॥ मा 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

Fax : (02462) 215572

Phone: (02462)215542

Academic-1 (BOS) Section

website: srtmun.ac.

E-mail: bos@srtmun.ac.

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: BIOTECHNOLOGY
(Single Major)

FACULTY OF SCIENCE AND TECHNOLOGY

B. Sc. First Year
(New Model Degree College, Hingoli)

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 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 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 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 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 deal with Basics of Cell Biology, Biochemistry, Fundamentals of Microbiology, Basics of Maths, Stats and Computer, Genetics, Bioinstrumentation, Immunology and Virology, Basic Molecular Biology, Principles of r-DNA Technology, Industrial Biotechnology, Agriculture Biotechnology, Pharmaceutical Biotechnology, Bioinformatics and Genomics and Proteomics.

Apart from the core courses, the Department Specific Elective Courses deal with Food Biotechnology, Animal Biotechnology, Bio-entrepreneurship Development and Environmental Biotechnology.

The Skill Enhancement Courses like Microbial Cultures and their Maintenance, Techniques in Forensic Biology, Drug Designing, Diagnostic Biology, Bio-pesticide Production Technology and Algal Biotechnology 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 of 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 and 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:

The students should have basic knowledge of science at 10+2 level. The optional courses 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.

The students seeking admission to this program should have cleared 10+2 examination from any recognized Board.

Dr Babsaheb S Surwase
Chairman, BOS in Biotechnology
(New Model Degree College, Hingoli),
Swami Ramanand Teerth Marathwada University, Nanded.
E Mail: bsurwase@rediffmail.com

Details of the Board of Studies Members in the subject Biotechnology 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 Babasaheb S Surwase School of Life Sciences SRTM University, Nanded Mob : 9075829767	Chairman	2	Dr Laxmikant Kamble School of Life Sciences, SRTM University, Nanded Moble: 8669695555	Member
3	Dr M M V Baig Dept of Biotechnology, Yeshwant Mahavidyalaya, Nanded. Mob: 9422170641	Member	4	Dr Prashant Thakare Department of Biotechnology, SGB Amravati University, Amravati-444602 Mobile: 982222822	Member
5	Dr Arun Ingale School of Life Sciences, North Maharashtra University, PO Box 80, Umavinagar, Jalgaon Mobile: 9822708707	Member	6	Dr Rahul Bhagat Department of Biotechnology, Govt. Inst. of Science, Aurangabad	Member
7	Dr Praveen Mamidala Dept of Biotechnology, Telangana University, Dichpally, Nizamabad 503322, Telangana. Mobile : 9177685454	Member	8	Dr Shivraj Hariram Nile Department of Food Science and Agriculture, National Agri-Food Biotechnology Institute (NABI), Sector 81, SAS Nagar, Mohali-140306, Punjab-India. Mobile : 09561740707	Member
9	Dr Sanjog T. Thul Environmental Biotechnology and Genomics Division, National Environmental and Engineering Research Institute (CSIR-NEERI), Nagpur Mob. : 91-712-2249885	Member	10	Mr Hanmant Barkate Glenmark Pharmaceuticals Pvt Ltd, Glenmark House, B. D. Sawant Marg, Chakala, Off Western Express Highway, Andheri (E), Mumbai – 400 099	Member
11	Mr Yogesh Hundekari Manager, R and D, Serum Institute of India Pvt Ltd., Hadapsar, Pune 411028 Mobile : 9011047097.	Member		--	
INVITEE MEMBER					
12	Dr Sunil Hajare Department of Biotechnology, New Model Degree College, Hingoli . Mob : 8378878817	Member		--	

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

Teaching Scheme

Subject	Course Code	Course Name	Credits Assigned			Teaching Scheme	
			Theory	Practical	Total	Theory (Hrs/week)	Practical (Hrs/week/ Batch)
Major Core 1	SBTTCT-3101	Basics of Cell Biology	02	--	**02**	02	--
	SBTTCP-3101	Lab Course in Basics of Cell Biology	-	02	**02**	--	04
Major Core 2	SBTTCT-3102	Biochemistry I	02	--	**02**	02	--
	SBTTCP-3102	Lab Course in Biochemistry I	--	02	**02**	--	04
Major Core 3	SBTTCT-3103	Fundamentals of Microbiology	02	--	**02**	02	
	SBTTCP-3103	Lab Course in Fundamentals of Microbiology	--	02	**02**	--	04
Generic Elective (GE), (From Other Faculty)	SBTTGE-3101	Bio-fuels and Bio-energy (Group A of Basket 3)	02	--	**02**	02	--
Vocational &Skill Enhancement Course	SBTTSC-3101	Microbial Cultures & their Maintenance	--	02	**02**	--	04
Ability Enhancement Course (ENG)	AECENG-3101	L1 – Compulsory English	02	--	**02**	02	--
Ability Enhancement Course (MIL)	AECXXX-3101	L2–Second Language Marathi (MAR), Hindi (HIN), Urdu (URD), Kannada (KAN), Pali (PAL) (Basket 4)	02	--	**02**	02	--
Indian Knowledge System (IKS)	IKSXXX - 3101	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	(T1+T2)/2	Total	CA	ESA	
Major Core 1	SBTTCT-3101	Basics of Cell Biology	10	10	10	40	--	--	50
	SBTTCP-3101	Lab Course in Basics of Cell Biology	--	--	--	--	20	30	50
Major Core 2	SBTTCT-3102	Biochemistry I	10	10	10	40	--	--	50
	SBTTCP-3102	Lab Course in Biochemistry I	--	--	--	--	20	30	50
Major Core 3	SBTTCT-3103	Fundamentals of Microbiology	10	10	10	40	--	--	50
	SBTTCP-3103	Lab Course in Fundamentals of Microbiology	--	--	--	--	20	30	50
Generic Elective (From Other Faculty)	SBTTGE-3101	Bio-fuels and Bio-Energy (Group A of Basket 3)	10	10	10	40	--	--	50
Skill Course	SBTTSC-3101	Microbial Cultures & their Maintenance	--	--	--	--	20	30	50
Ability Enhancement Course (ENG)	AECENG-3101	L1 – Compulsory English	10	10	10	40	--	--	50
Ability Enhancement Course (MIL)	AECXXX-3101	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 - 3101	Select from Basket 5	10	10	10	40	--	--	50

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

Teaching Scheme

Subject	Course Code	Course Name	Credits Assigned			Teaching Scheme	
			Theory	Practical	Total	Theory (Hrs/week)	Practical (Hrs/week/Batch)
Major Core 1	SBTTCT-3151	Biochemistry II	02	--	02	02	--
	SBTTCP-3151	Lab Course in Biochemistry II	--	02	02	--	04
Major Core 2	SBTTCT-3152	Genetics I	02	--	02	02	--
	SBTTCP-3152	Lab Course in Genetics I	--	02	02	--	04
Major Core 3	SBTTCT-3153	Basic Maths Stats and Computer	02	--	02	02	--
	SBTTCP-3153	Lab Course in Basic Maths Stats and Computer	--	02	02	--	04
Generic Elective (From Other Faculty)	SBTTGE-3151	Applications of Biotechnology in Agriculture (Group B of Basket 3)	02	--	02	02	--
Vocational/ Skill Enhancement Course (Related to Major)	SBTTSC-3151	Techniques in Forensic Biology	--	02	02	--	04
Ability Enhancement Course (ENG)	AECENG-3151	L1 – Compulsory English	02	--	02	02	--
Ability Enhancement Course (MIL)	AECXXX-3151	L2–Second Language Marathi (MAR), Hindi (HIN), Urdu (URD), Kannada (KAN), Pali (PAL) (Basket 4)	02	--	02	02	--
Value Education Course (VEC)	VECCOI-3151	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	(T1+T2)/2	Total	CA	ESA	
Major Core 1	SBTTCT-3151	Biochemistry II	10	10	10	40	--	--	50
	SBTTCP-3151	Lab Course in Biochemistry II	--	--	--	--	20	30	50
Major Core 2	SBTTCT-3152	Genetics I	10	10	10	40	--	--	50
	SBTTCP-3152	Lab Course in Genetics I	--	--	--	--	20	30	50
Major Core 3	SBTTCT-3153	Basic Maths, Stats and Computer	10	10	10	40	--	--	50
	SBTTCP-3153	Lab Course in Basic Maths, Stats and Computer	--	--	--	--	20	30	50
Generic Elective (GE) (From Other Faculty)	SBTTGE-3151	Applications of Biotechnology in Agriculture (Group B of Basket 3)	10	10	10	40	--	--	50
Vocational/ Skill Enhancement Course (Related to Major)	SBTTSC-3151	Techniques in Forensic Biology	--	---	---		20	30	50
Ability Enhancement Course (ENG)	AECENG-3151	L1 – Compulsory English	10	10	10	40	--	--	50
Ability Enhancement Course (MIL)	AECXXX-3151	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-3151	Constitution of India	10	10	10	40	--	--	50

SBTTCT-3101: Basics of Cell Biology

Theory: Basics of Cell Biology	**Subject Code: SBTTCT-3101 Credit: 2**
Total Marks for Evaluation: 50	No. of Contact Hours: 2hr/week

Course pre-requisite

- The candidate should have basic knowledge about cell and Chromosomes

Course objectives

- To introduce the students to the basic facts, concepts, and principles in Cell Biology.
- To understand the structures and basic components of prokaryotic and eukaryotic cells, especially macromolecules, membranes, and other cell organelles and their functions.
- To introduce the students to the basics of cell division, communication and cell signaling

Course outcomes: On successful completion of the course, the student 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 other cell organelles
- Explain the basics of cell division, communication and cell signaling

Curriculum Details:

Module No.	Unit No.	Topic	Hrs.
1.0		**Unit I**	08
	1.1	Ultrastructure, chemical composition and functions of Plasma membrane. Ultrastructure and functions of Cytoplasmic organelles: Mitochondria, BIS oxidative phosphorylation, Endoplasmic reticulum, Ribosomes, Lysosomes, Golgi bodies and Cytoskeleton.	
	1.2	Nucleus: Morphology, nuclear envelope, nucleoplasm, nucleolus and chromatin.	
	1.3	Ultra structure of Eukaryotic Chromosome: Macro-molecular organization Nucleosome model.	
	1.4	Primary and Secondary constriction, SAT-bodies, Special chromosomes-structure and function of Polytene and Lampbrush chromosome	
2.0		**Unit II**	08
	2.1	Nucleus :Nuclear envelope, nuclear pore complex and nuclear lamina chromatin–Molecular organization nucleolus	
	2.2	Protein sorting & transport: Endoplasmic Reticulum Structure, targeting and insertion of proteins in the ER.	
	2.3	Protein folding, processing and quality control in ER, smooth ER and lipid synthesis, export of proteins and lipids	
	2.4	Golgi Organization, protein glycosylation, and Apparatus protein sorting and export for Golgi apparatus Lysosomes	
3.0		**Unit III**	08

	3.1	Molecular Basis Cell Cycle and Cell Division: G1, S, G2 and M phase, Checkpoints.	
	3.2	Mitosis: Stages, Mitotic apparatus, cytokinesis, Mitogens and Inhibitors, Significance..	
	3.3	Meiosis: Stages, Synaptonemal complex, crossing over and chiasma formation, Significance	
	3.4	Cell senescence and Cell death: cellular features of Senescence- spontaneous and induced, Programmed cell death, Mechanism of cell death and significance.	
4.0		**Unit IV**	06
	4.1	Cell communication – overview	
	4.2	Tpes of cell signaling – signal molecules – signal amplification – receptor types – quorum sensing.	
	4.3	Signal Transduction – calcium and kinase Signaling Pathways.	
	4.4	Cell Cycle and Signal Transduction,	
		Total	30

Text Books:

1. Harvey Lodish, Molecular cell biology, 5th ed (W H Freeman, 2005).
2. G. M. Cooper and R. E. Hansman, The cell: A molecular approach, 4th ed ,ASM Press, 2007.
3. Bruce Alberts, Molecular biology of the cell, 4th ed ,Garland Publishing Science, 2002 (Taylors Francis).
4. S. F. Gilbert, Developmental biology, 5th ed, (1997), Sinauer, Associates, Massachusettes.
5. R. Tamarin, Principles of genetics, 3rd ed, (1991).
6. V. Rao, Developmental biology: A modern synthesis, Oxford &IBH, New Delhi, (1994).
7. E. D. P. De Robertis and E. M. F. Robertis, Cell and molecular biology (Lea & Febiger, 1991) 1991.

Reference Books

1. M. Cooper and Robert. E. Hausman The Cell: A Molecular Approach: Geoffrey. Sinauer Associates, 5th Ed. 2009
2. W. H. Freeman Lodish Molecular Cell Biology: 5th Ed. 2006
3. Jones, S. The Language of the Genes. Harper Collins, 1993
4. Muller, H. J. "Artificial Transmutation of the Gene". Science 66 , 1927
5. Miller. J. A laboratory manual and handbook for *Escherichia coli* and related bacteria. CSHL Press, NY. 1992
6. Strachan, T. and Read, A. Human Molecular Genetics. Garland Science, CRC Press, Florida. 2018
7. Griffiths, A.J.F., Wessler, R.S., Carroll, S.B., Doebley, J. Introduction to Genetic Analysis. W.H. Freeman and Company, New York. 2015.

SBTTCP-3101 Lab Course in Basics of Cell Biology

PRACTICAL	Subject Code: SBTTCP-3101
Total Marks for Evaluation: 50	No. of Contact Hours: 4hr/Week, Credits: 2

Course pre-requisite: Students must have basic knowledge of Cell structure

Course Objectives:

- To familiarize the students with practicals of Basics of Cell Biology

Course Outcomes : After successful completion of the course, the student shall be able to:

- Examine various cell organelles through micrograph techniques.
- Analyze various nucleic acids through staining techniques.
- Examine polyploidy through onion root with various treatments.
- Examine various stages of meiosis cell division.

Sr. No.	List of Experiments
Basics of Cell Biology	
1	Study of a representative plant and animal cell by microscopy
2	Study of the structure of cell organelles through electron micrographs
3	Study of polyploidy in Onion root tip by colchicine treatment
4	Study of different stages of Mitosis
5	Study of different stages of Meiosis
6	Cell division in insect gonads
7	Preparation of pre-treating/fixing agents/ stains for cytological studies.
8	Isolation and staining of Mitochondria
9	Mounting of polytene chromosomes
10	Blood typing in humans for multiple alleles and Rh factor
11	RBC cell count by Haemocytometer

Recommended Books:

1. Robert J. Brooker. Genetics: Analysis & Principles. 7th Edition. Mc Graw Hill Publication
2. M. Cooper and Robert. E. Hausman. The Cell: A Molecular Approach: Geoffrey. , Sinauer Associates, 5th Ed. 2009.
3. W. H. Freeman Lodish. Molecular Cell Biology: 5th Ed. 2003.
4. Bruce Alberts. Molecular Biology of the cell: Garland Publishing, 5th Ed. 2008.
5. Ganesh M. K. & Shivashankara A. R. Laboratory Manual for Practical Biochemistry: , Jaypee Publications, 2nd Ed. 2012.
6. Bhat, Sujata, V. Biometerials: ., Narosa Publishing House, 2010.
7. Vanholde & Johnson, P. Shing. Principles of Physical Biochemistry: , Pearson Prentice Hall Upper Saddle River, New Jersey, 2nd Ed. 2005.
8. David Sheehan. Physical Biochemistry: Principles and Applications: , Wiley, 2nd Ed. 2009.
9. David, M. Freifelder. Physical Biochemistry: Applications to Biochemistry and Molecular Biology, ACS publication, 1983

SBTTCT-3102 Biochemistry I

Theory: Biochemistry I	**Subject Code: SBTTCT-3102 Credit: 2**
Total Marks for Evaluation: 50	No. of Contact Hours: 2hr/week

Course pre-requisite:

- The candidate should have basic knowledge of Chemistry & Biology

Course objectives

- To acquaint the students with general introduction to the basic concepts of Biochemistry and the functions of carbohydrates, protein, lipids.
- To acquaint the students with insight to importance of biomolecules

Course outcomes: On successful completion of the course,

- The student shall be able to describe the chemical and molecular foundations of life and therole of energy rich compound in biological systems.
- Able to define the structure, properties and roles of carbohydrates.
- Able to explain the structure, properties and roles of lipids in biological system.
- Able to discuss structure, function and acid base properties of amino acids.

Curriculum Details:

Module No.	Unit No.	Topic	Hrs.
1.0		**Chemical Composition of Cell**	08
	1.1	First and Second law of thermodynamics	
	1.2	Gibb's free energy, Functional groups in Biochemistry	
	1.3	Biomolecules and Cell	
	1.4	Enzymes and Vitamins	
2.0		**Carbohydrates and Lipids**	08
	2.1	Families of monosaccharides: aldoses and ketoses, trioses, tetroses, pentoses, and hexoses, Stereo isomerism of monosaccharides, Epimers	
	2.2	Mutarotation and anomers of glucose. Furanose and pyranose forms ofglucose and fructose. Haworth projection formulae for glucose; chair and boat forms of glucose, Sugar derivatives, glucosamine, galactosamine, muramic acid, N- acetyl neuraminic acid.	
	2.3	Disaccharides; concept of reducing and non-reducing sugars, occurrence and Haworth projections of maltose, lactose, and sucrose, Polysaccharides, storage polysaccharides, starch and glycogen. Structural Polysaccharides, cellulose, peptidoglycan and chitin. Definition and major classes of storage and structural lipids,	
	2.4	Fatty acids structure and Storage lipids. Fatty acids structure and functions. Essential fatty acids. Triacyl glycerols structure, functions and properties. Saponification, structural lipids. Phosphoglycerides: Building blocks, General structure, functions and properties	
3.0		**Proteins**	07
	3.1	Concepts and Classification of Amino acids, Primary structures of	

		proteins: Amino acids, the building blocks of proteins	
	3.2	General formula of amino acid and concept of zwitterion. Titration curve of amino acid and its significance	
	3.3	Classification, biochemical structure and notation of standard protein amino acids	
	3.4	Ninhydrin reaction. Natural modifications of amino acids in proteins hydrolysine, cystine and hydroxyproline	
4.0		**Nucleotides and Nucleic Acids**	07
	4.1	Nucleotides and Nucleosidesand Nomenclature; Major and Minor Nitrogenous bases	
	4.2	Concept of base pairing; Double helical DNA structure, cellular and molecular level ; Types of RNA	
	4.3	A, B and Z form of DNA, DNA repair enzymes	
	4.4	Denaturation of nucleic acids – Tm values and their significance	
		Total	
			30

Text Books:

1. Biometerials: Bhat, Sujata, V., Narosa Publishing House, 2010.
2. Principles of Physical Biochemistry: Vanholde & Johnson, P. Shing, Pearson Prentice Hall Upper Saddle River, New Jersey, 2nd Ed. 2005.
3. Physical Biochemistry: Principles and Applications: David Sheehan, Wiley, 2nd Ed. 2009.
4. Physical Biochemistry: Applications to Biochemistry and Molecular Biology, David, M. Freifelder, ACS publication, 1983.

Reference Books:

1. Biochemistry (6thEdition) by Jeremy M. Berg, John L. Tymoczko Lubert Stryer Publisher:B.I publications Pvt.Ltd (2007) ISBN:071676766X ISBN13: 978071676 7664,978716767664.
2. Fundamentals of Biochemistry by J. L. Jain, Sunjay Jain and Nitin Jain, (2008)Publishers: S. Chand &Co Ltd ISBN: 81-219-2453-7 p: 73.
3. Lehninger Principles of Biochemistry by Nelson, D. L., Lehninger, A. L., & Cox, M. M.(2008) 5thEdition, ISBN: 978-0-230-22699-9, Publisher: W. H. Freeman and, Company, New York p: 239-255.

SBTTCP-3102 Lab Course in Biochemistry I

PRACTICAL	**Subject Code:** SBTTCP-3102
Total Marks for Evaluation: 50	No. of Contact Hours: 4hr/Week, Credits: 2

Course Objectives:

- To familiarize the students with practicals of Basics of Biochemistry

Course Outcomes

- To provide an in-depth understanding of chemical reaction mechanisms in biological processes.
- Analyze the characteristics of the compound on the basis of their pH
- Analyze the characteristics of the compound on the basis of their pH
- Examine various instruments using in separation and isolation of various analytical compounds

Sr. No.	List of Experiments
Biochemistry I	
1	Concept of molarity, molality and normality. Calculation and preparation of molar solutions. (Problems to be given in exams). Calculation and preparation of normal solutions and percent solutions and dilute solutions.
2	Calibration of volumetric glassware's (Burette, pipette).
3	Preparation of standard Sodium carbonate solution, standardization of HCl (Methylorange) and estimation of NaOH in the given solution. (methyl orange or phenolphthalein)
4	Preparation of standard Oxalic acid. Standardization of NaOH and estimation of H2SO4in the given solution (phenolphthalein).
5	Preparation of Normal solution- NaOH
6	Preparation of percentage solutions- Sulphuric acid (v/v)
7	Paper Chromatography- Isolation of the pigments from leaves of Radish
8	Qualitative analysis of Carbohydrate, protein & fats
9	Estimation of sulphuric acid and oxalic acid in a mixture using standard NaOH solution and standard KMnO4 solution.
10	Preparation of standard Potassium dichromate and estimation of ferrous/ferric mixture using diphenylamine indicator (Demonstration)
11	Preparation of standard potassium bi-phthalate solution, standardization of sodium hydroxide solution and estimation of alkalinity of antacids

Recommended Books:

1. The Cell: A Molecular Approach: Geoffrey. M. Cooper and Robert. E. Hausman, Sinauer Associates, 5th Ed. 2009.
2. Molecular Cell Biology: W. H. Freeman Lodish, 5th Ed. 2003.
3. Molecular Biology of the cell: Bruce Alberts, Garland Publishing, 5th Ed. 2008.
4. Laboratory Manual for Practical Biochemistry: Ganesh M. K. & Shivashankara A. R., Jaypee Publications, 2nd Ed. 2012.
5. Biometerials: Bhat, Sujata, V., Narosa Publishing House, 2010.
6. Principles of Physical Biochemistry: Vanholde & Johnson, P. Shing, Pearson Prentice Hall Upper Saddle River, New Jersey, 2nd Ed. 2005.
7. Physical Biochemistry: Principles and Applications: David Sheehan, Wiley, 2nd Ed. 2009.
8. Physical Biochemistry: Applications to Biochemistry and Molecular Biology, David, M. Freifelder, ACS publication, 1983.
9. Laboratory Manual for Practical Biochemistry: Ganesh M. K. & Shivashankara, A. R., Jaypee

SBTTCT-3103: Fundamentals of Microbiology

Theory: Fundamentals of Microbiology	Subject Code: SBTTCT-3103 Credit: 2
Total Marks for Evaluation: 50	No. of Contact Hours: 2hr/week

Course pre-requisite

- The candidate should have basic knowledge about Microbes

Course objectives

- To foster knowledge about the scope and applications of Microbiology in various fields.
- To learn about the prokaryotic cell structures and functions, Microbial Nutrition , Cultivation and preservation of Microbial Cells and working of instruments used in Microbiology Laboratory.

Course outcomes: On successful completion of the course, the student shall be able to:

- Summarize the evolution process for the formation the of earth and discovery of microorganisms
- Learn different microbial processes involved in the protection of industrially important products
- Describe the structure of prokaryotic cell organization, correlate functions of each component and distinguish cells on the basis of their cell wall component.

Curriculum Details:

Module No.	Unit No.	Topic	Hrs.
1.0		**Unit I**	08
	1.1	History and Scope of Microbiology.	
	1.2	Evolution of the planet, Origin of Life forms, Discovery of microorganisms	
	1.3	Conflict over spontaneous generation, Golden Age of Microbiology- Koch Postulate, Medical Microbiology, Immunology	
	1.4	Scope and relevance of Microbiology- Special reference to industrial developments in the current scenario, Future of Microbiology- Applications of Microbial Process.	
2.0		**Unit II**	08
	2.1	Bacterial chromosome (Nucleoid), Cell wall structure: Peptidoglycan Structure, Gram-Positive and Gram-Negative Cell Walls, Lipopolysaccharide layer, Functions of the cell wall	
	2.2	Prokaryotic Cell wall, Cell membrane: Fluid mosaic model, Components external to cell wall: Capsule, slime layer, flagella, pili, fimbriae.	
	2.3	Cytoplasmic matrix: Ribosomes, Nucleoid, Inclusion bodies,	
	2.4	Magnetosomes, Gas vesicles, Plasmids, Bacterial endospores and their formation	
3.0		**Unit III**	08
	3.1	Bacterial Endospore - Examples of spore forming organisms, habitats, function, formation and germination. Reproduction in bacteria.	
	3.2	Brief outlines on discovery, nature, origin, evolution, morphology and structure, Acetic acid bacteria, Mycloplasmas, Cyanobacteria,	

		Archaebacteria, Actinomycetes (Actinobacteria).	
	3.3	Composition, reproduction and other characteristics of Bacteria (Eubacteria) Spirochetes, Rickettsias, Chlamydias, Pseudomonads,	
	3.4	Industrially important bacteria. Probiotics microflora.	
4.0		**Unit IV**	06
	4.1	Fungi : Classification, structure, composition, reproduction and other characteristics of fungal divisions – Zygomycota, Ascomycota, Basidiomycota and Deuteromycota and slime and water molds. General characteristics and importance of fungi – Saccharomyces, Candida, Pichia, Penicillium, Neurospora, Rhizopus, Aspergillus, Agaricus, Cryptococcus, Fusarium, Trichoderma, Claviceps.	
	4.2	Algae : Classification, structure, reproduction and other characteristics of algal divisions. Characteristics of Chlorella, Senedesmus, Gelidiella and Gracellaria. Economic importance of algae, phytoplantanic microalgae.	
	4.3	Protozoan parasites : Classification, morphology and structure, reproduction and other characteristics of pathogenic protozoa	
	4.4	Parasitic diseases caused by Entamoeba, Plasmodium, Leishmania, Cryptosporidium, Trichomonas, Taxoplasma, Trypanosoma, Giardia.	
		Total	30

Text Books:

1. Madigan et al. ,Brock Biology of Microorganisms. 8th ed. Prentice-Hall International, Inc. 1997,
2. Prescott et al. Microbiology. 3rd ed. . Wm. C. Brown Publ. 1999.
3. R.A. Atlas. Principles of Microbiology. . 2nd ed.. Wm.C. Brown. Publ.1997
4. K. Talaro and A. Talaro.Foundations in Microbiology. 2nd ed. Wm. C. Brown Publ, 1996.
5. Pelczar et al.Microbiology. 5th ed. Tata McGram-Hill Publ. Company Ltd. 1996.
6. S.B. Sullia, General Microbiology, Oxford and IBH Publishers 1999.
7. Stainer et al. General Microbiology, Macmillan Educational Ltd. 1999
8. J. Nicklin et al. Instant Notes in Microbiology. Viva Books Pvt. Ltd. 1999.
9. Alexopoulos et al., Introductory Mycology. . 4th ed. John Wiley and Sons. 1996
10. H.D. Kumar.Introductory Psychology by . 2nd ed. . East West Press1999

SBTTCP-3103 Lab Course in Fundamentals of Microbiology

PRACTICAL	**Subject Code: SBTTCP-3103**
Total Marks for Evaluation: 50	No. of Contact Hours: 4hr/Week, Credits: 2

Course pre-requisite: Students must have basic knowledge of Microbiology

Course Objectives:

- To familiarize the students with Basics of major discoveries in microbiology, advanced microscopy, and microbe control methods.
- To familiarize the students to categorize microbes on structural, cellular, and morphological differences, compare and categorize organisms with prokaryotic a

Course Outcomes: After successful completion of the course, the student shall be able to:

- Inculcate the perceptions on major discoveries in microbiology, advanced microscopy, and microbe control methods; they shall also be able to categorize microbes on structural, cellular, and morphological differences, compare and categorize organisms with prokaryotic and

2025,

eukaryotic features

Sr. No.	List of Experiments
Lab Course in Fundamentals of Microbiology	
1	Microbiological laboratory standards and safety protocols
2	Operation and working principles of light and compound microscope
3	Working principle and operations of basic equipment's of microbiological laboratory (Autoclave, oven,incubator, LAF, spectrophotometer, colorimeter, vortex, magnetic stirrer etc.).
4	Bacterial motility by hanging drop method
5	Simple staining – Negative staining
6	Differential staining – Gram staining
7	Acid fast staining
8	Structural staining – Flagella and capsule
9	Bacterial endospore staining
10	Staining of reserved food materials (granular)
11	Staining of fungi by lactophenol cotton blue

Recommended Books:

1. Alexopoulos, C.J., Mims, C.W. and Blackwell, M. . Introductory Mycology.John Wiley and Sons(Asia) Pvt. Ltd. Singapore.. 2002
2. Atlas, R.M. Basic and practical microbiology. Mac Millan Publishers, USA. 1984
3. Black, J.G. Microbiology principles and explorations.7th edition. John Wiley and Sons Inc., NewJersey. 2008.
4. Dubey, R.C. and Maheshwari, D.K. . A Textbook of Microbiology, 1st edition, S. Chand & CompanyLtd. 1999
5. Madigan, M.T., Martinko, J.M., Dunlap, P.V. and Clark, D.P.. Brock Biology of Microorganisms, -12th edition, Pearson International edition, Pearson Benjamin Cummings 2009.
6. Michael Pelczar, Jr., Chan E.C.S., Noel Krieg. Microbiology - Concepts and Applications, International ed, McGraw Hill. 4. 1993
7. Pommerville, J.C. . Alcamo's Fundamentals of Microbiology. Jones and Bartlett 2013.
8. Schlegel, H.G. . General Microbiology. Cambridge University Press, Cambridge, 655 pp. ACS publication, 1995

GENERIC ELECTIVE
SBTTGE-3101 BIO-FUELS AND BIO-ENERGY

Theory	**Subject Code: SBTTGE-3101**
Total Marks for Evaluation: 50	No. of Contact Hours: 2hr/week, Credit: 2

Prerequisites of course: Awareness about mass and energy balances
Objectives of course:

- 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

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

- Will be able to analyse the various technologies available to energetically valorise 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.

Curriculum Details:

Module No.	**Unit No.**	**Topic**	**Hrs.**
1.0		**BIOMASS, BIO-ENERGY AND BIO-REFINERY**	08
	1.1	Basic concepts of circular economy based on organics.	
	1.2	Current energy consumption, Refinery and biorefinery concepts: Sugarcane/molasses-to-ethanol,Corn-starch-to-ethanol (Basic concept), Cellulosic-ethanol biorefinery, Vegetable oils-to-biodiesel.	
	1.3	Biomass typologies: lignocellulosic, starchy, sugary, oilseeds,, Sewage sludge, manure.	
	1.4	Biofuels: liquid (biodiesel, bioethanol), gaseous (syngas, biogas), solid (charcoal and biochar).	
2.0		**BIOMASS CONVERSION: THERMOCHEMICAL CONVERSION**	06
	2.1	Biomass storage and feeding systems	
	2.2	Innovative bioenergy plants: biomass to synthetic natural gas.	
	2.3	Absorption enhanced reforming.	
	2.4	Biomass Resources and its types	
3.0		**BASICS OF BIOMASS TEHNOLOGY**	08
	3.1	Basic Mechanism of light reaction	
	3.2	Exploration of Photosynthetic process	
	3.3	Hill Reaction	
	3.4	Integrated Biomass Systems and Assessments	
4.0		**BIOFUELS**	
	4.1	Electron transport process in light reaction	08

	4.2	Greenhouse Gases, Photosynthesis for Biofuels	
	4.3	Biofuels laboratory visit and related Lab Exercises	
	4.4	Biobased products, life cycle analysis, and water use in biofuels	
		Total	**30**

Reference Books:

1. Christopher Higman: Gasification, Elsevier, 2008
2. Peter Quaak, Harrie Knoef and Hubert Stassen: Energy from Biomass-A Review of Combustion and Gasification Technologies, World Bank Technical Paper No. 422 Energy Series 1999.
3. A.V. Bridgwater: Advances in Thermochemical Biomass Conversion, Springer, 2008
4. H.A.M Knoef: Handbook Biomass Gasification, BTG, 2005.
5. Bhattacharya S.C. and Salam P.A.: A Review of Selected Biomass Energy Technologies, RERIC, 2006
6. Donald L. Klass: Biomass for Renewable Energy, Fuels, and Chemicals, Academic Press, 1998
7. C. Y. WereKo - Brobby and E. B. Hagan: Biomass Conversion and Technology, John Wiley and Sons, 1996.
8. Souza-Santos M.L,: Solid Fuel Combustion and Gasification, Marcel Dekker Inc. 2004.
9. Prabir Basu: Combustion and Gasification in Fluidized Beds, CRC, 2006 10. Prabir Basu: Biomass Gasification and Pyrolysis: practical design and theory, 2010

SKILL ENHANCEMENT COURSE
SBTTSC-3101: Microbial Cultures & their Maintenance

PRACTICAL	**Subject Code: SBTTSC-3101**
Total Marks for Evaluation: 50	No. of Contact Hours: 4hr/Week, Credits: 2

Pre-requisite: Basic Knowledge of Microbiology

Objectives of course:

- The objective of this course to make students knowledgeable about the various basic concepts in a wide ranging contexts which involve the use of knowledge and skills of Microbiology specially Microbial Cultures & its Maintenance

Outcomes of course:

- On completion of the course on, the students will be able to understand the basics of Microbiology, different techniques of bacterial isolation and culture maintenance.

Curriculum Details:

Module No.	**Unit No.**	**Topic**	**Hrs.**
1.0		**UNIT I**	08
	1.1	Safety measures and Good Laboratory Practices in microbiology laboratory	
	1.2	Maintains of Pure Cultures by Streak Plate Technique	
	1.3	Isolation of Pure Culture of Bacteria; Streaking for isolation on an agar plate	
	1.4	Isolation of Pure Culture of Bacteria; The pour plate method	
2.0		**UNIT II**	08
	2.1	Determination of Cell Number by Turbidimetric Method	
	2.2	Biochemical Tests for Characterization of Enteric Bacteria Membrane	
	2.3	Biochemical Tests for Characterization of Enteric Bacteria Membrane	
	2.4	Sterilization and Enumeration of Bacteria and its culture	
3.0		**UNIT III**	07
	3.1	Maintain bacterial cultures in viable conditions using agar slants	
	3.2	Maintain bacterial cultures in viable conditions using agar deeps	
	3.3	Effect of Temperature on Growth of Bacteria	
	3.4	Determination of Lethal temperature of different bacterial cultures	
4.0		**UNIT IV**	07
	4.1	Isolation of Nitrifying (nitrite forming) bacteria	
	4.2	Detection of Toxic organisms in aquatic system	
	4.3	Solid plate culture of thermophilic microorganisms.	
	4.4	Stab cultures	
		Total	30

List of Experiments

Sr No	List of Experiments
1	Isolation of Pure Cultures by Streak Plate Technique
2	Isolation of Pure Culture of Bacteria by Serial Dilution - Agar Plate
3	Estimating the bacterial numbers in a batch culture by spread plate technique (Enumeration of aerobic plate count)
4	Determination of Cell Number by Turbidimetric Method
5	Biochemical Tests for Characterization of Enteric Bacteria
6	Membrane Filtration as a Means of Sterilization and Enumeration of Bacteria
7	Maintain bacterial cultures in viable condition using agar slants and agar deeps
8	Study of molds by slide culture technique
9	Effect of Temperature on Growth of Bacteria
10	Determination of Lethal temperature of different bacterial cultures
11	Isolation of Nitrifying (nitrite forming) bacteria
12	Detection of Toxic organisms in aquatic system (Microcystis spp. from pond water)

Reference/ Text Books

1. Mahon, C. R., Lehman, D. C., & Manuselis, G. . Textbook of diagnostic microbiology (5th ed.). Saunders 2014.
2. Alexopoulos C J, Mims C W, Blackwell M, Introductory Mycology, 4th ed., Blackwell Publishing 1996,
3. Atlas R M, Principles of Microbiology. 2nd edn., Wm. C. Brown Pub., Iowa, USA 1997,
4. Madigan, M.T., Martinko, J.M. and Parker, J. Brock Biology of Microorganisms. 8th Edition, Prentice Hall International, Inc., New York 1997.
5. Ehrlich H L, Newman, D K, Geomicrobiology, 5th edn. Boca Raton, FL: CRC Press/Taylor & Francis 2009.
6. Pelczar Jr, M J, Chan E C S, Krieg N R,. Microbiology: An Application Based Approach, 5th edn. McGraw-Hill Book Company, NY 1986,
7. Willey J, Sherwood L, Woolverton C, , Prescott, Harley, and Klein's Microbiology, 7th edn, Hill Book Company, NY 2011.
8. Kun LY. Microbial Biotechnology. World Scientific. 2006.
9. Tortora et al. Microbiology an introduction, Pearson Education 2008.
10. Michael J Pelczar et al. . TATA McGraw Hill 2000

SEMESTER II

SBTTCT-3151- Biochemistry II

Theory: Fundamentals of Biochemistry	**Subject Code: SBTTCT-3151 Credit: 2**
Total Marks for Evaluation: 50	No. of Contact Hours: 2hr/week

Course pre-requisite: The candidate should have been completed basic course in Biochemistry

Course Objectives: To introduce the students to the metabolism of biomolecules (Carbohydrates, Lipids and the Amino acids).

Course Outcomes:. On successful completion of the course, the students shall be able to

- Describe the fundamentals of thermodynamics in biochemical processes.
- Acquire the knowledge of energy production in living systems by the degradation of fatty acids.
- Explain the various pathways of fatty acid synthesis in living systems
- Describe the energy generated from the carbohydrate and amino acid metabolism.

Curriculum Details:

Module No.	Unit No.	Topic	Hrs.
1.0		**Biochemistry of Carbohydrate**	08
	1.1	Detailed account of glycolysis with energy considerations & regulation, Entry of fructose, mannose & galactose in glycolysis	
	1.2	Glycogenolysis & Glycogenesis – Detailed account & hormonal control. Formation of acetyl CoA & detailed account of TCA Cycle, Isotopic tests of TCA cycle (Concept of Prochirality), Regulation, Amphibolic and anaplerotic nature of TCA cycle.	
	1.3	Glyoxylate cycle and its role in conversion of fats into carbohydrates, Gluconeogenesis– Detailed account of bypass reactions, Regulation, Malate & glycerophosphate shuttle system.	
	1.4	Role of high energy compounds-Electron transport chain and Oxidative phosphorylation.	
2.0		**Lipid Metabolism**	07
	2.1	Oxidation of fatty acids – Beta oxidation, alpha oxidation and omega oxidation. Metabolism: Ketogenesis, Ketosis & ketoacidosis.	
	2.2	Biosynthesis of saturated fatty acids and unsaturated fatty acids.	
	2.3	Biosynthesis of triglycerides & phospholipids (Phosphatidyl-ethanolamine, choline, inositol).	
	2.4	Biosynthesis of sphingolipids. Biosynthesis and degradation of cholesterol.	
3.0		**Amino Acid Metabolism**	08
	3.1	Concepts and Classification of Amino acids, Primary structures of proteins: Amino acids, the building blocks of proteins	
	3.2	Amino Acids metabolism: Digestion, absorption and uptake of Amino Acids.	

	3.3	γ-glutamyl cycle, transamination, oxidative and nonoxidative deamination, glucose-alanine cycle, urea cycle Glucogenic and ketogenic amino acids.	
	3.4	Glucose-alanine cycle, urea cycle, Glucogenic and ketogenic amino acids. Catabolic pathways for the standard amino acids.	
4.0		**Nucleic acid Metabolism**	07
	4.1	Biosynthesis and degradation of purine and pyrimidine nucleotides	
	4.2	Uricotelic and urotelic system	
	4.3	Inhibitors of nucleotides biosynthesis	
	4.4	The fundamental relationship between nucleic acids and protein synthesis	
		Total	30

Text Books:

1. Nelson, D.L. and Cox, M.M. Lehninger's Principle of Biochemistry, W.H. Freeman, New York 2012.
2. Voet, D. and Voet, J.G. Biochemistry. John Wiley and Sons Inc., New Jersey 2010.

Reference Books:

3. Garrett, R.H. and Grisham, C.M. . Biochemistry, Cengage Learning, Mason. Ohio 2016.
4. Berg, J.M., Tymoczko, J.L., Stryer, L. Biochemistry,W. H. Freeman, New York 2011.
5. Harris, D.A. Bioenergetics at a glance. Willey J. and Sons Inc., New Jersey 1995 .
6. Hofman A. and Clokle S. Wilson and Walker's Principle and Techniques of Biochemistry and Molecular Biology. Cambridge University Press, Cambridge 2010.

SBTTCP-3151: Lab Course in Biochemistry II

PRACTICAL	**Subject Code: SBTTCP-3151**
Total Marks for Evaluation:50	No. of Contact Hours: 4hr/Week, Credits: 2

Course pre-requisite

- The candidate should have been basic knowledge in Biochemistry

Course objectives

- To enhance students' practical laboratory skills and equipment/instrument use in Biochemistry

Course outcomes: On successful completion of the course, the student shall be able to:

- Explain biochemical parameter of biological sample.
- Explain fermentation process by microorganism.
- Explain enzyme assay of salivary enzyme.
- Apply the various techniques for isolation of lipids.
- Practice the biochemical parameters in biological system.
- Practice the estimation of plasma sugar.
- Demonstrate the cholesterol level from known sources
- Demonstrate assay for various clinically important enzymes.
- Demonstrate serum test for various parameters.
- Demonstrate test serum for various parameters.
- Practice clinical test by various proteins in biological samples.

Sr No.	**List of Practicals**
	Biochemistry

1	Estimation of blood glucose.
2	Sugar fermentation by microorganisms.
3	Assay of salivary amylase. Isolation of genomic DNA
4	Cholesterol estimation.
5	Estimation of proteins by Biuret/Lowry method/Bradford method
6	Effect of temperature and pH on various functionally important Proteins
7	Estimation of cholesterol from known source (Groundnut oil)
8	Estimation of serum uric acid
9	Estimation of serum creatinine.
10	Protein separation by PAGE

Reference Book

1. S. K. Thimmaiah (ed). Standard Methods of Biochemical Analysis, , Kalyani Publishers, Ludhiana, 2003.
2. Keith Wilson and John Walker. Practical Biochemistry Principles and Techniques 5th edition Cambridge University Press 2005.
3. Upadhyay Nath . Biophysical Chemistry Principles and Techniques , Himalaya publishing house 2002.
4. Snedecor, G. W. and Cochran, W. G. Statistical methods. Iowa State Press, Iowa 1989.
5. Green, R. H. Sampling Design and Statistical Methods for Environmental Biologists, John Wiley & Sons, New Jersey 1979.
6. E. Balagurusamy. Programming in ANSI C, 6th Edition, Tata McGraw Hill 2011.
7. Kernighan, B.W. and Ritchie, D.. C Programming Language,2ndEdition, Prentice Hall 1988.
8. B.S. Gottfried . Schaum's Outlines: Programming with C, 2nd Edition, Tata McGraw Hill 1998.

SBTTCT-3152: Genetics I

Theory	Subject Code: SBTTCT-3152
Total Marks for Evaluation: 50	No. of Contact Hours: 2hr/week, Credit: 2

Course pre-requisite: The students should have basic knowledge of Cell Biology

Course objectives:

- To provide knowledge on understanding of Historical introduction to Genetics and genetic materials
- To provide understanding of the concept and principles of genetics exchanges

Course outcomes:

- On successful completion of the course, students will understand the Mendelian Inheritance pattern and Mendelian Genetics.

Curriculum Details:

Module No.	Unit No.	Topic	Hrs.
1. 0		**Mendelian Inheritance**	08
	1.1	Mendel's experiments- Choice of material, characters. Terminology and definitions –phenotypes, genotype, locus, allele, homozygotes, heterozygotes	
	1.2	Johanssen's Pure line concept, filial generations, reciprocal cross, back cross, test cross.	
	1.3	Law of Segregation- Monohybrid crosses with examples, Law of Independent Assortment – Dihybrid and Trihybrid crosses with examples.	
	1.4	Mendelian inheritance and probability (Multiplication and Addition rites).	
2.0		**Extensions to Mendelian Genetics**	10
	2.1	Gene-Gene Interactions - Different types of Epistasis with examples from different organisms.	
	2.2	Multiple alleles – theories of multiple allelic inheritance- Eye color in Drosophila, coat color in mice and rabbits.	
	2.3	ABO blood groups, blood group incompatibility in transfusion. Self incompatibility in plants.	
	2.4	Extrachromosomal inheritance in Paramecium, Yeast, Drosophila.	
3.0		**Cytogenetics**	08
	3.1	Human Karyotyping, Banding techniques. Gene theraphy, Pedigree analysis.	
	3.2	Human Genetic diseases	
	3.3	Gene theraphy, Pedigree analysis.	
	3.4	Molecular Cytogenetic Techniques.	
4.0		**Linkage and Crossing over**	04
	4.1	Phases of linkage, test cross, recombination frequency.	
	4.2	Gene mapping, determination of map distances based on two and three point test crosses, coincidence, interference eg. Drosophila and Maize.	
	4.3	Tetrad analysis – Neurospora.	

	4.4	Cytological proof of crossing over.	
		Total	30

Reference Books:

1. Klug, WS., Cummins, MR., Spencer, C., Palladino, MA. Concepts of Genetics. 10th Edition. Pearsons Publication 2020.
2. Genetics: A Conceptual approach.Benjamin A.Pierce. . 7th edition. McMillan Publication 2000.
3. Genetics From Genes to Genomes. Hartwell. L., Michael. L Gold berg., Anne E. Reynolds and
4. Lee. M. Silver. . 4th Edition. Mc Graw Hill Publication 2009.
5. Genetics: Analysis & Principles. Robert J. Brooker 7th Edition. Mc Graw Hill Publication.
6. Genetics: Analysis of Genes and Genomes.Daniel L. Hartl . 5th Edition Jones and Bartlett
7. Publishers. Inc 2014.

SBTTCP-3152- Lab Course in Genetics I

Course Objectives:

- To teach students the concept of Mitosis and visualize the sex chromatin under the microscope.
- To give hands on experience in quantification of important biological constituents of cell .

Course Outcomes: On successful completion of the course, the student shall be able to:

- Successfully quantify the important biological constituents of cell.
- Analyze the sex chromatin present in different cells.
- Examine and evaluate the stages of Mitosis
- Could able to separate and interpret the mixture of components

Sr. No.	List of Experiments
1	Mendel's law of genetics - Mono and Dihybrid crosses (Demo).
2	Mitosis
3	Observation of Genetic model organisms (*Arabidopsis thaliana* and *Coenorrabditis elegans*)
4	Preparation of polytene chromosomes
5	Genetic problems- Multiple alleles, Gene interaction
6	Breeding experiments in Drosophila Melanogaster
7	Monohybrid, Dihybrid
8	Mitotic cell division using onion root tips
9	Meiosis in Onion Bud cell.
10	Staining of DNA and RNA – Methyl green pyronin.

Recommended Books:

1. Robert J. Brooker. Genetics: Analysis & Principles. 7th Edition. Mc Graw Hill Publication
2. M. Cooper and Robert. E. Hausman. The Cell: A Molecular Approach: Geoffrey. , Sinauer Associates, 5th Ed. 2009.
3. W. H. Freeman Lodish. Molecular Cell Biology: 5th Ed. 2003.
4. Bruce Alberts. Molecular Biology of the cell: Garland Publishing, 5th Ed. 2008.
5. Ganesh M. K. & Shivashankara A. R. Laboratory Manual for Practical Biochemistry: , Jaypee Publications, 2nd Ed. 2012.
6. Bhat, Sujata, V. Biometerials: ., Narosa Publishing House, 2010.

SBTTCT-3153: Fundamentals of Maths, Stats, and Computer

Theory: Fundamentals of Maths, Stat, and Computer	**Subject Code: SBTTCT-3153 Credit: 2**
Total Marks for Evaluation: 50	No. of Contact Hours: 2hr/week

Course pre-requisite

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

Course objectives

- To provide one roof solution for all requirements that students generally have while learning Mathematics, Statistics and Computer,

Course outcomes:

- On successful completion of this module, students will be able to apply fundamental concepts in Mathematics, Statistics and Basic in Computer science for real world problem solving.

Curriculum Details:

Module No.	**Unit No.**	**Topic**	**Hrs.**
1.0		**Fundamentals of Mathematics**	08
	1.1	Number Systems	
	1.2	Sequences and Series	
	1.3	Real Number System R Properties of R	
	1.4	Introduction to Logic, Boolean Algebra, Differentiation and Integration Differential Equations and Mathematical Modeling	
2.0		**Fundamentals of Statistics**	08
	2.1	Statistical Methods:Descriptive Statistics	
	2.2	Sets and Relations	
	2.3	Random Variables	
	2.4	Probability, Correlation and Regression	
3.0		**Descriptive Statistics II**	08
	3.1	Measures of Central Tendency: mathematical and positional.	
	3.2	Measures of Dispersion: range,quartile deviation, mean deviation, standard deviation, coefficient ofvariation, Moments, absolute moments, factorial moments,	
	3.3	Skewness and kurtosis, Sheppard's corrections.	
	3.4	Handling of bulky data.	
4.0		**Basics in computer**	06
	4.1	Computer Science Basics; Fundamentals of Embedded Systems;Digital Electronics	
	4.2	Computer Science Applications; Basic Programming Concepts; C Programming	
	4.3	Introduction to Data Structures; Fundamentals of Operating Systems	
	4.4	Types of computer languages	
		Total	30

Text Books:

1. Glover. T. and Mitchell, K Introduction to Biostatistics. McGraw –Hill Science. 2015.

References Books:

1. Zar. J.H. Biostatistical Analysis, Pearson Education, New Jersey 2010.
2. Matthews, J.R. and Matthews, R.W. Successful Scientific writing: A step-by- step Guide for Biomedical Scientists, Cambridge University Press, Cambridge 2007 .
3. Snedecor, G. W. and Cochran, W. G. .Statistical methods. Iowa State Press, Iowa 1989.
4. Green, R. H.) Sampling Design and Statistical Methods for EnvironmentalBiologists, John Wiley & Sons, New Jersey 1979
5. E. Balagurusamy : Programming in ANSI C, 6th Edition, Tata McGraw Hill. 2011.
6. Kernighan, B.W. and Ritchie, D.: C Programming Language,2ndEdition, Prentice Hall. 1988.
7. B.S. Gottfried .: Schaum's Outlines: Programming with C, 2nd Edition, Tata McGraw Hill 1998.
8. Pranab Kumar Banerjee, . Introduction to Biostatistics. S. Chand and company Limited. 2004.

SBTTCP-3153: Lab Course in Basic Maths, Stats and Computer

PRACTICAL	**Subject Code: SBTTCP-3153**
Total Marks for Evaluation:50	No. of Contact Hours: 4hr/Week, Credits: 2

Course pre-requisite:

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

Course objectives:

- To provide one roof solution for all requirements that students generally have while learning Mathematics, Statistics and Computer

Course objectives:

- This will provide one roof solution for all requirements that students generally have while learning Mathematics, Statistics and Computer

List of Practicals (Basics of Maths, Stats and Computer)

Sr No.	**List of Practicals**
1	Differential calculus
2	Plotting the graphs of different functions
3	Find numbers between two real numbers and plotting of finite and infinite subset of $\mathbb{R}$
4	Use various graphical and pictorial representation for presenting data
5	Analysing biological data using methods for central tendency
6	Calculate measures of dispersion in various data
7	Interpret the correlation coefficient to determine the strength and direction of the linear relationship between variables
8	Apply computer software for manipulating biological data

9	Programming with python-I
10	Linux fundamentals
11	Algorithms and programming with C

Reference Books:

- Snedecor, G. W. and Cochran, W. G. .Statistical methods. Iowa State Press, Iowa 1989.
- Green, R. H. Sampling Design and Statistical Methods for Environmental Biologists, John Wiley & Sons, New Jersey.1979.
- E. Balagurusamy : Programming in ANSI C, 6th Edition, Tata McGraw Hill. 2011.
- Kernighan, B.W. and Ritchie, D.: C Programming Language,2ndEdition, Prentice Hall. 1988.
- B.S. Gottfried .: Schaum's Outlines: Programming with C, 2nd Edition, Tata McGraw Hill. 1998.

(Generic Elective)
SBTTGE-3151 Applications of Biotechnology in Agriculture

Theory Applications of Biotechnology in Agriculture	Subject Code: SBTTGE-3151 ; Credit: 2
Total Marks for Evaluation: 50	No. of Contact Hours: 2hr/week

Course pre-requisite

- The candidate should have been basic knowledge of Plant Biotechnology.

Course objectives

- To introduce the students to the applications of Biotechnology in Agriculture and its practical value for Crop improvement. The module also gives insight to development of tissue culture & transgenic plants.

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

- Understand the biotechnological applications in agriculture
- Understand the importance of biotechnological methods such as plant tissue culture
- Comprehend the pros and cons of GM crops and their plant products
- Appreciate the biotechnological applications for effective pest control and crop improvement.

Curriculum Details

Module No.	Unit No.	Topic	Hrs.
1.0		**PLANT BIOTECHNOLOGY**	08
	1.1	Concepts and scope of biotechnology in Agriculture. Plant tissue culture, micro propagation, entrepreneurship in commercial plant tissue culture.	
	1.2	Plant transformation, Vectors for plant transformation, molecular characterization of transgenic plants using PCR	
	1.3	Gene transfer methods: Direct and Indirect methods	
	1.4	Biosafety concerns and regulatory mechanisms	
2.0		**MOLECULAR ASPECTS**	07
	2.1	Molecular farming of plants for applications in medicine systems, heterologous protein production in transgenic plants; Successful case studies	
	2.2	Post-harvest Protection: Antisense RNA technology for extending shelf life of fruits and shelf life of flowers.	
	2.3	Genetic engineering for quality improvement	
	2.4	Molecular biology of photosynthetic processes	
3.0		**PLANT TISSUE CULTURE**	08
	3.1	Historical benchmarks of plant cell and tissue culture; Culture media components and modifications; Sterilization techniques	
	3.2	*In vitro* differentiation: Organogenesis and somatic embryogenesis; Plant growth regulators: mode of action, effects on *in vitro* culture and regeneration.	
	3.3	Applications: Micropropagation; Anther and microspore culture.	
	3.4	Somaclonal variation, Production of secondary metabolites	
4.0		**DNA MARKERS**	07

	4.1	Types of molecular markers- RFLP; PCR based markers like RAPD,SCAR, SSR, STS, CAPS, AFLP, SNP and their variants;.	
	4.2	Uses of molecular markers: Application as a genetic tool for genotyping and gene mapping;	
	4.3	Linkage maps, Physical maps	
	4.4	Marker Assisted Selection (MAS), Trait related markers and characterization of genes involved	
		Total	**30**

Text Book:

1. Singh B.D. . Biotechnology Expanding Horizon, Kalyani Publication 2015.
2. Chawla HS. Introduction to Plant Biotechnology. Science Pub. Inc 2002..
3. Stewart NC Jr. Plant Biotechnology and Genetics: Principles, Techniques and Applications. John Wiley & Sons Inc 2008..

Reference Books:

1. Green MR & Sambrook J. . Molecular Cloning: A Laboratory Manual. 4th Ed. Vol I, II & III. Cold Spring Harbor Laboratory Press 2014.
2. Grierson D. . Plant Genetic Engineering. Springer Netherlands 2012.
3. Primose SB & Twyman RM. . Principles of Gene Manipulation and Genomics, 7th Ed. Blackwell Publishing 2006.
4. Sambrook J. and Russel D. . Molecular Cloning: A Laboratory Manual. 3rd Ed Cold Spring Harbor Laboratory Press 2001.

(Skill Enhancement Course)

SBTTSC-3151: Techniques in Forensic Biology

PRACTICAL	Subject Code: SBTTSC-3151
Total Marks for Evaluation: 50	No. of Contact Hours: 4hr/Week, Credits: 2

Course pre-requisite

- No as such pre requisite required

Course objectives

- To introduce the students to use and applications of modern tools, techniques and skills in forensic biology.

Course outcomes: on successful completion of the course, the student shall be able to

- Rationalize the significance of biological and serological evidence
- Justify the importance of biological fluids – blood, urine, semen, saliva, sweat and milk – in crime investigations
- Explain the basic principle of DNA analysis and forensic significance of PCR analysis

Curriculum Details:

Module No.	Unit No.	Topic	Hrs.
1.0		**UNIT 1**	08
	1.1	Introduction to forensic science	
	1.2	Biotechnological tools in forensic science	
	1.3	Practical significance of biological evidence	
	1.4	Practical significance of serological evidence	
2.0		**UNIT 2**	07
	2.1	Techniques and skills in forensic biology	
	2.2	Importance of biological fluids	
	2.3	Blood and Saliva in crime investigation	
	2.4	Sweat and hair samples in crime investigation	
3.0		**UNIT 3**	08
	3.1	Titre of antisera.	
	3.2	Precipitin test for species of origin determination	
	3.3	Electrophoresis for separation of various polymorphic Enzyme	
	3.4	Separation of sampling material by various methods	
4.0		**UNIT 4**	07
	4.1	Principles of DNA analysis	
	4.2	Importance of PCR techniques in Forensic Biology	
	4.3	Microscopic examination.	
	4.4	Separation& detection of biological fluid by using chromatography	
		Total	
			30

List of Experiments

Sr. No.	**List of Experiments**	**Hrs**
1	To determine titre of antisera.	3
2	To perform precipitin test for species of origin determination	6
3	To perform Immuno-diffusion test for species of origin.	3
4	To prepare gel plates for electrophoresis	3
5	Organic extraction of DNA from blood.	3
6	Extraction of DNA from other body fluids.	6
7	Quantification of DNA	6
8	PCR for DNA samples	5
9	Accessing of DNA databases.	5

Reference Books

1. J A Siegel, P.J Saukko Encyclopaedia of Forensic Sciences Vol. I, II and III, Acad. Press 2000.
2. Saferstein Forensic Science Handbook, Vol I, II & III, Prentice Hall Inc. USA,1976 .
3. Saferstein nalistics, Prentice Hall Inc. USA, 2000, Crim.
4. Bryant, V.M. Jr, Mildenhall, D.C. and Jones, J.G., Forensic Polynology in the United States of America Polynology. 1990, 14.PP.193-208
5. Faegri, K. Iverson, J. and Krzywinski, K. Textbook of Pollen Analysis 4th Edition. John Wiley & Sons, New York 1989.
6. Keith In man and Norah Rudin An Introduction to Forensic DNA Analysis, CRC Press; Ny,1997
7. John M. Butler Forensic DNA Typing: Biology, Technology, and Genetics of STR Markers Academic press.2005.

****