॥ सा विद्या या विमुक्तये ॥

स्वामी रामानंद तीर्थ मराठवाडा विद्यापीठ, नांदेड

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

SWAMI RAMANAND TEERTH MARATHWADA UNIVERSITY, NANDED

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

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

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

प रि प त्र क

या परिपत्रकान्वये सर्व संबंधितांना कळविण्यात येते की, या विद्यापीठा अंतर्गत येणा–या सर्व संलग्नित महाविद्यालयामध्ये शैक्षणिक वर्ष २०२४–२५ पासून पदवीस्तरावर राष्ट्रीय शैक्षणिक धोरण –२०२० लागू करण्याच्या दृष्टीकोनातून विज्ञान व तंत्रज्ञान विद्याशाखे अंतर्गत येणा–या अभ्यासमंडळांनी तयार केलेल्या पदवी प्रथम वर्षाचे अभ्यासक्रमांना मा. विद्यापरिषदेने दिनांक १५ मे २०२४ रोजी संपन्न झालेल्या बैठकीतील विषय क्रमांक १५/५९–२०२४ च्या ठरावाअन्वये मान्यता प्रदान केली आहे. त्यानुसार विज्ञान व तंत्रज्ञान विद्याशाखेतील खालील बी. एस्सी प्रथम वर्षाचे अभ्यासक्रम (Syllabus) लागू करण्यात येत आहेत.

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

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

'ज्ञानतीर्थ' परिसर,
विष्णुपुरी, नांदेड – ४३१ ६०६.
जा.क्र.:शै–१/एनइपी/विवत्रंविपदवी/२०२४–२५/123
दिनांक २०.०६.२०२४

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

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

SWAMI RAMANAND TEERTH MARATHWADA UNIVERSITY, NANDED

STRUCTURE AND SYLLABUS OF FOUR YEAR MULTIDISCIPLINARY DEGREE PROGRAM WITH MULTIPLE ENTRY AND EXIT OPTION

UNDER

NATIONAL EDUCATION POLICY (NEP 2020)

In

SUBJECT: Biotechnology (Vocational)

FACULTY OF SCIENCE AND TECHNOLOGY

B. Sc. First Year
(Affiliated Colleges)

With Effect From June 2024

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

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

SRTM University has been producing a good number of high 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 with 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 and Bioinformatics prepared the curriculum to ensure up-to-date level of understanding of Vocational Biotechnology. Studying Vocational 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 and UPSC and the UGC model curriculum is 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 (Vocational) 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 field of Vocational Biotechnology.

The Core Courses deal with Fundamental Cell Biology, Introductory Biochemistry, Basics of Genetics and General Microbiology, Bioinstrumentation, Immunology and Virology, Basic Maths, Stats and Computer, 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 Microbial Cultures and their Maintenance, Techniques in Forensic Biology, Molecular Diagnostics, Drug Designing, Biopesticide 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 employability and the development of their own enterprises.

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

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

Program Educational Objectives:

The Objectives of this program are:

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

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

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

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

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 employability and for the development of their own enterprises.

Program Outcomes:

The Outcomes of this program are:

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

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

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

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

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

PO6: This will also develop specific skills amongst students for 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 Sunita D Lohare

Chairman, BOS in Biotechnology and Bioinformatics,

Swami Ramanand Teerth Marathwada University,

Nanded 431606.

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

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

Swami Ramanand Teerth Marathwada University, Nanded

Faculty of Science and Technology (Three Optional in the First Year)

Credit Framework for Four Year Multidisciplinary Degree Program with Multiple Entry and Exit

Subject: DSC (Major) /DSM (Minor 1 and Minor 2)

(For illustration PHY, CHE and ELE combinations are considered, which may change for different combinations)

Year & Level	Semester	Optional 1 (Major) *(From the same Faculty)*	Optional 2 (Minor 1) *(From the same Faculty)*	Optional 3 (Minor 2) *(From the same Faculty)*	Generic Elective (GE) (select from Basket 3 of *Faculties other than Science and Technology*)	Vocational & Skill Enhancement Course	Ability Enhancement Course (AEC) (Basket 4) Value Education Courses (VEC) / Indian Knowledge System (IKS) (Basket 5) *(Common across all faculties)*	Field Work / Project/Internship/ OJT/ Apprenticeship / Case Study Or Co-curricular Courses (CCC) (Basket 6 for CCC) *(Common across all faculties)*	Credits	Total Credits
1	2	3	4	5	6	7	8	9	10	11
1 (4.5)	I	SPHYCT1101(T 2Cr) SPHYCP1101(P 2Cr) 4 Credits	SCHECT1101 (T 2Cr) SCHECP1101 (P 2Cr) 4 Credits	SELECT1101 (T 2Cr) SELECP1101 (P 2Cr) 4 Credits	SPHYGE1101 (2cr)	SPHYSC1101 2 Credits	AECENG1101 (2Cr) ACEMIL1101 (MAR/HIN/URD /KAN/PAL)(2Cr) IKSXXX1101 (2Cr) 6 Credits	--	22	44
	II	SPHYCT1151(T 2Cr) SPHYCP1151(P 2Cr) 4 Credits	SCHECT1151 (T 2Cr) SCHECP1151 (P 2Cr) 4 Credits	SELECT1151 (T 2Cr) SELECP1151 (P 2Cr) 4 Credits	SPHYGE1151 (2cr)	SPHYSC1151 2 Credits	AECENG1101 (2Cr) ACEMIL1151 (MAR/HIN/URD /KAN/PAL)(2Cr) VECCOI1151 (2Cr) *Constitution of India* 6 Credits	--	22	
	Cum. Cr.	08	08	08	04	04	12	00	44	
Exit option: UG Certificate in Opt 1, Opt 2 and Opt 3 on completion of 44 credits and additional 4 credits from NSQF / Internship										

2 (5.0)	III	SPHYCT1201 (2cr) SPHYCT1202 (2cr) SPHYCP1203 (2cr) SPHYCP1204 (2cr) 8 Credits	SCHEMT1201 SCHEMP1201 (1T+1P) 2 Credits	--	SPHYGE1202 (2cr) 2 Credits	SPHYSC1201 2 Credits	ACEENG1201 (2cr) ACEMIL1201 (2Cr) (MAR/HIN/URD /KAN/PAL) 4 Credits	CCCXXX1201 (2Cr) *(NCC/NSS/SPT(sports)/ CLS(Cultural Studies)/HWS(Health Wellness)/ YGE(Yoga Education) / FIT(Fitness)* SPHYFP1201 (2Cr) 4Credits	22	
	IV	SPHYCT1251 (2cr) SPHYCT1252 (2cr) SPHYCP1253 (2cr) SPHYCP1254 (2cr) 8 Credits	SCHEMT1251 SCHEMP1251 (1T+1P) 2 Credits	--	SPHYGE1251 (2cr) 2 Credits	SPHYVC1251 2 Credits	ACEENG1201 (2cr) ACEMIL1201 (2Cr) (MAR/HIN/URD /KAN/PAL) VECEVS1251 (2Cr) 6 Credits	CCCXXX1251 (2Cr) *(NCC/NSS/SPT(sports)/ CLS(Cultural Studies)/HWS(Health Wellness)/ YGE(Yoga Education) / FIT(Fitness)* 2 Credits	22	
	Cum. Cr.	24	12	08	08	08	22	06	88	88
Exit option: UG Diploma in Major DSC and Minor DSM on completion of 88 credits and additional 4 credits NSQF / internship in DSC										
3 (5.5)	V	SPHYCT1301 (T 3Cr) SPHYCT1302 (T 3Cr) SPHYIK1303 (T 2Cr) SPHYCP1304 (P 2Cr) SPHYCP1305 (P 2Cr) 12 Credits	SPHYET1301 (T 3Cr) SPHYEP1301 (P 1Cr) 4 Cr	--		--	SPHYVC1301 4 Credits	--	SPHYFP1301 (2 Cr) 2 Credits	22	
	VI	SPHYCT1351 (T 3Cr) SPHYCT1352 (T 3Cr) SPHYCT1353 (T 2Cr) SPHYCP1354 (P 2Cr) SPHYCP1355 (P 2Cr) 12 Credits	SPHYET1351 (T 3Cr) SPHYEP1351 (P 1Cr) 4 Cr	--		--	SPHYVC1351 2 Credits	--	SPHYOJ1351 4 Credits	22	
	Cum. Cr.	56	12	08	08	6 + 8 =14	22	*04+08*		132
Exit option: B. Sc. (Bachelor in Science) with Major in DSC and Minor in DSM										

4 (6.0)	VII	SPHYCT1401 (T 4Cr) SPHYCT1402 (T 4Cr) SPHYCT1403 (T 2Cr) SPHYCP1404 (P 4Cr) **14 Credits**	SPHYET1401 (T 3Cr) SPHYEP1401 (P 1Cr) 4 Cr	*Research Methodology* SPHYRM1401 **4 Credits**		--	--	--	--	22	
	VIII	SPHYCT1451 (T 4Cr) SPHYCT1452 (T 4Cr) SPHYCT1453 (T 2Cr) SPHYCP1454 (P 4Cr) **14 Credits**	SPHYET1401 (T 3Cr) SPHYEP1401 (P 1Cr) 4 Cr	--		--	--	--	SPHYOJ1451 **4 Credits**	22	
	Cum Cr	**Honours : 92**		**12+4**	**08**	**08**	**V-08 + S-06**	**AEC-8+MIL-8 +VEC-4 +IKS-2**	**16**		**176**
***Exit option*: B. Sc. (Hons) with Major in DSC and Minor inDSM**											
4 (6.0)	VII	SPHYCH1401 (T 3Cr) SPHYCH1402 (T 3Cr) SPHYCH1403 (T 4Cr) **(H- Honours)** **10 Credits**	SPHYET1401 (T 3Cr) SPHYEP1401 (P 1Cr) 4 Cr	*Research Methodology* SPHYRM1401 **4 Credits**		--	--	--	Research Project SPHYRP1401 **4 Credits**	22	44
	VIII	SPHYCH1451 (T 3Cr) SPHYCH1452 (T 3Cr) SPHYCH1453 (T 4Cr) **(H- Honours)** **10 Credits**	SPHYET1451 (T 3Cr) SPHYEP1451 (P 1Cr) 4 Cr	--		--	--	--	Research Project SPHYRP1451 **8 Credits**	22	
***Exit option*: B. Sc. (Hons with Research) in DSC and Minor in DSM**											
Total Credits		**Major – 92 / 84**		**Minor 1 -12+ RM - 04**	**Minor-2 08**	**GE/OE - 08**	**(V-08 + S-06) 14**	**(AEC-8 + MIL-8+VEC-4 + IKS-2)22**	**(CC-04+FP/CS-04+OJT-04+RP-12) 30**	**176**	

Abbreviations:

1. **DSC:** Department/Discipline Specific Core (Major)
2. **DSE:** Department/Discipline Specific Elective (Major)
3. **DSM:** Discipline Specific Minor
4. **GE/OE:** Generic/Open Elective (Internship/Apprenticeship)
5. **VSEC:** Vocational Skill and Skill Enhancement Course
6. **VSC:** Vocational Skill Courses
7. **SEC:** Skill Enhancement Courses
8. **AEC:** Ability Enhancement courses
9. **RP:** Research Project/Dissertation
10. **MIL:** Modern Indian languages
11. **IKS:** Indian Knowledge System
12. **VEC:** Value Education Courses
13. **OJT:** On Job Training:
14. **FP:** Field Projects
15. **CEP:** Community Engagement and Service
16. **CC:** Co-Curricular Courses
17. **RM:** Research Methodology

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)
Optional 1 Major	SBTVCT-1101	Fundamental Cell Biology	02	--	02	02	--
	SBTVCP-1101	Lab Course in Fundamental Cell Biology	--	02	02	--	04
Optional 2 Minor 1	SDSCCT-1101	--	02	--	02	02	--
	SDSCCP-1101	--	--	02	02	--	04
Optional 3 Minor 2	SDSCCT-1101	--	02	--	02	02	--
	SDSCCP-1101	--		02	02	--	04
Generic Elective	SBTVGE-1101	Biofuels and Bio-energy (From Basket 3)	02	--	02	02	--
Vocational & Skill Enhancement Course	SBTVSC-1101	Microbial Cultures & their Maintenance	--	02	02	--	04
Ability Enhancement Course	AECENG-1101	L1 – Compulsory English	02	--	02	02	--
Ability Enhancement Course	AECXXX-1101	L2–Second Language Marathi (MAR), Hindi (HIN), Urdu (URD), Kannada (KAN), Pali (PAL) (Basket 4)	02	--	02	02	--
Indian Knowledge System (IKS)	IKSXXX-1101	Select from Basket 5	02	--	02	02	--
Total Credits			**14**	**08**	**22**	**14**	**16**

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

Examination Scheme

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

Subject	CourseCode	Course Name	Theory				Practical		Total
			Continuous Assessment(CA) Avg of			ESA			
			Test I	Test II	(T1+T2)/2	Total	CA	ESA	
Major	SBTVCT-1101	Fundamental Cell Biology	10	10	10	40	--	--	50
	SBTVCP-1101	Lab Course in Fundamental Cell Biology	--	--	--	--	20	30	50
Optional 1	SDSCCT-1101	--	10	10	10	40	--	--	50
	SDSCCP-1101	--	--	--	--	--	20	30	50
Optional 2	SDSCCT-1101	--	10	10	10	40	--	--	50
	SDSCCP-1101	--	--	--	--	--	20	30	50
Generic Elective (From other faculty)	SBTVGE-1101	Biofuels and Bio-energy (From Basket 3)	10	10	10	40	--	--	50
Vocational & Skill Enhancement Course	SBTVSC-1101	Microbial Cultures & their Maintenance	--	--	--	--	20	30	50
Ability Enhancement Course	AECENG-1101	L1 – Compulsory English	10	10	10	40	--	--	50
Ability Enhancement Course	AECXXX-1101	L2–Second Language Marathi (MAR), Hindi (HIN), Urdu (URD), Kannada (KAN), Pali (PAL) (Basket 4)	10	10	10	40	--	--	50
Indian Knowledge System (IKS)	IKSXXX-1101	Select from Basket 5	10	10	10	40	--	--	50

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

Teaching Scheme

Subject	Course Code	Course Name	Credits Assigned			Teaching Scheme	
			Theory	Practical	Total	Theory (Hrs/ Week)	Practical (Hrs/ Week/Batch)
Major	SBTVCT-1151	Basics of Genetics	02	--	02	02	--
	SBTVCP-1151	Lab course in Basics of Genetics	--	02	02	--	04
Optional 1	SDSCCT-1151	--	02	--	02	02	--
	SDSCCP-1151	--	--	02	02		04
Optional 2	SDSCCT-1151	--	02	--	02	02	--
	SDSCCP-1151	--	--	02	02		04
Generic Elective (From Other Faculty)	SBTVGE-1151	Biosafety and Bioethics (Group B of Basket 3)	02	--	02	02	--
Vocational & Skill Enhancement Course	SBTVSC-1151	Techniques in Forensic Biology	--	02	02	--	04
Ability Enhancement Course (AEC)	AECENG-1151	L1- Compulsory English	02	--	02	02	--
Ability Enhancement Course	AECXXX-1151	L2–Second Language Marathi (MAR), Hindi (HIN), Urdu (URD), Kannada (KAN), Pali (PAL) (Basket 4)	02	--	02	02	--
Value Education Course (VEC)	VECCOI-1151	Constitution of India	02	-	02	02	--
		Total Credits	**14**	**08**	**22**	**14**	**16**

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

Examination Scheme

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

Subject	Course Code	Course Name	Theory				Practical		Total
			Continuous Assessment (CA)			ESA			
			Test I	Test II	(T1+T2)/2	Total	CA	ESA	
Major	SBTVCT-1151	Basics of Genetics	10	10	10	40	--	--	50
	SBTVCP-1151	Lab course in Basics of Genetics	--	--	--	--	20	30	50
Optional 1	SDSCCT-1151	--	10	10	10	40	--	--	50
	SDSCCP-1151	--	--	--	--	--	20	30	50
Optional 1	SDSCCT-1151	--	10	10	10	40	--	--	50
	SDSCCP-1151	--	--	--	--	--	20	30	50
Generic Elective (GE)	SBTVGE-1151	Biosafety and Bioethics (Group B of Basket 3)	10	10	10	40	--	--	50
Vocational & Skill Enhancement Course	SBTVSC-1151	Techniques in Forensic Biology	--	--	--	--	20	30	50
Ability Enhancement Course (AEC)	AECENG-1151	L1- Compulsory English	10	10	10	40	--	--	50
Ability Enhancement Course	AECXXX-1151	L2–Second Language Marathi (MAR), Hindi (HIN), Urdu (URD), Kannada (KAN), Pali (PAL) (Basket 4)	10	10	10	40	--	--	50
Value Education Course (VEC)	VECCOI-1151	Constitution of India	10	10	10	40	--	--	50

SBTVCT-1101: Fundamental Cell Biology

B.Sc. Vocational Biotechnology

Marks: 50 **Hours: 30**

Course pre-requisite: Basic knowledge of Biology

Course objectives:

1. To provide knowledge on cell structure and its function.
2. To understand the structures and purposes of basic components of prokaryotic and eukaryotic cells, especially macromolecules, membranes, and organelles
3. To understand how these cellular components are used to generate and utilize energy in cells
4. To understand the cellular components underlying mitotic and meiosis cell division and cellular communication

Course outcomes: Students will be able to

1. Recognise the fundamental make-up and purpose of cells by elucidating the various cell kinds, the organelles that make up cells, and how cells perform their fundamental jobs are all part of this.
2. Understand how cells function and how their structure is based on molecules. This includes comprehending how proteins, nucleic acids, and other biomolecules interact to build cells and carry out cellular functions, as well as their structure and function.
3. Elucidate the fundamentals of cell division and differentiation thereby understanding how cells divide to create new cells as well as how they differentiate to become specialised cells with various tasks is part of this.
4. Classify the function and growth of cells in organisms by learning how cells cooperate with one another to form tissues and organs, as well as how cells interact with one another.

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	Basic Techniques in cell Biology	
2.0		**CELL STRUCTURE AND CELL ORGANELLES**	08
	2.1	Ultrastructure of prokaryotic and Eukaryotic cell; Ultra structure of cell membrane, cytosol, endoplasmic reticulum, golgi bodies, Ultrastructure of mitochondria, chloroplast and nucleus.	
	2.2	Lysosomes, peroxisomes and ribosomes, cytoskeletal system, Cilia and flagella	
	2.3	Transport across cell membrane	
3.0		**CELL DIVISION & CONTROL**	07
	3.1	Cell cycle – mitosis, Meiosis	
	3.2	Cell differentiation in multi cellular organisms: Totipotent, pleuripotent, multipotent	
	3.3	Cell cycle regulation and apoptosis	
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	Cyclic AMP pathway, Cyclic GMP and MAP kinase pathway	
		Total	30

Text Books:

1. Lodish, Harvey etal., "Molecular Cell Biology", 5 th Edition, W.H.Freeman, 2005.
2. Cooper, G.M. and R.E. Hansman "The Cell : A Molecular Approach", 4 th Edition, ASM Press, 2007.
3. Alberts, Bruce etal., "Molecular Biology of the Cell", 4 th Edition, Garland Science (Taylors Francis), 2002.

Reference Books:

1. P. S. Verma and V.K. agrawal Cell Biology,enetics,Molecular Biology Evolution and Ecology; S. Chand and Company Ltd New Delhi 2005.
2. Lodish Molecular Cell Biology "Scientific American Book, Eduard Gasque 2004
3. Cooper & Hausman, The Cell – A Molecular Approach 2004
4. Leininger A.L., Nelson D.L. and Cox M.M. , Principles of biochemistry (W.Freeman, USA). 2005
5. Stryer L, J. M. Berg, J.L. Tymoczko , Biochemistry (W.H. Freeman and Company, New York). 2001.
6. G.L. Zubay, W.W. Parson, D.E. Vance. Principles of biochemistry, 1995.
7. Bucke C.. Carbohydrate biotechnology protocols (Humana Press) 1995.
8. H. R. Horton, A. J. Scism, L.A. Moran, R.S. Ochs, J.D Rawn, K.G. Scrimgeour. Principles of biochemistry, 2006.
9. Gerald Karp, Cell and molecular biology: Concepts and experiments , John Wiley & Sons International, 2009

SBTVCP 1101: Lab Course in Fundamental Cell Biology
B.Sc. Vocational Biotechnology

Marks: 50 **Hours: 30**

Sr No	List of Experiments
Fundamental 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
6	Study of Osmosis

Generic Elective (Group A)
SBTVGE-1101 Biofuels and Bio-Energy
B.Sc. Vocational Biotechnology

Marks:50 **Hours:30**

Prerequisite of course: Awareness about mass and energy balances

Course Objectives:

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

Course Outcomes: The student , at the end of the course, will be able to

1. Analyse the various technologies available to energetically valorise the various types of biomass and organic waste;
2. Evaluate performances and limits of the same technologies in relation to the substrate to be treated
3. 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, Cornstarch-to-ethanol (Animation), Cellulosic-ethanol biorefinery, Vegetable oils-to-biodiesel.	
	1.3	Biomass typologies: lignocellulosic, starchy, sugary, oilseeds, OFMSW, Sewage sludge, manure. Biofuels: liquid (biodiesel, bioethanol	
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 , Biomass Pyrolysis	
3.0		**BASIC OF BIOMASS TECHNOLOGY**	
	3.1	Basic Mechanism of light reaction	08
	3.2	Exploration of Photosynthetic process , Hill Reaction	
	3.3	ETS and conversion of CO_2 in Carbohydrate	
4.0		**BIOFUELS**	
	4.1	Electron transport process in light reaction	08
	4.2	Greenhouse Gases, Photosynthesis for Biofuels & Biobased products	
	4.3	Biofuels laboratory visit and related Lab Exercises	

		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 (SEC)
SBTVSC-1101: Microbial Cultures & Their Maintenance

Marks : 50 **Hours : 30**

Pre requisite:

- Basic knowledge of microorganisms

Course Objectives:

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

Course Outcomes:

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

Curriculum Details

Module No.	Unit No.	Topic	Hrs.
1. 0		**Unit 1: Introduction to Microbial Culture**	08
	1.1	Overview of microorganisms , Types of microbial cultures	
	1.2	Methods of microbial culture, Growth media and culture	
	1.3	Aseptic technique	
2.0		**Unit 2: Maintenance of Microbial Cultures**	08
	2.1	Subculturing and streaking	
	2.2	Preservation of microbial cultures	
	2.3	Quality control of microbial cultures	
3.0		**Unit 3: Applications of Microbial Culture**	08
	3.1	Industrial applications of microbial culture	
	3.2	Medical applications of microbial culture	
	3.3	Environmental & Agricultural applications of microbial culture	
4.0		**Unit 4: Methods of Microbial Culture preservation**	06
	4.1	Short-term & long term methods for preservation	
	4.2	Immersing in Oil, Ordinary Freezing, Deep-Freezing, Drying.	
	4.3	Freeze-Drying (Lyophilization) Equipment, Vials. Culture Preparation. Cryoprotective Agents, Culture Recovery	
		Total	30

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 Numbers 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 sp from pond water)

Reference Books

1. B.R Tortora G.J., Funke. and case C.L, Microbiology, Introduction, 5th edn. The Benjamin/cummings Publishing co., Inc USA 1994.
2. Ronald M. Atlas ; Microorganisms in our world, Mosby. Year Book Inc. USA, 1995
3. Atlas R.M; General Microbiology, 2nd Ed. Wm. C. Brown publishers. Dubuque 1997
4. Madigan M.T., Martinko J.M and Parker. J., Brock, Biology of Microorganisms.. 9th ed., Prentice-Hall, Inc., Englewood Cliffs, New Jersey, 2000.
5. Collius, C.H., Lyne, P.M. and Grange J.M, Microbiological methods.. seventh edn. Arnold, London, 2001.
6. Perry J.J., Staley J.T. and Lorey, S, Microbial life, Sinauer Associates Inc., USA, 2002.
7. Manual of Microbiology, Tools & Techniques, Kanika Sharma,. second edn. Anne Books India, 2008.
8. Tauro P., Kapoor K. K and Yadav K.S, An Introduction to Microbiology,. Wiley Eastern Limited 1986.
9. Pelczar M.J., Chan E.C.S. and Kreig N.R, Microbiology. McGraw Hill book Company Singapore, 1986.
10. Edward A, Fundamentals of Microbiology. Fifth ed. The Benjamin/Cummings Publishing Company. Inc. Redwood City CA, 1994.
11. Tortora G., Berdell R.F. and Case C.L., Microbiology: An Introduction,. Addison Wesley 2003.
12. Prescott L.M., Harley J.P. and Klein D.A; Microbiology, 5th ed. McGraw Hill; New York, 2002.

SEMESTER – II

SBTVCT-1151 Basics of Genetics

B. Sc Vocational Biotechnology

Marks: 50 **Hours: 30**

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

Course objectives:

1. To introduce the students to the Genetics and its practical value for human welfare.
2. To introduce the students to chromosome abnormalities.

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

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

Curriculum Details:

Module No.	Unit No.	Topic	Hrs.
1. 0		**MENDELIAN GENETICS**	08
	1.1	Introduction to model organisms and Mendelism	
	1.2	History of Genetics; Mendel's principles and rediscovery; Cell division; Chromosomes structure and function; Sex determination and sex differentiation	
	1.3	Multiple allelism; Linkage and crossing-over; Mutations; Hardy-Weinberg law; Introduction to Human genetics	
2.0		**BACTERIAL GENETICS**	08
	2.1	Allelic variation and gene function - dominance relationships, multiple alleles, lethal alleles and null alleles	
	2.2	Genetic definition of a gene: Complementation test, limitations of cis-trans test,	
	2.3	Genetics of bacteria and viruses,	
3.0		**Concept of Mutation**	08
	3.1	Concept of Gene, Classical & modern gene concepts, Mapping of gene	
	3.2	Mutation : Basic Concept, Types –Spontaneous, Induced Mutations	
	3.3	Mechanism of mutagenesis : Base analogues, Nitrous acid, hydroxyl amine, alkylting agent, Acridine dyes, U. V. light	
4.0		**Plasmid**	06
	4.1	Plasmid- Structure, Types, properties and applications;	
	4.2	Genetic recombination in bacteria – definition, transformation, Conjugation, transduction	
	4.3	Transposable elements	

		Total	30

Reference Books

1. M.W., Strickberger , Genetics, , Prentice Hall College Division
2. David Friefelder -Microbial Genetics- Narosa Publications
3. General Microbiology , Stanier
4. P.K. Gupta - Genetics, Rastogi Publication.
5. Genetics - C. Sarin
6. Molecular Genetics of Bacteria, Larry Snyder Wendy Champness
7. Arora - Genetics- Himalaya Publications
8. B.D. Singh , Genetics -Himalaya Publication 2008

SBTVCP 1151 Lab Course in Basics of Genetics

Sr No	**List of Experiments**
Basics of Genetics	
1.	Two examples on Dihybrid cross
2.	Two examples on Monohybrid cross.
3.	One example each on interaction of genes.
4.	Study of Karyotype.
5.	Study of Human blood group.
6.	Study of special types of chromosomes.

Generic Elective (GE)
SBTVGE-1151 Biosafety and Bioethics

B.Sc Vocational Biotechnology

Marks: 50 **Hours: 30**

- **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:**

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

- **Course outcome** As a result of studying this course, students shall know:

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

Curriculum Details:

Module No.	Unit No.	Topic	Hrs.
1. 0		**UNIT 1**	08
	1.1	BIOETHICS & LEGAL ISSUES: Principles of bioethics: Legality, morality and ethics, human rights, beneficence, privacy, justice, equity etc., bioethics vs. business ethics, 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, Public education to increase the awareness of bioethics with regard to generating new forms of life for informed decision making-with case studies.	
	1.3	Species Biodiversity; status of survey, endemic species, cultivated plants/Agro biodiversity.	
2.0		**UNIT 2**	08
	2.1	Maintenance of ecological biodiversity hot spots in India; Legal instruments relevant to biological diversity in India	
	2.2	Endangered species Act, Federal role in wild life preservation	
	2.3	Convention on Biological diversity; FAO and NBA Cartagena protocol of Biosafety;	
3.0		**UNIT 3**	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	
4.0		**UNIT 4**	06
	4.1	Regulatory framework for GMOs in India	
	4.2	GEAC, SBCC, DLC, RDAC, IBSC, RCGM	
	4.3	Biosafety regulations and national and international guidelines with regard to recombinant DNA technology., IPR History of IPs in India, Nature and Scope	
		Total	**30**

Text Books:

1. Singh, R., . Bioethics. New Age International. 2012
2. Gruen, L., & Grabel, L. The Ethics of Animal Research: Exploring the Controversy. MIT Press. 2019
3. Rasmussen, L. M. . Ethics of Human Genome Editing: From Bathrooms to Boardrooms. Routledge. 2018
4. Dyson, A. Bioethics in Biotechnology: Ethics of Genetic Engineering and Transgenic Animals. Routledge, 2013
5. Resnik, D. B. Playing God: Biological and Spiritual Perspectives on Biotechnology and Human Enhancement. Oxford University Press 2015.
6. Tzamalis, G. Bioethics and Biotechnology. Routledge. 2018
7. Ravitsky, V., & Fiester, A. The Penn Center Guide to Bioethics. Springer. 2019
8. World Health Organization (WHO) . Laboratory Biosafety Manual (3rd ed.). World Health Organization. 2007
9. World Health Organization (WHO). Biorisk Management: Laboratory Biosecurity Guidance. World Health Organization. 2009
10. Peccoud, J., & Gallegos, J. E. Safety and Security in Synthetic Biology: A Comprehensive Approach. Academic Press.2019
11. US National Research Council. . Prudent Practices in the Laboratory: Handling and Management of Chemical Hazards (Updated Version). National Academies Press. 2007

Websites

1. http://patentoffice.nic.in
2. www.wipo.org
3. www.dbtindia.nic.in
4. www.dbtbiosafety.nic.in

Skill Enhancement Course (SEC)

SBTVSC-1151 Techniques in Forensic Biology

B.Sc Vocational Biotechnology

Marks: 50 **Hours: 30**

Course pre-requisite: No as such pre requisite required

Course objectives

1. To introduce students to 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 & serological evidence	
2.0		**UNIT 2**	08
	2.1	Techniques and skills in forensic biology	
	2.2	Importance of biological fluids	
	2.3	Blood, Swea,t Saliva 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	
4.0		**UNIT 4**	06
	4.1	Principles of DNA analysis	
	4.2	Importance of PCR techniques in Forensic Biology	
	4.3	Microscopic examination. Separation& detection of biological fluid by chromatography	
		Total	**30**

Sr No	List of Experiments
1	To determine titre of antisera.
2	To perform precipitin test for species of origin determination
3	To perform Immuno diffusion test for species of origin.
4	Blood grouping from stains of blood, semen, saliva and other body fluids by Absorption inhibition,.
5	Absorption-elution and mixed agglutination technique, determination of Secretor/non secretor status

6	Identification and culture of bacteria of forensic significance.
7	Identification of wild life materials such as skin, fur, bones, nails, horn, teeth, flowers plants.
8	Study of pollen grains and spores of forensic significance.
9	Detection of biological fluid by using PCR.

Reference Books

1. Roos M. Gardner & Tom Bevel -Practical Crime Scene Analysis & Reconstruction
2. Scott A. Wagner - Death Scene Investigation
3. B.R. Sharma - Forensic Science in criminal investigation and trials
4. Dr. Mrs. Rukmani Krishnamurthy - Forensic Science in Crime Investigation
5. Stuart H. James & Jon J. Nordby - Forensic Science – An introduction to scientific and investigative techniques
6. P.V. Guharaj & M. R. Chandran - Forensic Medicine
7. Bryant, V.M. Jr, Mildenhall, D.C. and Jones, J.G., Forensic Polynology in the United States of America Polynology., 14.PP.193-208, 1990
8. Faegri, K. Iverson, J. and Krzywinski, K. Textbook of Pollen Analysic 4th Edition. John Wiley & Sons, New York 1989.
9. Roger Breeze, Bruce Budowle, Steven E. Schutzer - Microbial forensics. Elsevier Academic Press
10. Ashraf Mozayani, Carla Noziglia.- The Forensic Laboratory Handbook Procedures and Practice 2nd edition.. Human Press 2011.

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