॥ 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

स्वामी रामानंद तीर्थ मराठवाडा विद्यापीठ, नांदेड

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विज्ञान व तंत्रज्ञान विद्याशाखे अंतर्गत राष्ट्रीय शैक्षणिक धोरण २०२० च्या अनुषंगाने शैक्षणिक वर्ष २०२३–२४ पासून संलग्न महाविद्यालये व विद्यापीठ संकुलांत पदव्युत्तर पदवी प्रथम वर्ष आणि विद्यापीठ संकुले व न्यू मॉडेल डिग्री कॉलेज मध्ये पदवी प्रथमवर्ष अभ्यासक्रम लागू करण्याबाबत.

प रि प त्र क

या परिपत्रकान्वये सर्व संबंधितांना कळविण्यात येते की, शासन निर्णय क्र. एनईपी २०२०/प. क्र. ०९/विशि–३/शिकाना, दिनांक २० एप्रिल २०२३ व शासन पत्र. क्र एनईपी २०२०/प. क्र. ०९/विशि–३, दिनांक १६ जून २०२३ अन्वये सूचित केल्यानुसार राष्ट्रीय शैक्षणिक धोरण २०२०च्या अनुषंगाने दिलेल्या आराखडया नुसार दिनांक १६ जून २०२३ रोजी संपन्न झालेल्या मा. विद्यापरिषदेच्या बैठकीत ऐनवेळचा विषय क्र. ०५/५६–२०२३ अन्वये मान्यता दिल्यानुसार प्रस्तुत विद्यापीठाच्या विज्ञान व तंत्रज्ञान विद्याशाखा अंतर्गत खालील पदव्युत्तर पदवी अभ्यासक्रम (AICTE, PCL, BCI, CoA, NCTE इ. सारख्या नियमक संस्थाची मान्यता आवश्यक असलेले अभ्यासक्रम वगळून) संलग्न महाविद्यालये, विद्यापीठ परिसर व उपपरिसर संकुलांमध्ये आणि पदवी प्रथम वर्ष अभ्यासक्रम विद्यापीठ परिसर व उपपरिसर संकुले व विद्यापीठ संचलित न्यू मॉडेल डिग्री कॉलेज, हिंगोली येथे शैक्षणिक वर्ष २०२३–२४ पासून लागू करण्यात येत आहे.

1) M.Sc. Biotechnology (1st Year) - Campus School
2) M.Sc. Biotechnology (1st Year) – Affiliated colleges
3) B.Sc. Biotechnology (1st Year) – New Model Degree College, Hingoli
4) M.Sc. Botany (1st Year) - Campus School
5) M.Sc. Botany (1st Year) – Affiliated colleges
6) M.Sc. Herbal Medicine (1st Year) - Affiliated colleges
7) M.Sc. Chemistry (1st Year) - Campus School
8) M.Sc. Chemistry (1st Year) - Affiliated colleges
9) M.Sc. Computer Science / Computer Network / Computer Applications (1st Year) University campus, sub campus Latur
10) M.Sc. System Administration & Networking (1st Year) – Affiliated colleges
11) M.Sc. Computer Management (1st Year) – Affiliated Colleges
12) M.Sc. Computer Science (1st Year) – Affiliated Colleges
13) M.Sc. Dairy Science (1st Year) - Affiliated colleges
14) M.Sc. Electronic (1st Year) - Affiliated colleges
15) M.Sc. Geology (1st Year) – University Campus
16) M.Sc. Geography (1st Year) – University Campus
17) M.Sc. Applied Mathematics (1st Year) – Affiliated Colleges
18) M.Sc. Mathematics (1st Year) – Affiliated Colleges
19) M.Sc. Microbiology (1st Year) - University Campus
20) M.Sc. Microbiology (1st Year) – Affiliated colleges

21) M.Sc. Physics (1st Year) - University Campus
22) M.Sc. Physics (1st Year) – Affiliated Colleges
23) M.Sc. Statistics (1st Year) - University Campus
24) M.Sc. Statistics (1st Year) – Affiliated colleges
25) M.Sc. Biochemistry (1st Year) – Affiliated Colleges
26) M.Sc. Zoology (1st Year) – Affiliated Colleges

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/एनइपी२०२०/S&T/अक/२०२३–२४/ 130

सहा.कुलसचिव
शैक्षणिक (१–अभ्यासमंडळ) विभाग

दिनांक : ३०.०६.२०२३.

प्रत : १) मा. प्राचार्य, सर्व संलग्नित महाविद्यालये, प्रस्तुत विद्यापीठ.
२) मा. संचालक, सर्व संकुले परिसर व उपपरिसर, प्रस्तुत विद्यापीठ
३) मा. प्राचार्य, न्यु मॉडेल डिग्री कॉलेज हिंगोली.
४) मा. समन्यवक, कै. श्री उत्तमराव राठोड आदिवासी विकास व संशोधन केंद्र, किनवट.

प्रत माहितीस्तव :
१) मा. कुलगुरू महोदयांचे कार्यालय, प्रस्तुत विद्यापीठ.
२) मा. कुलसचिव, प्रस्तुत विद्यापीठ.
३) मा. सर्व आधिष्ठाता, प्रस्तुत विद्यापीठ.
४) सर्व प्रशासकीय विभाग प्रमुख साहाय्यक, प्रस्तुत विद्यापीठ.
५) सिस्टीम एक्सपर्ट, शैक्षणिक विभाग, प्रस्तुत विद्यापीठ.

SWAMI RAMANAND TEERTH MARATHWADA UNIVERSITY, NANDED

(R-2023)

STRUCTURE AND SYLLABUS OF FOUR YEAR MULTIDISCIPLINARY

DEGREE PROGRAM WITH MULTIPLE ENTRY AND EXIT OPTION

UNDER

NATIONAL EDUCATION POLICY (NEP 2020)

In

SUBJECT: BIOTECHNOLOGY

FACULTY OF SCIENCE AND TECHNOLOGY

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

With Effect From June 2023

Introduction:

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

Some of the important features of National Education Policy are Increasing gross enrolment ratio in higher education, Holistic and multidisciplinary education with multiple entry/exit options, Establishment of academic bank of credit, Setting up of multidisciplinary education and research Universities and National Research Foundation, Expansion of open and distance learning to increase gross enrolment ratio, Internationalization of education, Motivated, energized and capable faculty, Online and digital education and Effective governance and leadership.

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

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

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 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 Cell Biology, Biochemistry, Basics of Maths, Stats and Computer, Genetics, Bioinstrumentation, Immunology and Virology, Basic Molecular Biology, Principles of r-DNA Technology and Genomics and Proteomics.

Apart from the core courses, the Department Specific Elective Courses deal with Industrial and Food Biotechnology, Pharmaceutical Biotechnology and Drug Designing, Bio-entrepreneurship Development, Agriculture and Animal Biotechnology, Environmental Biotechnology and Bioinformatics.

The Skill Enhancement Courses like Diagnostic Biology, Microbial Culture and its Maintenance, Drug Designing, Techniques in Forensic 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 course 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 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	SBTTC-101	Basics of Cell Biology	02	--	**02**	02	--
	SBTTC-102	Biochemistry I	02	--	**02**	02	--
	SBTTC-103	Lab Course in Basics of Cell Biology & Biochemistry I	-	02	**02**		04
Generic Elective	SBTTG-101	Bio-fuels and Bio-energy (Group A of Basket 2)	02	--	**02**	02	--
	SBTTG-102	Bio-entrepreneurship (Group B of Basket 2)	02	--	**02**	02	--
Vocational & Skill Enhancement Course	SBTTV-101	Diagnostic Biology	--	02	**02**	--	04
	SBTTS-101	Microbial Cultures & its Maintenance	--	02	**02**	--	04
Ability Enhancement Course	AECEN-101	L1 –Compulsory English	02	--	**02**	02	--
Value Education Course (VEC)	VECCI-101	Constitution of India	02	-	**02**	02	--
Indian Knowledge System (IKS)	IKSXX-101	--- (Basket 4)	02	--	**02**	02	--
Community Engagement Services (CES)	CCXXX-101	Any one of NCC/ NSS /Sports (SPT)/ Culture Studies (CLS) /Health Wellness (HWS) / Yoga Education (YGE) / Fitness (FIT) (Basket 5)	-	02	**02**	--	04
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	SBTTC-101	Basics of Cell Biology	10	10	10	40	--	--	50
	SBTTC-102	Biochemistry I	10	10	10	40	--	--	50
	SBTTC-103	Lab Course in Basics of Cell Biology & Biochemistry I	--	--	--	--	20	30	50
Generic Elective	SBTTG-101	Bio-fuels and Bio-energy (Group A of Basket 2)	10	10	10	40	--	--	50
	SBTTG-102	Bio-entrepreneurship (Group B of Basket 2)	10	10	10	40	--	--	50
Vocational & Skill Enhancement Course	SBTTV-101	Diagnostic Biology	--	--	--	--	20	30	50
	SBTTS-101	Microbial Cultures & its Maintenance	--	--	--	--	20	30	50
Ability Enhancement Course	AECEN-101	L1–Compulsory English	10	10	10	40	--	--	50
Value Education Course	VECCI-101	Constitution of India	10	10	10	40	--	--	50
Indian Knowledge System	IKSXX-101	--- (Basket 4)	10	10	10	40	--	--	50
Community Engagement Services (CC)	CCXXX-101	Any one of NCC/ NSS /Sports (SPT)/ Culture Studies (CLS) /Health Wellness (HWS) /Yoga Education (YGE) / Fitness (FIT) (Basket 5)	--	--	--	--	20	30	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	SBTTC-151	Biochemistry II	02	--	02	02	--
	SBTTC-152	Basics of Maths, Stats and Computer	02	--	02	02	--
	SBTTC-153	Lab Course in Biochemistry II and Basics of Maths, Stats and Computer	-	02	02	--	04
Minor	SBTTC-151	Cell Biology & Genetics (Basket 1)	02	--	02	02	--
Generic Elective	SBTTG-151	Applications of Biotechnology in Agriculture (Group A of Basket 2)	02	--	02	02	--
	SBTTG-152	Bio-safety and Bioethics (Group B of Basket 2)	02	--	02	02	--
Vocational & Skill Enhancement Course	SBTTV-151	Drug Designing	--	02	02	--	04
	SBTTS-151	Techniques in Forensic Biology	--	02	02	--	04
Ability Enhancement Course	AECXX-101	L2–Second Language Marathi (MR), Hindi (HN), Urdu (UR), Kannada (KN), Pali (PL) (Basket 3)	02	--	02	02	--
Value Education Course (VEC)	VECES-151	Environmental Studies	02	-	02	02	--
Community Engagement Services (CES)	CCXXX-151	Any one of NCC / NSS /Sports (SPT) / Culture Studies (CLS) / Health Wellness (HWS) / Yoga Education (YGE) / Fitness (FIT) (Basket 5)	-	02	02	--	04
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)			ESA			
			Test I	Test II	Avg of (T1+T2)/2	Total	CA	ESA	
Major	SBTTC-151	Biochemistry II	10	10	10	40	--	--	50
	SBTTC-152	Basics of Maths, Stats and Computer	10	10	10	40	--	--	50
	SBTTC-153	Lab course Biochemistry II and Basics of Maths, Stats and Computer	--	--	--	--	20	30	50
Minor	SBTTC-151	Cell Biology & Genetics (Basket 1)	10	10	10	40	--	--	50
Generic Elective	SBTTG-151	Applications of Biotechnology in Agriculture (Group A of Basket 2)	10	10	10	40	--	--	50
	SBTTG-152	Bio-safety and Bioethics (Group B of Basket 2)	10	10	10	40	--	--	50
Vocational & Skill Enhancement Course	SBTTV-151	Drug Designing	--	--	--	--	20	30	50
	SBTTS-151	Techniques in Forensic Biology	--	--	--	--	20	30	50
Ability Enhancement Course	AECXX-101	L2–Second Language Marathi (MR), Hindi (HN), Urdu (UR), Kannada (KN), Pali (PL) (Basket 3)	10	10	10	40	--	--	50
Value Education Course	VECES-151	Environmental Studies	10	10	10	40	--	--	50
Community Engagement Services (CC)	CCXXX-151	Any one of NCC / NSS /Sports (SPT) / Culture Studies (CLS) / Health Wellness (HWS) / Yoga Education (YGE) / Fitness (FIT) (Basket 5)	--	--	--	--	20	30	50

Course Structure: Teaching Scheme

Course Code	Course Name (Paper Title)	Teaching Scheme (Hrs/Week)		Credits Assigned		
		Theory	Practical	Theory	Practical	Total
SBTTC-101	Basics of Cell Biology	02	--	02	--	02
SBTTC-102	Biochemistry I	02	---	02	--	02

Assessment Scheme

Course Code	Course Name	Theory				Practical		Total
		CA			ESA			
		Test I	Test II	Avg (T1+T2)/2		CA	ESA	
SBTTC-101	Basics of Cell Biology	10	10	10	40	--	--	50
SBTTC-102	Biochemistry I	10	10	10	40	--	--	50

SBTTC-101: Basics of Cell Biology

Course pre-requisite:

- Basic knowledge about Biology

Course objectives:

- To provide knowledge of cell structure and its functions.
- To acquaint the students with the structures and purposes of basic components of prokaryotic and eukaryotic cells, especially macromolecules, membranes, and cell organelles
- To acquaint the students with how these cellular components are used to generate and utilize energy in cells
- To provide knowledge of 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.
- Use and apply those facts, concepts, and principles appropriately, even in situations that you have not previously encountered.
- Interpret and evaluate evidence for hypotheses about cell structure and function.
- Devise strategies to address unsolved issues in Cell Biology.

Curriculum Details:

Module No.	Unit No.	Topic	Hrs.
1.0		**Introduction to Cell**	07
	1.1	History of Cell Biology	
	1.2	Cell Theory	
	1.3	Protoplasm theory and Organismal Theory	
	1.4	Techniques in cell biology; Microscopy – light microscopy, methods of sample preparation for light microscopy, electron microscopy, methods of sample preparation for transmission electron microscopy; X-ray diffraction analysis	
2.0		**Cell Structure and Cell Organelles**	08
	2.1	Ultra-structure of Prokaryotic and Eukaryotic cell; Ultra structure of cell membrane, cytosol, endoplasmic reticulum, Golgi bodies, Ultra-structure of mitochondria, chloroplast and nucleus.	
	2.2	Lysosomes, peroxisomes and ribosomes, cytoskeletal system, (microfilament, Intermediate filament and microtubules)	
	2.3	Cilia and flagella; Models of membrane structure; Transport across cell membrane.	
	2.4	Molecular composition of Prokaryotic and Eukaryotic cell.	
3.0		**Cell Division & Control**	07
	3.1	Cell cycle – mitosis, meiosis Cell cycle and mitosis —general events of interphase, prophase, metaphase, anaphase, telophase, cytokinesis, physiology of cell cycle and mitosis, significance of mitosis; meiosis and reproductive cycle, kinds of meiosis, process of meiosis, heterotypic division or first meiotic division, homotypic or second meiotic division; significance of meiosis ; comparison of mitosis and meiosis.	
	3.2	Cell differentiation in multi cellular organisms: Totipotent, Pleuripotent, multipotent.	
	3.3	Cell-cell interactions, interactions of cells with their Environment	
	3.4	Mechanism of Action of the Cell-Division Inhibitor	
4.0		**Macromolecules and Cellular Communication**	08
	4.1	DNA, RNA and Proteins: basic units, architectural hierarchy and organisation, functions.	
	4.2	Cell –Cell Interaction, Cell Signalling :Signalling molecules and their receptors	
	4.3	Function of cell surface receptors, Pathways of intra-cellular receptors	
	4.4	Cyclic AMP pathway, Cyclic GMP and MAP kinase pathway	
		Total	30

Text Books:

- Lodish, Harvey "Molecular Cell Biology", 5th Edition, W.H.Freeman, 2005.
- Cooper, G.M. and R.E. Hansman "The Cell : A Molecular Approach", 4th Edition, ASM Press, 2007.
- Alberts, Bruce "Molecular Biology of the Cell", 4th Edition, Garland Science (Taylors Francis), 2002.
- Gilbert, S.F., 1997. Developmental Biology, 5th Edn, Sinauer, Associates, Massachusettes.
- Tamarin, R., 1991, Principles of Genetics, 3rd edition.
- Vasudeva Rao, 1994. Developmental Biology: A modern synthesis, Oxford & IBH, New Delhi .

- De Robertis, E.D.P. and Robertis, E.M.F. 1991. Cell and molecular biology. Lea and Febiger

Reference Books:

- P.S. Verma and V.K. Agrawal (2005); Cell Biology, Genetics, Molecular Biology Evolution and Ecology; S. Chand and Company Ltd.
- Lodish 2004 Molecular Cell Biology (Scientific American Book) Eduard Gasque
- Lehninger A.L., Nelson D.L. and Cox M.M. 2005 Principles of biochemistry (W. Freeman, USA).
- Stryer L, J. M. Berg, J.L. Tymoczko 2001. Biochemistry (W.H. Freeman and Company,
- New York)..
- Bucke C. 1999. Carbohydrate biotechnology protocols (Humana Press).
- H.R. Horton, A.J. Scism, L.A. Moran, R.S. Ochs, J.D Rawn, K.G. Scrimgeour. 2006.
- Gerald Karp 2009. Cell and molecular biology: Concepts and experiments (John Wiley & Sons International

SBTTC-102: Biochemistry I

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 the role 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 of glucose 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:

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

Reference Books:

- Biochemistry (6thEdition) by Jeremy M. Berg, John L. Tymoczko Lubert Stryer Publisher:B.I publications Pvt.Ltd (2007) ISBN:071676766X ISBN13: 978071676 7664,978716767664.
- 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.
- 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.

SBTTC-103 Lab Course in Basics of Cell Biology & Biochemistry I

PRACTICAL	Subject Code: SBTTC-103
Total Marks for Evaluation: 50	No. of Contact Hours: 4hr/Week, Credits: 2

Course Objectives: To familiarise the students with practicals of Basics of Cell Biology & Biochemistry I

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

- Describe the basic lab requirements and their uses.
- Examine various cell organelles through micrograph techniques.
- Analyse various nucleic acids through staining techniques.
- Examine polyploidy through onion root with various treatments.
- Examine various stages of meiosis cell division.
- Analyse the characteristics of the compound on the basis of their pH
- Analyse 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
Basics of Cell Biology	
1	Study 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
Biochemistry I	
6	Basic Lab requirements Volumetric flask, falcons, mortar and pestle, watch glass, wash bottle, beaker, measuring cylinder, dropper, burette, spatula, reagent bottle, test tube stand, pipette stand, tripod stand, Bunsen burner, wire gauze, crucible, funnel, centrifuge tubes
7	Separator funnel, centrifuge, pH meter, Electric balance, hot plate
8	Determination of pH of various solutions using a pH meter – NaOH, sulphuric acid, distilled water
9	Preparation of Normal solution- NaOH
10	Preparation of percentage solutions- Sulphuric acid (v/v)
11	Paper Chromatography- Isolation of the pigments from leaves of Radish
12	Qualitative analysis of Carbohydrate, protein & fats

Recommended Books:

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

publications, 2nd Ed. 2012.

SEMESTER –I (GENERIC ELECTIVE)

SBTTG-101 BIO-FUELS AND BIO-ENERGY

Theory	**Subject Code: SBTTG-101**
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.

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

Text book: Lecture notes

Reference Books:

- Christopher Higman: Gasification, Elsevier, 2008
- 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.
- A.V. Bridgwater: Advances in Thermochemical Biomass Conversion, Springer, 2008
- H.A.M Knoef: Handbook Biomass Gasification, BTG, 2005.
- Bhattacharya S.C. and Salam P.A.: A Review of Selected Biomass Energy Technologies, RERIC, 2006
- Donald L. Klass: Biomass for Renewable Energy, Fuels, and Chemicals, Academic Press, 1998
- C. Y. WereKo - Brobby and E. B. Hagan: Biomass Conversion and Technology, John Wiley and Sons, 1996.
- Souza-Santos M.L,: Solid Fuel Combustion and Gasification, Marcel Dekker Inc. 2004.
- Prabir Basu: Combustion and Gasification in Fluidized Beds, CRC, 2006 10. Prabir Basu: Biomass Gasification and Pyrolysis: practical design and theory, 2010

SEMESTER –I (GENERIC ELECTIVE)

SBTTG-102 BIO-ENTREPRENEURSHIP

Theory	**Subject Code: SBTTG-102**
Total Marks for Evaluation: 50	**No. of Contact Hours: 2hr/week, Credit: 2**

Pre-requisite:

- The course can be selected without former knowledge in Bio-Business, Innovation and entrepreneurship

Objectives of course:

- To familiarize students with the central skills in science-based entrepreneurship in the biotech industry.

Outcomes of course:

- The course will provide students with the necessary knowledge on how to bridge science and business and translate biotech concepts into commercial terms.
- It also enable students to understand the differences in issues and challenges in science-based industries related to entrepreneurship and innovation.
- Finally, students will develop the skills to successfully work in interdisciplinary teams and jointly produce business plans that are ready for submission to a business plan competition or presented to potential venture capitalists**.**

Curriculum Details:

Module No.	Unit No.	Topic	Hrs.
1.0		**Basic Entrepreneurship**	08
	1.1	Introduction: Entrepreneur, Creativity & Entrepreneurial personality and Entrepreneurship in Biotechnology	
	1.2	Pillars of bio-entrepreneurship and major start-ups in biotechnology, concept and theories of entrepreneurship, entrepreneurial traits and motivation.	
	1.3	Nature and importance of Entrepreneurs.	
	1.4	Government schemes for commercialization of technology.	
2.0		**Project Management**	07
	2.1	Project management: search for a business idea, concept of project and classification	
	2.2	Project identification, project formulation	
	2.3	Project design and network analysis	
	2.4	Entrepreneurial Planning	
3.0		**Financial Management**	
	3.1	Financial analysis	08
	3.2	Ratio analysis, Investment process, Break even analysis	
	3.3	Profitability analysis, Budget and planning process.	
	3.4	Government initiatives and support for Start-ups in various field	
4.0		**Biotech Enterprises**	07
	4.1	Biotech enterprises: Desirables in start-up, Setting up Small, Medium & Large scale industry	08
	4.2	Quality control in Biotech industries	
	4.3	Location of an enterprise, steps for starting a small industry.	
	4.4	Incentives and subsidies, exploring export possibilities	

		Total	
			30

Textbook: Lecture notes

Reference Books:

1. The Business of Biotechnology: From the Bench of the Street: By Richard Dana Ono Published Butterworth- Heinemann, 1991.

2. Entrepreneurship in Biotechnology: Managing for growth from start-up By Martin Gross Mann, 2003

3. Innovation and entrepreneurship in biotechnology: Concepts, theories & cases by D. Hyne & John Kapeleris, 2006

4. Dynamics of Entrepreneurial Development and Management by Vasant Desai, Himalaya Publishing House, 2005.

5. Projects Planning Analysis, Selection, Implementation & Review by Prasannan. 6. Best Practices in Biotechnology Education: By Yali Friedman, Published by Logos Press, 2008.

VOCATIONAL COURSE
SBTTV-101: Diagnostic Biology

PRACTICAL	**Subject Code: SBTTV-101**
Total Marks for Evaluation: 50	No. of Contact Hours: 4hr/Week, Credits: 2

Pre-requisite:

Basic Knowledge of Microbiology and Bioinstrumentation

Course Objectives

- To acquaint the students with the practical applications of molecular diagnostics in the clinical laboratory. Students will learn to perform technical molecular biology assays on proteins, DNA, RNA that can be used in the diagnosis of human diseases.

Outcomes of course

On the completion of the course, the student should be able to:

- Understand the difference between Quality Control and Quality Assurance in the molecular laboratory
- Understand the importance of good pipetting techniques
- Understand and perform simple and serial dilutions
- Describe methods for quantification of nucleic acids
- Report results for molecular testing
- Follow a protocol to perform testing
- Understand the use and purpose for isolating DNA, RNA and proteins 8. Explain the principle of electrophoresis as it applies to nucleic acids and proteins

Curriculum Details:

Module No.	**Unit No.**	**Topic**	**Hrs.**
1.0		**BASIC TECHNIQUES IN DIAGNOSTIC BIOLOGY**	08
	1.1	Introduction to Molecular Diagnostics Laboratory, Laboratory requirements, instruments and its calibration	
	1.2	Plating of pathogenic and non-pathogenic bacterial cultures	
	1.3	Pipetting Techniques, pipetting microplates and weight boats	
	1.4	Calculations/Dilutions/ Conversion/Solutions/Normality/Molarity	
2.0		**MOLECULAR TECHNIQUES DIAGNOSTIC BIOLOGY**	08
	2.1	PCR, Gel electrophoresis, in identification of specimen	
	2.2	Standardization of DNA-RNA extraction methods	
	2.3	Bacterial DNA isolation and quantification; Case studies in genetic engineering	
	2.4	Restriction Digestion Hae III and Analysis	
3.0		**GENETIC ENGINEERING AND HYBRIDIZATION TECHNIQUES**	07
	3.1	Restriction Digestion and Analysis of Lambda DNA	
	3.2	Western Blot and ELISA	
	3.3	Southern blot	
	3.4	Northern blot	
4.0		**ADVANCES IN DIAGNOSTIC BIOLOGY**	07
	4.1	Introduction to CRISPR Genome Editing Technology	

	4.2	Molecular Diagnostics in the Post-genomic Era	
	4.3	Role of Sequencing in Microbial Disease	
	4.4	Information to COVID 19 and Severe Acute Respiratory Syndrome (SARS)	
		Total	
			30

List of Experiments

Sr. No.	**List of Experiments**
1.	Introduction to Molecular Diagnostics Laboratory
2.	Safe Laboratory Practice, Laboratory requirements, instruments and its calibration
3.	Plating of pathogenic and non-pathogenic bacterial cultures Plating of *E. coli* bacteria – overnight;
4.	Pipetting Techniques, pipetting microplates and weight boats, Calculations/Dilutions/ Conversion/Solutions/Normality/Molarity
5.	Nucleic Acid extraction methods – Introduction to DNA Analysis, WBC/ DNA Extraction from whole blood, quantitation of genomic DNA electrophoresis and using the spectrophotometer.
6.	DNA isolation from E. coli bacteria – DNA quantitation
7.	Case Study – Enteric pathogens, Skills: Polymerase chain reaction set up and run
8.	Restriction Digestion Hae III and Analysis
9.	Restriction Digestion and Analysis of Lambda DNA
10.	Western Blot and ELISA; Information to COVID-19

Required Course Textbook:

- Molecular Diagnostics: Fundamentals, Methods and Clinical Applications. 2019. Buckingham, A. Davis, Philadelphia, PA.

Reference Books

- Molecular cell Biology, by Darnell, Lodish, Baltimore, Scientific American Books, Inc., 1994
- Karp's Cell and Molecular Biology: Concepts and Experiments, 8th Edition. Gerald Karp, Janet Iwasa Wallace Marshall.2015
- Cell biology D E SadavaCBS Publishers & Distributors, 2009
- Gene Cloning, an introduction – T. A. Brown, Chapman and Hall, 3rd Edition, 1995.
- Gardner et al (1991). Principles of Genetics. John Wiley.
- Hartl. D.L. A primer of population genetics. III edition, Sinauer associates inc. Sunderland, 2000
- Human genetics, A. Gardner, R. T. Howell and T. Davies, Published by VinodVasishtha for Viva Books private limited, 2008.
- The science of Genetics by Alan G. Atherly, Jack. R, Girton, Jhon. F, Mc Donald. Sounders college publishers.
- Primrose. S.B., Twyman R.M. (2014) Principles of Gene Manipulation and Genomics,7th Edition, Blackwell Science Limited.
- Primrose .S.B (1994) Molecular Biotechnology., Blackwell Scientific Publishers, Oxford.
- Alberts. B., Johnson. A.D., Lewis. J., Morgan. D (2014) Molecular Biology of the Cell.
- Brown, T. A. (2006). Genomes (3rd ed.). New York: Garland Science Pub.

SKILL ENHANCEMENT COURSE

SBTTS-101: Microbial Cultures & its Maintenance

PRACTICAL	**Subject Code: SBTTS-101**
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			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			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			07
	3.1	Maintain bacterial cultures in viable condition using agar slants	
	3.2	Maintain bacterial cultures in viable condition using agar deeps	
	3.3	Effect of Temperature on Growth of Bacteria	
	3.4	Determination of Lethal temperature of different bacterial cultures	
4.0			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

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

SBTTC-151: Biochemistry II

Theory: Biochemistry II	Subject Code: SBTTC-151 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 acid).

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 Lipid**	08
	1.1	Bioenergetics: Concept of free energy, Entropy, Enthalpy & Redox Potential. Determination of ΔG^{0}' for a reaction, High energy phosphate compounds (Ex. ATP, Phosphoenol pyruvate, Creatine phosphate etc) – phosphate potential, Free energy of hydrolysis of ATP along with reasons for high ΔG^{0}	
	1.2	Lipid metabolism: Hydrolysis of triacylglycerols, transport of fatty acids into mitochondria -oxidation in mitochondria andβ(Carnitine), Detailed account of - oxidation of fatty acids (peroxisomes),	
	1.3	Oxidation of unsaturated fatty acids & odd carbon fatty acids. ATP yield from fatty acid oxidation	
	1.4	Regulation, Detailed account of HMP Shunt & its significance in general, its connection to lipid metabolism	
2.0		**Lipid Metabolism**	07
	2.1	Metabolism: Ketogenesis, Ketosis & ketoacidosis in physiology & pathology, Biosynthesis of fatty acids	
	2.2	Regulation, Microsomal & Mitochondrial system of chain elongation & synthesis of unsaturated fatty acids,- acetyl neuraminic acid,	
	2.3	Biosynthesis of triglycerides & phospholipids (Phosphatidyl-ethanolamine, choline, inositol), sphingolipids.	
3.0		**Biochemistry of Carbohydrate**	08
	3.1	Concepts and Classification of Amino acids, Primary structures of proteins: Amino acids, the building blocks of proteins	
	3.2	Detailed account of glycolysis with energy considerations & regulation, Entry of fructose, mannose & galactose in glycolysis, Cori cycle, Futile or substrate cycles in carbohydrate metabolism	
	3.3	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.	
4.0		**Carbohydrate and Amino Acid Metabolism**	07

	4.1	Glyoxylate cycle and its role in conversion of fats into carbohydrates, Gluconeogenesis– Detailed account of bypass reactions, Regulation, Malate & glycerophosphate shuttle system.	
	4.2	Electron Transport chain-Structure of mitochondria, oxidative and substrate level phosphorylation.	
	4.3	Amino Acids metabolism: Digestion, absorption and uptake of Amino Acids including γ-glutamyl cycle; Transamination, oxidative and nonoxidative deamination, glucose-alanine cycle, urea cycle and inherited defects of urea cycle, Glucogenic and ketogenic amino acids, catabolic pathways for the standard amino acids.	
		Total	
			30

Text Books:

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

Reference Books:

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

Basics of Maths, Stats and Computer

Theory: Basics of Maths, Stats and Computer	**Subject Code: SBTTC-152 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

- By using algorithms, numerical methods and symbolic computation, students will be able to conduct research in mathematics and other science fields where computation is a fundamental component. Research in computational mathematics and statistics has applications in various fields, including data analysis, signal processing, fluid mechanics and biological networks. Topics studied by students of computational mathematics include:
- Numerical analysis
- Mathematics for machine learning and data science
- Numerical and non-linear algebra
- Machine arithmetic

Curriculum Details:

Module No.	**Unit No.**	**Topic**	**Hrs.**
1.0		**Calculus, Algebra, Real Analysis & Differential Equations**	08
	1.1	Derivatives for Graphing and Applications Sketching and Tracing of Curves	
	1.2	Theory of Equations and Complex Numbers Equivalence Relations and Functions	
	1.3	Real Number System R Properties of R	
	1.4	Population Growth Models Differential Equations and Mathematical Modeling	
2.0		**Descriptive Statistics I**	08
	2.1	Statistical Methods: Definition and scope of Statistics, concepts of statistical population and sample.	
	2.2	Presentation: tabular and graphical, including histogram and ogives, consistency and independence of data with special reference to attributes.	
	2.3	Data: quantitative and qualitative, attributes, variables, scales of measurement nominal, ordinal, interval and ratio.	
	2.4	Presentation: tabular and graphical, including histogram and O-gives, consistency and independence of data with special reference to attributes.	
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 of variation, Moments, absolute moments, factorial moments,	
	3.3	Skewness and kurtosis, Sheppard's corrections.	
	3.4	Handling of bulky data- construction a histogram- interpretation of	

		histogram- the normal distribution- the mean-mode-and standard deviation-uncertainties in estimating a mean.	
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:

- Glover. T. and Mitchell, K. (2015) Introduction to Biostatistics. McGraw –Hill Science.

References Books:

- Zar. J.H. (2010) Biostatistical Analysis, Pearson Education, New Jersey.
- Matthews, J.R. and Matthews, R.W. (2007) Successful Scientific writing: A step-by- step Guide for Biomedical Scientists, Cambridge University Press, Cambridge.
- Snedecor, G. W. and Cochran, W. G. (1989).Statistical methods. Iowa State Press, Iowa. 4. Green, R. H. (1979) Sampling Design and Statistical Methods for Environmental Biologists, John Wiley & Sons, New Jersey.
- E. Balagurusamy (2011): Programming in ANSI C, 6th Edition, Tata McGraw Hill.
- Kernighan, B.W. and Ritchie, D. (1988): C Programming Language,2ndEdition, Prentice Hall.
- B.S. Gottfried .(1998): Schaum's Outlines: Programming with C, 2nd Edition, Tata McGraw Hill
- Pranab Kumar Banerjee, 2004. Introduction to Biostatistics. S. Chand and company Limited.
- Roland Ennos, 2006. Statistical and Data Handling Skills in Biology, 2nd Edition. Pearson Education.

Lab Course in Biochemistry II and Basics of Maths, Stats and Computer

PRACTICAL	Subject Code: SBTTC-153
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 II
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.

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 Book

- Standard Methods of Biochemical Analysis, S. K. Thimmaiah (ed), Kalyani Publishers, Ludhiana ISBN 81-7663-067-5, p 12 – 18
- Practical Biochemistry Principles and Techniques by Keith Wilson and John Walker 5th edition (2005), Cambridge University Press, p: 580-681
- Biophysical Chemistry Principles and Techniques by Upadhyay Nath Upadhyay, Himalaya publishing house (2002), p: 175-270, 344-421, 422-478.
- Snedecor, G. W. and Cochran, W. G. (1989).Statistical methods. Iowa State Press, Iowa. 4. Green, R. H. (1979) Sampling Design and Statistical Methods for Environmental Biologists, John Wiley & Sons, New Jersey.
- E. Balagurusamy (2011): Programming in ANSI C, 6th Edition, Tata McGraw Hill.
- Kernighan, B.W. and Ritchie, D. (1988): C Programming Language,2ndEdition, Prentice Hall.
- B.S. Gottfried .(1998): Schaum's Outlines: Programming with C, 2nd Edition, Tata McGraw Hill

Cell Biology & Genetics (Minor)

Theory Cell Biology & Genetics	Subject Code: SBTTC-151 Credit: 2
Total Marks for Evaluation: 50	No. of Contact Hours: 2hr/week

Course pre-requisite

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

Course objectives

- To introduce the students to the Cell Biology & Genetics and its practical value for human welfare. The module also gives insight to chromosome abnormalities.

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

- Describe the different model organisms of genetics and basic principles of heredity.
- Give examples of the law of probability, binomial expansion, formulating and testing genetic hypothesis.
- Discuss about the gene interaction, function, relationship and types of different alleles.
- Differentiate between Complementation test and limitations of cis-trans test
- Derive the mechanism of genetic exchange and gene mapping in bacteria.

Curriculum Details:

Module No.	Unit No.	Topic	Hrs.
1.0		**STRUCTURE OF CELL**	08
	1.1	Structure of Cell: Plasma membrane: Structure and transport of small molecules , Cell Wall: Eukaryotic cell wall, Fluid mosaic model in detail	
	1.2	Extra cellular matrix and cell matrix interactions Cell-Cell Interactions - adhesion junctions, tight junctions, gap junctions, and plasmodesmata (only structural aspects),	
	1.3	Chloroplasts and peroxisomes , Cytoskeleton: Structure and organization of actin filaments,	
	1.4	Ribosomes, Association of actin filaments with plasma membrane, Cell surface protrusions, Intermediate filaments, microtubule	
2.0		**CELL ORGANISATION**	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		**MENDELIAN GENETICS**	08
	3.1	Introduction to model organisms and Mendelism. Extensions of Mendelism: Allelic variation and gene function - dominance relationships, multiple alleles, lethal alleles and null alleles	
	3.2	History of Genetics; Mendel‟s principles and rediscovery; Cell division; Chromosomes structure and function; Chromosome theory of inheritance; Sex-linked, sex-limited and sex-influenced inheritance; Sex determination and sex	

		differentiation	
	3.3	Multiple allelism; Linkage and crossing-over; Gene-gene interaction; Genetic analysis in prokaryotes and eukaryotes.	
	3.4	Extra chromosomal inheritance; Mutations; Hardy-Weinberg law; Quantitative inheritance; Introduction to Human genetics; Genetic basis of evolution.	
4.0		**BACTERIAL GENETICS**	06
	4.1	Bacterial Chromosomes in the Nucleoid, its structure	
	4.2	Recombination in bacteria	
	4.3	Genetics of bacteria, Mechanism of genetic exchange - conjugation, transformation, Generalized and Specialized transduction.	
	4.4	Extra-chromosomal and moveable elements: Plasmids: gene cloning and Mutation: General introduction	
		Total	
			30

Reference Books

- M. Cooper and Robert. E. Hausman, (2009). The Cell: A Molecular Approach: Geoffrey. Sinauer Associates, 5th Ed.
- W. H. Freeman Lodish (2006) Molecular Cell Biology: 5th Ed.
- Jones, S. 1993. The Language of the Genes. Harper Collins ISBN 0006552439. Muller, H. J. (1927). "Artificial Transmutation of the Gene". Science 66 (1699)
- Miller. J. (1992); A laboratory manual and handbook for Escherichia coli and related bacteria. CSHL Press, NY.
- Strachan, T. and Read, A. (2018) Human Molecular Genetics. Garland Science, CRC Press, Florida. 15
- Griffiths, A.J.F., Wessler, R.S., Carroll, S.B., Doebley, J. (2015) Introduction to Genetic Analysis. W.H. Freeman and Company, New York.

Applications of Biotechnology in Agriculture (Generic Elective)

Theory Applications of Biotechnology in Agriculture	Subject Code: SBTTG-151 Credit: 2
Total Marks for Evaluation: 50	No. of Contact Hours: 2hr/week

Course pre-requisite

- The candidate should have been basic knowledge of 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	In 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:

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

Reference Books:

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

Biosafety and Bioethics (Generic Elective)

Theory Biosafety and Bioethics	Subject Code: SBTTG-152 Credit: 2
Total Marks for Evaluation: 50	No. of Contact Hours: 2hr/week

Course pre-requisite

- The study of the course " Biosafety and Bioethics " is subject to knowledge of natural and socio-humanitarian disciplines of the first year, both compulsory and elective: "Basic of Cell Biology", "Genetics", etc

Course objectives

- To form in students a holistic view of the Biosafety and Bioethics of human life and the biosphere in general, To lay the foundations of a healthy lifestyle and prevention of dangerous situations in the professional activities of future Biotechnologist.

Course outcomes: As a result of studying this course, students shall know:

- Basic principles of safety in ensuring human life;
- Requirements of legislative and normative acts on life safety, labor protection of biotechnology workers;
- Requirements for occupational safety of biotechnological personnel in modern conditions.
- Historical stages of development of medical ethics and bioethics
- Basic principles of biomedical ethics;
- International declarations on biosafety, medical ethics, bioethics.
- Basics of state biosafety;
- Bioethical problems of public health in various fields of medicine and Biotechnology

Curriculum Details:

Module No.	Unit No.	Topic	Hrs.
1.0		**BIOETHICS & LEGAL ISSUES**	08
	1.1	Principles of bioethics: Legality, morality and ethics, autonomy, human rights, beneficence, privacy, justice, equity etc. ethical dimensions of IPR, technology transfer and other global biotech issues.	
	1.2	The legal, institutional and socioeconomic impacts of biotechnology; biotechnology and social responsibility	
	1.3	Species Biodiversity; status of survey, endemic species, cultivated plants/Agro biodiversity.	
	1.4	Population biodiversity; Development pressure.	
2.0		**ROLE IN BIODIVERSITY**	07
	2.1	Maintenance of ecological biodiversity hot spots in India; Legal instruments relevant to biological diversity in India, Endangered species Act,	
	2.2	Convention on Biological diversity; FAO and NBA. Federal role in wild life preservation	
	2.3	Cartagena protocol of Bio-safety.	
	2.4	Definition, objectives, LMOs, Precautionary approach, main features, applications	
3.0		**BIOSAFETY**	08
	3.1	Risk management of GMOs	
	3.2	Biosafety guidelines in India; EPA-1986	
	3.3	DBT, MOEF, IBC, RCGM, GEAC, Rules and Regulations of Biosafety	
	3.4	The expanding scope of ethics from biomedical practice to biotechnology, bioethics vs. business ethics, ethical dimensions of IPR, technology transfer and other global	

		biotech issues.	
4.0		**REGULATORY BODIES**	07
	4.1	Regulatory framework for GMOs in India	
	4.2	GEAC, SBCC, DLC, RDAC, IBSC, RCGM	
	4.3	Introduction to Intellectual property; Definition, History of IPs in India, Nature and Scope	
	4.4	Biosafety regulations and national and international guidelines with regard to recombinant DNA technology. Guidelines for research in transgenic plants	
		Total	
			30

Text Books:

- Singh BD. 2007. Biotechnology: Expanding Horizon. Kalyani Publishers
- Kumar U. and Asija M. 2009. Biodiversity: Principles and Conservation. Agrobios (India).
- Mu Ramkumar 2008. Intellectual Property Rights Demynstified. New India Publishing Agency.
- **Websites**
- http;//patentoffice.nic.in
- www.wipo.org
- www.dbtindia.nic.in
- www.dbtbiosafety.nic.in

Drug Designing (Vocational Course)

PRACTICAL	Subject Code: SBTTV-151
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 provide students with an understanding of the process of drug discovery and development from the identification of novel drug targets to the introduction of new drugs into clinical practice

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

- Explain biochemical parameter of biological sample.
- Explain fermentation process by microorganisms.
- Explain enzyme assay of salivary enzyme.
- Apply the various techniques for isolation of lipids.
- Practice the biochemical parameters in biological system.

Curriculum Details:

Module No.	Unit No.	Topic	Hrs.
1.0		**UNIT 1**	08
	1.1	Introduction to the Drug Discovery/Development	
	1.2	Source of drugs	
	1.3	Drug properties	
	1.4	Stages of drug discovery and development	
2.0		**UNIT 2**	07
	2.1	Structure based & Ligand based drug design	
	2.2	Rational approaches to lead discovery based on traditional medicine	
	2.3	Enzymes as Targets of drug design	
	2.4	Enzyme kinetics; enzyme inhibition and activation	
3.0		**UNIT 3**	08
	3.1	Analog based drug design	
	3.2	Bioisosterism and its classification	
	3.3	Bioisosteric replacement	
	3.4	case studies	
4.0		**UNIT 4**	07
	4.1	Computer-Aided Drug Design	
	4.2	Docking and virtual screening	
	4.3	Molecular Dynamics and binding free energy methods	
	4.4	Drug and databases	
		Total	
			30

List of Experiments

Sr No.	**List of Experiments**
1	Drug Discovery basic
2	Target and lead identification of drug
3	Structure based & Ligand based Drug Design
4	Drug Solubility
5	Rational approaches to lead discovery based on traditional medicine
6	Random and non-random screening
7	Serendipitous drug discovery
8	lead discovery based on drug metabolism
9	Rigid docking, flexible docking, manual docking, Docking based screening. De novo drug design.

Text Books:

- R.Leach - Molecular Modeling Principles and Application, 2nd edition, Longman Publications, 1996.
- D. Baxivanis and Foulette - Bioinformatics: A Practical Guide to the Analysis of Genes and Proteins, Wiely Indian Edition, 2001.

Reference Book

- T K Attwood, D J parry-Smith, Introduction to Bioinformatics, Pearson Education, 1st Edition, 11th Reprint 2005

Techniques in Forensic Biology (Skill Enhancement Course)

PRACTICAL	Subject Code: SBTTS-151
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 be able to use and apply 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**	**Contact Hours**
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

- J A Siegel, P.J Saukko (2000) Encyclopaedia of Forensic Sciences Vol. I, II and III, Acad. Press
- Saferstein (1976) Forensic Science Handbook, Vol I, II & III, Prentice Hall Inc. USA.
- Saferstein (2000) Criminalistics, Prentice Hall Inc. USA.
- 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
- Faegri, K. Iverson, J. and Krzywinski, K. Textbook of Pollen Analysis 4th Edition. JohnWiley& Sons, New York 1989.
- Keith In man and Norah Rudin (1997) An Introduction to Forensic DNA Analysis, CRC Press; Ny
- John M. Butler (2005) Forensic DNA Typing: Biology, Technology, and Genetics of STR Markers Academic press.

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