Course in Basic Maths, Stats and Computer	--	02	02	--	04
Generic Elective (GE)	SBTTGE-1151	Applications of Biotechnology (Group B of Basket 3)	02	--	02	02	--
Vocational & Skill Enhancement Course	SBTTSC-1151	Techniques in Forensic Biology	--	02	02	--	04
Ability Enhancement Course (ENG)	AECENG-1151	L1 – Compulsory English	02	--	02	02	--
Ability Enhancement Course (MIL)	AECXXX-1151	L2–Second Language Marathi (MAR), Hindi (HIN), Urdu (URD), Kannada (KAN), Pali (PAL) (Basket 4)	02	--	02	02	--
Value Education Course (VEC)	VECCOI-1151	Constitution of India	02	--	02	02	--
		Total Credits	**14**	**08**	**22**	**14**	**16**

B. Sc. First Year Semester II (Level 4.5)

Examination Scheme

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

Subject	Course Code	Course Name	Theory				Practical		Total
			Continuous Assessment (CA)Avg. of			ESA			
			Test I	Test II(5)	(T1+T2)/2	Total	CA	ESA	
Major Core 1	SBTTCT-1151	Biochemistry - II	10	10	10	40	--	--	50
	SBTTCP-1151	Lab Course in Biochemistry - II	--	--	--	--	20	30	50
Major Core 2	SBTTCT-1152	Genetics - I	10	10	10	40	--	--	50
	SBTTCP-1152	Lab Course in Genetics - I	--	--	--	--	20	30	50
Major Core 3	SBTTCT-1153	Basic Maths, Stats and Computer	10	10	10	40	--	--	50
	SBTTCP-1153	Lab Course in Basic Maths, Stats and Computer	--	--	--	--	20	30	50
Generic Elective (GE)	SBTTGE-1151	Applications of Biotechnology (Group B of Basket 3)	10	10	10	40	--	--	50
Vocational &Skill Enhancement Course	SBTTSC-1151	Techniques in Forensic Biology	--	--	--	--	20	30	50
Ability Enhancement Course (ENG)	AECENG-1151	L1 – Compulsory English	10	10	10	40	--	--	50
Ability Enhancement Course (MIL)	AECXXX-1151	L2–Second Language Marathi (MAR), Hindi (HIN), Urdu (URD), Kannada (KAN), Pali (PAL) (Basket 4)	10	10	10	40	--	--	50
Value Education Course (VEC)	VECCOI-1151	Constitution of India	10	10	10	40	--	--	50

SBTTCT-1101: Basics of Cell Biology

Marks: 50 **B.Sc. Biotechnology** **Hours: 30**

Course pre-requisite: Basic knowledge about Biology
Course objectives:

- To provide knowledge of cell structure and its functions.
- To understand the structures and basic components of prokaryotic and eukaryotic cells, especially macromolecules, membranes, and cell organelles
- To understand the cellular components underlying mitotic and meiosis cell division and cellular communication

Course Outcomes: Students shall be able to

- Explain the basic facts, concepts, and principles in Cell Biology.
- Understand the structures and basic components of prokaryotic and eukaryotic cells, especially macromolecules, membranes, and cell organelles

Module No.	Unit No.	Topic	Hrs.
1.0	**1.0**	**Cell biology**	08
	1.1	History of cell biology.	
	1.2	Cell as basic unit of life.	
	1.3	Cell theory, protoplasm theory and organismal theory.	
	1.4	Broad classification of cell types. Prokaryotic (Bacteria, Archaea) and eukaryotic cells and their similarities and differences.	
2.0	**2.0**	**Structure and functions of cell wall**	08
	2.1	Bacterial cell wall and plant cell wall.	
	2.2	Structure and functions of cell wall.	
	2.3	Plasma membrane - exocytosis, endocytosis, phagocytosis.	
	2.4	Vesicles and their importance in transport. Cytoskeleton structure-microtubules, microfilaments, intermediate filament.	
3.0	**3.0**	**Structure and functions of cell organelles**	08
	3.1	Endoplasmic reticulum (rough endoplasmic reticulum and smooth endoplasmic reticulum).	
	3.2	Vacuoles, centriole, and basal bodies.	
	3.3	Ribosomes and lysosomes.	
	3.4	Golgi apparatus and microbodies (peroxysomes and glyoxysomes).	
4.0	**4.0**	**Mitochondria**	06
	4.1	Mitochondria.	

	4.2	Organization of respiratory chain, chloroplasts, photophosphorylation.	
	4.3	Nucleus, nucleolus, nuclear membrane, and organization of chromosomes.	
	4.4	cell cycle and its check points. cell division (mitosis and meiosis).	
		Total	30

SBTTCP-1101: Lab Course in Basics of Cell Biology

B.Sc. Biotechnology **Marks: 50**

Sr. No.	List of Experiments: Basics of Cell Biology
1	Microscopy – Compound microscope and Bright field microscopy
2	Microtomy- Maceration of various tissue explants
3	Study of Mitosis
4	Study of Meiosis
5	Study of Osmosis, and membrane selective permeability
6	Study of karyotyping
7	Separation of chlorophyll pigments by chromatography
8	Analysis of chlorophyll by spectrophotometric methods
9	Sub-cellular fraction and isolation of chloroplast
10	Demonstration of Sub-cellular fraction and isolation of Mitochondria

Reference Books

1. Verma P.S. and Agarwal V.K., Cell Biology (Cytology, Biomolecules, Molecular Biology), Paperback, S. Chand, and Company Ltd.,2016
2. Kumar P. and Mina U., Life Sciences: Fundamentals and Practice, Part-I, 6thEdn., Pathfinder Publication, 2018
3. Hardin J. and Bertoni G., Becker's World of the Cell, 9th Edn., (Global Edition), Pearson Education Ltd., 2017
4. Karp G., Iwasa J. and Masall W., Karp's Cell, and Molecular Biology – Concepts and Experiments, 8th Edn., John Wiley and Sons. p.832., 2015
5. Cooper G.M., The Cell – A Molecular Approach, 8thEdn., Sinauer Associates Inc., Oxford University Press.,2019
6. Bruce Albert, Alexander Johnson, Julian Lewis, Molecular Biology of The Cell, 5th edition, Garland Science, 2008

SBTTCT-1102: Biochemistry - I

Marks: 50 **B.Sc. Biotechnology** **Hours: 30**

Course pre-requisite:

- The candidate should have basic knowledge in Biochemistry

Course Objectives:

- To understand a general introduction to the basic concepts of Biomolecules
- To understand the structure, behavior and importance of biomolecules.

Course Outcomes:

- Students will be able to describe the molecular basis of life and role of energy rich compounds in biological system
- Students will be able to describe structure, properties and roles of biomolecules.

Module No.	Unit No.	Topic	Hrs.
1.0	**01**	**Carbohydrates**	08
	1.1	Introduction: Basics of carbohydrates.	
	1.2	Classification, Structure and properties of carbohydrates	
	1.3	Chemical Properties of Monosaccharide.	
	1.4	Introduction to disaccharide (lactose maltose sucrose) and polysaccharide (heparin starch and glycogen).Biological function/ roles of carbohydrates.	
2.0	**2.0**	**Protein**	08
	2.1	Protein: Concepts and classification of amino acids	
	2.2	Classification of protein based on solubility, shape, composition, and function.	
	2.3	Primary structure of proteins: Amino acids, Building blocks of proteins	
	2.4	Structure, classification of protein based on polarity, Peptide bond formation, Properties (physical, chemical), titration of amino acid.	
3.0	**3.0**	**Lipid and Vitamin**	08
	3.1	Introduction: Biological function of lipids, Occurrence, properties and classification of lipids.	
	3.2	Importance of phospholipid, sphingolipid and glycerolipid.	
	3.3	Definition Vitamin: classification and functions Fat and water soluble vitamins.	
	3.4	Introduction to minerals: Sources and functions of minerals (calcium, phosphorus, iodine, chlorine, magnesium, sodium).	

4.0	**4.0**	**Nucleic Acid**	06
	4.1	Structure of nucleic acid – Nitrogenous bases, pentose, nucleotides, nucleosides, nucleoside di and triphosphate.	
	4.2	Physicochemical properties and biological function of nucleic acids,	
	4.3	Basic structure of DNA & RNA: Forms of DNA, Types of RNA.	
	4.4	**Enzyme-**Nomenclature, Classification and Role of Enzymes.	
		Total	30

SBTTCP-1102: Lab Course in Biochemistry - I

Marks: 50 **B.Sc. Biotechnology** **Hours: 30**

Sr. No.	List of Experiments: Biochemistry - I
1	General Rules and Safety in Laboratory
2	Preparation of Standard solutions – Molar, Molal, Normal, Percent.
3	Preparation of Buffers Solutions
4	Identification of Bio molecules by Spot test.
5	Estimation of Carbohydrate by DNSA Reagent
6	Detection of sugar by paper chromatography/TLC
7	Estimation of Protein by Biuret method.
8	Qualitative estimation of DNA by Diphenylamine method
9	Qualitative estimation of RNA by Orcinol method
10	Estimation of vitamin by DNPH/ Iodometric method.

Reference Books

1. Nelson, D.L. and Cox, M.M, Lehninger: Principles of Biochemistry, 6thedition, W.H. Freeman, and Company (New York), 2013
2. Devlin, T.M., Textbook of Biochemistry with Clinical Correlations, 7th edition, John Wiley & Sons, Inc. (New York), 2011
3. Berg, J.M., Tymoczko, J.L. and Stryer L., Biochemistry, 7thedition., W.H. Freeman, and Company (New York), 2012
4. Voet and Voet, Biochemistry, 4th edition, John Wiley, and Sons, 2021
5. U. Satyanarayana, U. Chakrapani, Biochemistry, 6thedition, Elsevier, 2021
6. Prasad Manjeshwar, Textbook of Biochemistry, 5th edition, Sheetal distributors, 2022

SBTTCT-1103: Basics of Microbiology

Marks: 50 **B.Sc. Biotechnology** **Hours: 30**

Course pre-requisite:

- The students should have basic knowledge about Microbiology

Course Objectives:

- To understand basic concepts in Microbiology.
- To understand the morphology and fine structure of bacteria

Course Outcomes:

- Students will understand the History of Microbiology.
- They will learn the fine structure of bacteria and applied areas of Microbiology

Module No.	Unit No.	Topic	Hrs.
1.0	**01**	**Basic Microbiology**	08
	1.1	Landmark achievements in 20th century: Microbial world.	
	1.2	Controversy over spontaneous generation.	
	1.3	Discovery of penicillin.	
	1.4	Major contribution of scientists– Antony van Leeuwenhoek, Robert Koch, Louis Pasteur, Edward Jenner, Alexander Fleming, Joseph Lister	
2.0	**02**	**Microscopy**	08
	2.1	Principles and applications, Stains, and staining.	
	2.2	Principles of staining, simple staining, negative staining.	
	2.3	Morphology and Fine Structure of Bacteria	
	2.4	Morphology of Bacteria, Size and shape, Arrangements.	
3.0	**03**	**Ultrastructure of Bacteria**	08
	3.1	Structure, function and Chemical composition of Capsule, Cell Wall (Gram Positive & Gram negative).	
	3.2 **3.3**	Cell membrane, Mesosome, Cytoplasm, Nucleoid and Ribosome's.	
	3.4	Flagella, Pili and Fimbriae, Cytoplasmic inclusion – PHB granules, glycogen, carbohydrates, Gas vesicles.	
4.0	**04**	**Control of Microbes**	06
	4.1	Sterilisation: Physical- Dry heat, Moist heat	
	4.2	Pasteurization.	
	4.3	Disinfection, Antiseptic, Tyndallisation.	
	4.4	UV light, Ionizing Radiation, Filtration.	

		Total	30

SBTTCP-1103: Lab Course in Basics of Microbiology

B.Sc. Biotechnology **Marks: 50**

Sr. No.	List of Experiments: Basics of Microbiology
1	General Rules and Safety in Microbiology Laboratory.
2	Study of basic equipment's used in Microbiology Laboratory- Autoclave, Hot air oven & Incubator
3	Preparation of Media
4	Morphological study of bacteria
5	Simple staining, Grams staining
6	Negative staining
7	Flagella and Endospore staining
8	Isolation of microorganisms from air.
9	Measurement of size of microorganism by Micrometry method
10	Study of motility of Microorganisms by hanging drop method

Reference Books:

1. Pelczar, Chan and Krieg, Microbiology, (Indian edition), McGraw Hill Education, 2016
2. Pawar and Daginawala, Microbiology, Vol II., Himalaya Publishing House, 2015
3. Dubey and Maheswari, A Textbook of Microbiology, 5th edition, S. Chand Ltd., 2000
4. Purohit, Microbiology fundamentals and applications, 7thedition, Agrobios, 2001
5. Gerard Tortora, BerdellFunke and Christine Case, Microbiology An Introduction, 13th edition, Pearson, 2018
6. Christopher J. Woolverton, Linda M. Sherwood, Johanne M. Willey, Prescott's Microbiology, 10th edition, McGraw Hill, 2016

Generic Elective (Group A)

SBTTGE-1101: Biofuels and Bioenergy

Marks: 50 **B.Sc. Biotechnology** **Hours: 30**

Course Prerequisite:

- The Students should be aware about mass and energy balances

Course Objectives:

- To acquaint the students with Bio-Energy and in particular on the exploitation of biomass and organic waste for energy recovery
- To familiarize the students with thermo-chemical energy processes (combustion, gasification, pyrolysis, reforming, hydrothermal conversion), mechanical and chemical processes (oil extraction and trans-esterification), finally biochemical processes (fermentation and anaerobic digestion). Emphasis is given to thermo-chemical processes and anaerobic digestion

Course Outcomes: The student at the end of the course, students

- Will be able to analyze the various technologies available to energetically valorize the various types of biomass and organic waste;
- Will be able to evaluate performances and limits of the same technologies in relation to the substrate to be treated
- Will have clear concepts and design elements to address the design of a bioenergy plant.

Module No.	Unit No.	Topic	Hrs.
1.0	**01**	**Unit I Overview of Biofuel**	08
	1.1	Basics of Biofuels.	
	1.2	Generation of biofuels.	
	1.3	Development of biological conversion technologies.	
	1.4	Integration of biofuels into bio refineries. Energy security and supply.	
2.0	**02**	**Unit II Biogas and Biodiesel**	08
	2.1	Biogas: Biogas systems and classifications and Biodiesel	
	2.2	Microorganisms and raw materials used for microbial Oil production.	
	2.3	Treatment of the feedstocks prior to production.	
	2.4	Environmental sustainability of biofuels. Economic sustainability of biofuels.	

3.0	**03**	**Unit III Bio-energy**	08
	3.1	Bio-energy: Renewability and sustainability of biomass.	
	3.2	Origin of bio-mass (Photosynthetic process) sources, characteristics.	
	3.3	Biofuel production process and Biomass conversion methods.	
	3.4	Energy farming, Pyrolysis. Gasification, types of biomass gasification.	
4.0	**04**	**Unit IV Anaerobic digestion of wastes**	06
	4.1	Anaerobic digestion of wastes.	
	4.2	High performance bio-gas systems.	
	4.3	Cleaning of bio-gas.	
	4.4	Use of bio- mass for electricity production. Bio-gas compression and storage.	
		Total	30

Reference Books:

1. B.D. Singh, Biotechnology: Expanding Horizon,12th edition, Kalyani Publications,2022
2. P.K. Gupta, Elements of Biotechnology, Rastogi Publications,2022
3. R.C. Dubey, A Text book of Biotechnology, S. Chand, 2022
4. S.N. Jogdand, Advances in Biotechnology, Himalaya Publication, 2007
5. Balasubranian, Concepts in Biotechnology, University Press, 1995
6. Purohit, Biotechnology,AgrobiosPublication, 2005
7. H.D. Kumar, Modern concepts of Biotechnology,VikasPublicationsPrabirBasu, "Biomass Gasification and Pyrolysis", Elsevier Inc., 2010.
8. Sunggyu Lee and Y.T. Shah, "Biofuels and Bioenergy: Processes and Technologies", CRC Press, Taylor & Francis Group, 2013.
9. Erik Dahlquist, "Biomass as Energy Source Resources, Systems and Applications", CRC Press, Taylor & Francis Group, UK, 2013.
10. 10.G.N. Tiwari, M.K.Ghosal, "Fundamentals of Renewable Energy Sources", Narosa Publishing House, 2005.

Skill Enhancement Course (SEC)

SBTTSC-1101: Microbial Cultures and their Maintenance

Marks: 50 **B.Sc. Biotechnology** **Hours: 30**

Pre requisite:

- Basic knowledge of microorganisms

Course Objectives:

- To provide fundamental understanding of the microbial world, basic structure and functions of microbes.
- To understand practical skills for cultivation and maintenance of MOs through various techniques.

Course Outcomes:

- Students will be able to acquire the knowledge about the culturing techniques of microorganisms and their maintenance in the laboratory,
- Students will be able to construct an ideal Microbiology laboratory.

Module No.	Unit No.	Topic	Hrs.
1.0	**1.0**	**Unit I Introduction and safety aspects of Microbiology Lab**	08
	1.1	Introduction and safety aspects of microbiology lab.	
	1.2	Instructions and handling of basic Microbiology equipment's & tools such as an autoclave and hot air oven	
	1.3	Basic principle and handling of pH meter	
	1.4	Basic principle and handling of Colony counter, Shaker with incubator.	
2.0	**2.0**	**Unit II Microbial culture media and its importance**	08
	2.1	Microbial culture media and its importance.	
	2.2	Enrichment media.	
	2.3	Isolation of microorganisms from soil, Air and water.	
	2.4	Serial dilution Method	
3.0	**3.0**	**Unit III Isolation, Screening and Sub culturing of microbes in solid and liquid media**	08
	3.1	Isolation of pure culture from mixed population	
	3.2	Primary and Secondary Screening of microorganisms	
	3.3	Sub culturing of microbes in solid media.	
	3.4	Sub culturing of microbes in liquid media.	

4.0	**4.0**	**Unit IV Preservation and Maintenance of Pure Culture**	06
	4.1	Basics of Preservation and Maintenance of Pure Culture.	
	4.2	Morphological behaviour of microbes.	
	4.3	Identification and confirmation by Biochemical test of preserved cultures.	
	4.4	Techniques used in maintenance: Lyophilization, Deep freezer Cryopreservation.	
		Total	30

Sr. No.	**List of Experiments**
1	Safety rules of Microbiology Laboratory.
2	Counting of colony by using Colony Counter.
3	Isolation of microorganisms from air.
4	Isolation of Pure Cultures by Streak Plate Technique.
5	Estimating the bacterial numbers in a batch culture by spread plate technique (Enumeration of aerobic plate count).
6	Isolation and enumeration of microorganisms from soil sample by using serial dilution
7	Membrane Filtration as a Means of Sterilization and Enumeration of Bacteria.
8	To Maintain pure culture using agar slant and mineral oil overlay.
9	Lyophilization method (to activate Lyophilized microbes).
10	Morphological and biochemical study of isolated microorganisms.

Reference Books:

1. K.R.Aneja, Experiments in Microbiology, Plant Pathology and Biotechnology, 4th edition, Newage International Publishers, 2010
2. R.C.Dubey, Experiments in Microbiology, S. Chand Publ., 2013
3. Dr. V.Singh, A Text Book of botany diversity of microbes and cryptogams, 5th edition, Rastogi Publication, 2020
4. Sabina Fijan, Probiotics and antimicrobial effect, Mdpi AG, 2023
5. Anju Dhir, Applied Microbiology, 2nd edition, CBCS publisher and distributors Pvt. Ltd., 2022
6. Lorrence Green, Emanuel Goldmann, Practical Handbook of Microbiology, 4th edition, CRC Press, 2020

SEMESTER II

SBTTCT-1151: Biochemistry - II

Marks: 50 **B.Sc. Biotechnology** **Hours: 30**

Course pre-requisite:

- The candidate should have basic knowledge in Biochemistry

Course Objectives:

- To understand a general introduction to the basic concepts of Biomolecules
- To understand the structure, behavior and importance of biomolecules.

Course Outcomes:

- Students will be able to describe the molecular basis of life and role of energy rich compounds in biological system
- Students will be able to describe structure, properties and roles of biomolecules.

Module No.	Unit No.	Topic	Hrs.
1.0	**01**	**Unit I: Carbohydrates metabolism**	08
	1.1	Photosynthesis: Trapping of solar energy into chemical energy (PS-I & PS-II) in green plants	
	1.2	Utilization of chemical energy to synthesis of carbohydrates(Calvin Cycle)	
	1.3	C-4 & CAM Plants and pathway, Photorespiration (C2 Cycle).	
	1.4	Concept of Respiration Aerobic respiration: Glycolysis ,Kreb Cycle, Electron Transport Chain & Anaerobic respiration pathway	
2.0	**2.0**	**Unit II: Proteins and Enzyme**	08
	2.1	Structure of proteins: Primary, Secondary and Tertiary and Quaternary structure of proteins with suitable examples and Ramachandran plots.	
	2.2	Classification of protein based on polarity, Peptide bond formation, Properties (physical, chemical),	
	2.3	Methods of isolation purification & characterization of enzymes	
	2.4	Concept of Enzyme assay, Enzyme activity, coenzyme, Isoenzymes	
3.0	**3.0**	**Unit III: Fatty Acids**	08
	3.1	Fatty acid oxidation, Saturated fatty acid oxidation and unsaturated fatty acids oxidation.	
	3.2	Role of carnitine and Odd carbon fatty acids	
	3.3	Biosynthesis of Fatty acids: fatty acid synthase complex ands regulation,	

	3.4	Microsomal and mitochondrial system of chain elongation and synthesis of Unsaturated fatty acid	
4.0	**4.0**	**Unit IV: Nucleic Acids and Amino acids**	06
	4.1	Concept of nucleosides, nucleotides and nucleic acids	
	4.2	Synthesis of Pyrimidine and Purines	
	4.3	Metabolic breakdown of amino acids , transamination (Mechanism)	
	4.4	Oxidative and non –oxidative deamination. Urea cycle, Metabolic disorder of urea cycle	
		Total	30

Reference Books

7. Nelson, D.L. and Cox, M.M, Lehninger: Principles of Biochemistry, 6thedition, W.H. Freeman, and Company (New York), 2013
8. Devlin, T.M., Textbook of Biochemistry with Clinical Correlations, 7th edition, John Wiley & Sons, Inc. (New York), 2011
9. Berg, J.M., Tymoczko, J.L. and Stryer L., Biochemistry, 7thedition., W.H. Freeman, and Company (New York), 2012
10. Voet and Voet, Biochemistry, 4th edition, John Wiley, and Sons, 2021
11. U. Satyanarayana, U. Chakrapani, Biochemistry, 6thedition, Elsevier, 2021
12. Prasad Manjeshwar, Textbook of Biochemistry, 5th edition, Sheetal distributors, 2022

SBTTCP-1151: Lab Course in Biochemistry -II

Marks: 50 **B.Sc. Biotechnology** **Hours: 30**

Sr. No.	List of Experiments: Biochemistry-II
1	Concept of buffers and preparation of different pH solutions
2	Normality and Morality (Problem solving and preparations)
3	Estimation of Carbohydrates and sugars
4	Study of Lambert Beer's law
5	Study of enzymes
6	Study of hydrolysis of starch by enzymes

7	Separation photosynthetic pigments by TLC
8	Estimation of vitamin by DNPH/ Iodometric method.
9	Estimation of amino acid and cholesterol
10	Determination of Acid value of oil and Fat
11	Spectroscopic analysis of DNA and RNA

SBTTCT 1152: Genetics - I

Marks: 50 **B.Sc. Biotechnology FY** **Hours: 30**

Course pre-requisite
The candidate should have been basic knowledge about cell and Chromosome

Course objectives:

- The course is aimed to impart knowledge of structural and functional aspects of cells as unit of living system.
- To understand Mendelian genetics, Microbial genetics, concept of Genes

Course Outcomes:

- Students will learn functions of various organelles.
- Students will acquire the laboratory skills of microbial recombination.

Module No.	Unit No.	Topic	Hrs.
1.0	**01**	**Unit I: Mendel's law of Inheritance**	08
	1.1	Mendel's law of Inheritance: principal of segregation, independent assortment, Dominance.	
	1.2	Mendelian genetics in humans.	
	1.3	Varity of gene expression –modifiers, suppressors, pleiotropic gene, multiple alleles.	
	1.4	Interaction of gene-Epistasis, complimentary gene, supplementary gene, duplicate gene.	
2.0	**02**	**Unit: II Linkage**	08
	2.1	Linkage –definition, coupling and repulsion hypothesis.	
	2.2	linkage groups.	
	2.3	Crossing over- Mechanism and theory	
	2.4	Structural and numerical changes in chromosomes. Extra chromosomal inheritance-mitochondrial and plastids, Karyotype study	
3.0	**03**	**Unit: III Genes and Mutation**	08
	3.1	Concept of Gene.	
	3.2	Classical & modern gene concepts.	
	3.3	Mapping of gene, Mutation and types of mutation (Spontaneous and Induced), Mechanism of Mutagenesis.	
	3.4	Base analogues, Nitrous and hydroxyl amines, alkyalting agents, Acridine orange, U.V. light	

4.0	**04**	**Unit: IV Plamid**	06
	4.1	Plasmid – structures ,types ,properties and aapplication: transposable elements	
	4.2	Genetic recombination in bacteria: Defination, transformation	
	4.3	.Conjugation and it's mechanism	
	4.4	Transduction and its mechanism	
		Total	30

SBTTCP-1152: Lab Course in Genetics - I

Marks: 50 **B.Sc. Biotechnology** **Hours: 30**

Sr. No.	List of Experiments: Genetics I
1	Two Examples on Monohybrid Cross
2	Two Examples on Dihybrid cross
3	One example each on interaction of genes
4	Study of karyotypes
5	Study of Human blood groups
6	Study of Special types of chromosomes
7	Study of cell structure
8	Study on sex linked inheritance in drosophilla
9	Study of model preparation on DNA /RNA
10	Study of pedigree analysis in human

Reference Books:

1. M.W. Strickberger,Genetics, Prentice Hall College Division, 1999
2. David Friefelder, Microbial Genetics, NarosaPublications, 2008
3. Stanier, "General Microbiology", Palgrave Macmillan, 1999
4. P.K. Gupta, Genetics,Rastogi Publication., 2018
5. C. Sarin "Genetics", 1988
6. Larry Snyder Wendy Champness, "Molecular Genetics of Bacteria", 2007
7. Arora, Genetics, Himalaya Publications, 2017
8. B.D. Singh, Genetics, Himalaya Publication, 2009

SBTTCT 1153: Basic Maths, Stats and Computer

Marks: 50 **B.Sc. Biotechnology FY** **Hours: 30**

Course pre-requisite

- The candidate should have been basic knowledge about Maths, Stats and Computer

Course objectives:

- To develop skills of Mathematics, Statistics and Computers in the field of biology

Course Outcomes:

- Students will learn functions of various statics equations, Computer in field of Biology
- Students will acquire the laboratory skills of Computer laboratory.

Module No.	Unit No.	Topic	Hrs.
1.0	**01**	**Unit I: Set Theory**	08
	1.1	Set, types of set	
	1.2	subset, universal set	
	1.3	Venn diagram	
	1.4	Set operation. Examples	
2.0	**02**	**Unit II: Graphical representation and measures of central tendency**	08
	2.1	Definition of Biostatistics, Data and Central Tendency	
	2.2	Graphical representation (Histogram, frequency polygon, frequency curve)	
	2.3	Diagrammatic representation (simple Bar, Subdivided bar, pie chart)	
	2.4	Concepts, definition, formulas of ungrouped and grouped data. Examples of Mean, Median, Mode.	
3.0	**03**	**Unit III: Measures of Variation**	08
	3.1	Concept, Definition, formula, examples of Range	
	3.2	Standard Deviation	
	3.3	Definition, Examples of Variance	
	3.4	Coefficient of Variation	
4.0	**04**	**Unit IV: Basics of Computer**	06
	4.1	Introduction to computer system	
	4.2	Binary Number System	
	4.3	Introduction to O.S. Windows & Linux. Introduction to MS word, Excel, Power point	
	4.4	Internet concept, WWW,URL, http, Browsers, Search engines etc	
		Total	30

SBTTCP-1153: Lab Course in Mathematics, Statistics and Computer

Marks: 50 **B.Sc. Biotechnology** **Hours: 30**

Sr. No.	List of Experiments: : Mathematics, Statistics and Computer
1	Problem based on Measures of central tendency
2	Problem based on Measures of variation
3	Problem based on set theory
4	Study of word processing MS-word
5	Preparation of chart & graphs by MS – Excel
6	Making presentation in MS power point
7	Internet – E-mail, Search Engines.
8	Examples of Mean, Median, Mode
9	Study of different biological data base
10	Examples of Standard deviation

Reference Books:

1. Introduction of Mathematics for Life science - E. B atschelet – Springer
2. Discrete Mathematics-Semyour Lipschutz & Marc Lipson –McGrawHill
3. Statistical Methods – Gupta – Himalaya
4. Fundamental of Biostatistics–P. Hanamantrao
5. Introduction to Biostatistics Dr. Pranabkumar Banerjee
6. Introduction of Computer Science-Pcushman & R. Mata Toledo, McGraw Hill
7. Computer fundamentals – P.K. Sinha – BPB New Delhi.
8. Microsoft Office – 2000Complete – BPB Practicals

Generic Electives (Group B)

SBTTGE-1151: Applications of Biotechnology

Marks: 50 **B.Sc. Biotechnology FY** **Hours: 30**

Course pre-requisite:

- The candidate should have basic knowledge of types of Biotechnology and their applications

Course Objectives:

- To have overview and understanding of world of Biotechnology with applications.
- To understand the major groups of microorganism's tools in Biotechnology.

Course Outcomes:

- Students become able to understand the applications of Biotechnology in different fields.
- Student would gain insight in agriculture, PTC, Environment and Biofuel.

Module No.	Unit No.	Topic	Hrs.
1.0	**1.0**	**Unit I: Introduction of Biotechnology**	08
	1.1	Introduction: Definition, Historical overview of Biotechnology.	
	1.2	Recent discoveries from Cell biology to Biotechnology.	
	1.3	Application of Biotechnology in Agriculture: Plant tissue culture, Seed Technology.	
	1.4	Transgenic plants and their applications, Bio-fertilizers, Bio-pesticide with examples. etc.	
2.0	**2.0**	**Unit II: Biotechnology in Health & Biopharmaceuticals**	08
	2.1	Biotechnology in Health and Biopharmaceuticals: Diagnostics-Ag-Ab interactions and other types of diagnosis.	
	2.2	Concept of Stem Cells.	
	2.3	Hybridoma Technology.	
	2.4	Genetic Counselling. Transgenic Animals and their applications.	
3.0	**3.0**	**Unit III :Biotechnology in Industry**	08
	3.1	Beverage-Winery, Distillery.	
	3.2	Dairy industry and their applications	
	3.3	Food Processing and packaging.	
	3.4	Enzymes and therapeutic uses, Paper & Pulp etc.	
4.0	**4.0**	**Unit IV: Application of Biotechnology in Environment &**	06

		Biodiversity	
	4.1	Composting, Waste water treatment, Solid waste management.	
	4.2	Biodegradation, Bioremediation	
	4.3	Biofuel- Biodiesel, Biogas, Ethanol.	
	4.4	Biodiversity: in situ, ex situ conservation of endangered species. Ethical, Legal (IPR, Patent) and social impact of Biotechnology.	
		Total	30

Reference Books and text:

1. Introduction to Biotechnology- Brown, C Publications Campbell F.G., Priest-Panima Publications, 2002
2. Biotechnology-U Satyanarayana- New Age Publications, 2017
3. Biotechnology - B.D. Singh, Kalyani Publications, 2010
4. Biotechnology: Expanding Horizon- B.D. Singh- Kalyani Publications, 2012
5. Elements of Biotechnology - P.K. Gupta, Rastogi Publications, 1994
6. A Text book of Biotechnology - R.C. Dubey- S. Chand, 1993
7. Advances in Biotechnology- S.N. Jogdand- Himalaya Publication, 2007
8. 8.Concepts in Biotechnology-Balasubranian- University Press, 2004
9. Biotechnology - Purohit- Agrobios Publication, 2005
10. Modern concepts of Biotechnology, H.D. Kumar, Vikas Publications, 1998

Sr No	**List of Activities: Applications of Biotechnology**
1	Students field Trip to Biotech Companies
2	Survey and report on commercial dairy products and packaged food products available in market
3	Survey and report on vaccination programme in India and vaccines in market.
4	Survey and report on use of Biofuel (Biodiesel and biogas)
5	Visit and report on local drinking and waste water treatment, bio composting, biogas units.
6	Report on government agencies- DBT, CSIR, ICMR, ICAR, TIFR, IISER, IIT, DRDO
7	Report on Top 10 Biotech companies in India and World
8	Visit and report on Biotech Research Institute, Forensic Laboratory and Biotech Industry.

Skill Enhancement Course (SEC)

SBTTSC-1151: Techniques in Forensic Biology

Marks: 50 **B.Sc. Biotechnology** **Hours: 30**

Course pre-requisite:

- No as such pre requisite required

Course Objectives:

- To apply theoretical knowledge of principles and concepts of Forensic Biology to understand practical problems.
- To understand and study DNA analysis as most convincing form of forensic evidence.

Course Outcomes:

- Students will able to analyze cellular and tissue samples.
- Will be able to analyze tissue, hair samples as well as physiological fluids relevant to legal investigation

Module No.	Unit No.	Topic	Hrs.
1.0	**1.0**	**Unit I: Forensic Examination of Blood**	08
	1.1	Identification (Preliminary and Confirmatory tests).	
	1.2	Species of Origin.	
	1.3	Individualization.	
	1.4	Blood Grouping, Enzyme Typing.	
2.0	**2.0**	**Unit II: Analysis of Biological Fluids**	08
	2.1	Analysis of Biological Fluids: Composition	
	2.2	Examination of Biological Fluids such as Saliva, Semen, Vaginal Fluid, Urine and Sweat.	
	2.3	Protection of Biological Evidences.	
	2.4	Collection, Packaging, Preservation & Transportation of Biological Evidences.	
3.0	**3.0**	**Unit III: Blood Pattern Analysis**	08
	3.1	History of Bloodstain Pattern Interpretation.	
	3.2	Target Surface Considerations, Size, Shape and Directionality of Blood Stains.	
	3.3	Interpretation of Bloodstain on Clothing and Footwear.	
	3.4	Documentation and Photography for Bloodstain Pattern Analysis.	
4.0	**4.0**	**Unit IV: DNA Profiling**	06
	4.1	Introduction, History of DNA Typing.	
	4.2	Human Genetics- Heredity, Alleles, Mutations and Population Genetics.	
	4.3	Molecular Biology of DNA, Variations, Polymorphism.	

	4.4	DNA Typing Systems- RFLP Analysis, PCR Amplifications, Sequence Polymorphism, Forensic Significance of DNA Profiling.	
		Total	30

References:

1. Culliford, B.E. The Examination and Typing of Blood Stains, US Deptt. of Justice, Washingron, 1971.
2. Furley, M.A. & Harrington, J.J. Forensic DNA Technology, 1991.
3. DNA structure and functions by Richard R. Sinden; Academic Press, Inc. 1994.
4. DNA Profiling and DNA fingerprinting; Edited by Jorg T. Epplen and Thomas Lubjuhn; BirkhauserVerlag, Switzerland, 1999.
5. DNA and other Polymorphism in Forensic Science by Henry C. Lee and R.E. Gaensslen; Year book Medical Publishers, Inc. 1990.
6. DNA Technology in Forensic Science by committee on DNA Technology in Forensic Science, Boardon Biology, Commission on Life Sciences, National Research council; National Academy Press,Washington, D.C. 1992.

Sr No	**List of Experiments**
1.	To prepare slides of scale patterns of human hair.
2.	To identify blood stains/saliva stains/semen stains.
3.	To perform precipitin test for species of origin determination.
4.	To perform immunodiffusion test for species origin.
5.	Extraction of DNA from other body fluids.
6.	Microscopic Identification of plant poisons.
7.	To prepare gel plates for electrophoresis.
8.	Extracting poisons from viscera/blood and urine samples.
9.	TLC separation of pesticides/insecticides & Identification using chromomeric reagents
10.	Estimation alcohol in Blood.
11.	Examination of hair of different domestic animals as cat, dog, cow, horse and goat.

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