॥ 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

Fax : (02462) 215572

Phone: (02462)215542

Academic-1 (BOS) Section

website: srtmun.ac.

E-mail: bos@srtmun.ac.

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

प रि प त्र क

या परिपत्रकान्वये सर्व संबंधितांना कळविण्यात येते की, या विद्यापीठा अंतर्गत येणा–या सर्व संलग्नित महाविद्यालयामध्ये शैक्षणिक वर्ष २०२४–२५ पासून पदवीस्तरावर राष्ट्रीय शैक्षणिक धोरण –२०२० लागू करण्याच्या दृष्टीकोनातून विज्ञान व तंत्रज्ञान विद्याशाखे अंतर्गत येणा–या अभ्यासमंडळांनी तयार केलेल्या पदवी द्वितीय वर्षाचे अभ्यासक्रमांना मा. विद्यापरिषदेने दिनांक १५ मे २०२४ रोजी संपन्न झालेल्या बैठकीतील ऐनवेळचा विषय क्रमांक ०४/५९–२०२४ च्या ठरावाअन्वये मान्यता प्रदान केली आहे. त्यानुसार विज्ञान व तंत्रज्ञान विद्याशाखेतील खालील बी. एस्सी द्वितीय वर्षाचे अभ्यासक्रम (Syllabus) लागू करण्यात येत आहेत.

1) B. Sc. II year - Computer Sciene (New Model Degree College Hingoli)
2) B. Sc. II year – Biotechnology (New Model Degree 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/एनएमडीसी/२०२४–२५/116
दिनांक १८.०६.२०२४

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

प्रत : १) मा. आधिष्ठाता, विज्ञान व तंत्रज्ञान विद्याशाखा, प्रस्तुत विद्यापीठ.
२) मा. संचालक, परीक्षा व मुल्यमापन मंडळ, प्रस्तुत विद्यापीठ.
३) मा. प्राचार्य, न्यू मॉडल डिग्री कॉलेज हिंगोली.
४) 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

FACULTY OF SCIENCE AND TECHNOLOGY

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

With Effect From June 2024

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

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

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

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

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

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

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

Preamble:

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

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

As per the National Education Policy, the Government of Maharashtra has proposed a model curriculum framework and an implementation plan for the State of Maharashtra. It is to suggest and facilitate the implementation of schemes and programs, which improve not only the level of academic excellence but also improve the academic and research environment in the state. The proposed curriculum framework 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, General Microbiology, Immunology and Virology, Basic Molecular Biology, Principles of r-DNA Technology, Industrial Biotechnology, Agriculture Biotechnology, Pharmaceutical Biotechnology and Genomics and Proteomics.

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

The Skill Enhancement Courses like Diagnostic Biology, Microbial Culture and its Maintenance, Drug Designing, Techniques in Forensic Biology, Principles of Fermentation Technology and Vermiculture and Vermicompost 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		--	--

Swami Ramanand Teerth Marathwada University, Nanded

Faculty of Science & Technology

Structure for Four Year Multidisciplinary Degree Program with Multiple Entry and Exit

Subject: BIOTECHNOLOGY

Subject CODE: SBTTCxxx [First letter S-Sci, next three letters BTT-Major /DSM-Minor subject, fourth letter C-Core/E-Elective, x-Year and last two numbers represent xx-paper no.).

Year & Level	Semester	Subject-1 Major (DSC/DSE)	Subject-2 Minor (DSM) (Basket 1)	Generic Elective (GE) (Basket 2) *(Select one each from Group A and B of Basket 2, should not be related to DSC / DSM in col. 3 and 4)*	Vocational & Skill Enhancement Course (V/SEC) *(Related to DSC)*	Ability Enhancement Course (AEC) (Basket 3 for L2) Value Education Courses (VEC) / Indian Knowledge System (IKS) *(Common across faculty)*	Field Work / Project/ Internship/ OJT/ Apprenticeship / Case Study Or Co-curricular Courses (CC) (Basket 4 for CC) *(Common across faculty)*	Credits	Total Credits
1	2	3	4	5	6	7	8	9	10
1 (4.5)	I	SBTTC101 (2Cr) (Theory) SBTTC102 (2Cr) (Theory) SBTTC103 (2Cr) (Practical) **6 Credits**	--	SBTTG101 (2Cr) SBTTG102 (2Cr) **4 Credits**	SBTTV101 (2Cr) SBTTS101 (2Cr) **4 Credits**	AECEN101 (2Cr) VECCI101 (2Cr) ***Constitution of India*** IKSCM101 (2Cr) **6 Credits**	CCXXX101 (2Cr) ***(XXX any one of NCC/NSS/Sports / Culture/Health Wellness/ Yoga Education / Fitness)*** **2 Credits**	22	44

	II	SBTTC151 (2Cr) (Theory) SBTTC152 (2Cr) (Theory) SBTTC153 (2Cr) (Practical) **6 Credits**	SDSMC151 (2Cr) **2 Credits**	SBTTG151 (2Cr) SBTTG152 (2Cr) **4 Credits**	SBTTV151 (2Cr) SBTTS151 (2Cr) **4 Credits**	AECXX151 (2Cr) ***(XX: Hin, Mar, Kan, Pal, etc)*** VECES151 (2Cr) ***Environmental Studies*** **4 Credits**	CCXXX151(2Cr) ***(XXX any one of NCC/NSS/Sports / Culture/Health Wellness/ Yoga Education / Fitness)*** **2 Credits**	**22**	
***Exit option*: UG Certificate in Major DSC on completion of 44 credits** and additional **4 credits from NSQF / Internship**									
2 **(5.0)**	**III**	SBTTC201 (2Cr) (Theory) SBTTC202 (2Cr) (Theory) SBTTC203 (2Cr) (Practical) SBTTC204 (2Cr) (Practical) **8 Credits**	SDSMC201 (2Cr) SDSMC202 (2Cr) **4 Credits**	SBTTG201 (2Cr) **2 Credits**	SBTTV201 (2Cr) **2 Credits**	AECEN201 (2Cr) **2 Credits**	SBTTP201 (2Cr) CCXXX201 (2Cr) ***(XXX any one of NCC/NSS/Sports / Culture/Health Wellness/ Yoga Education / Fitness)*** **4 Credits**	**22**	**44**

	IV	SBTTC251 (2Cr) (Theory) SBTTC252 (2Cr) (Theory) SBTTC253 (2Cr) (Practical) SBTTC254 (2Cr) (Practical) **8 Credits**		SDSMC251 (2Cr) SDSMC252 (2Cr) **4 Credits**	SBTTG251 (2Cr) **2 Credits**	SBTTS251 (2Cr) **2 Credits**	AECXX251 (2Cr) ***(X: Hin, Mar, Kan, Pal, etc)*** **2 Credits**	SBTTP251 (2Cr) (FP/CS) CCXXX251 (2Cr) ***(XXX any one of NCC/NSS/Sports / Culture/Health Wellness/ Yoga Education / Fitness)*** **4 Credits**	**22**	
Exit option: UG Diploma in Major BTTand Minor DSM on completion of 88 credits and additional **4 credits NSQF / internship in DSC**									
3 **(5.5)**	**V**	SBTTC301 (4Cr) SBTTC302 (4Cr) SBTTC303 (2Cr) **10 Credits**	SBTTE301 (2Cr) SBTTE302 (2Cr) **4 Credits**	SDSMC301 (2Cr) SDSMC302 (2Cr) **4 Credits**	--	SBTTV301 (2Cr) **2 Credits**	--	SBTTP301 (2Cr) (FP/CS) **2 Credits**	**22**	**44**

	VI	SBTTC351 (4Cr) SBTTC352 (4Cr) SBTTC353 (2Cr) **10 Credits**	SBTTE351 (2Cr) SBTTE352 (2Cr) **4 Credits**	SDSMC351 (2Cr) SDSMC352 (2Cr) **4 Credits**	--	--	--	SBTTO351 (4Cr) **(OJT)** **4 Credits**	**22**	
Exit option: Bachelor in Science with Major in BTT and Minor in DSM										**130**
4 (6.0)	**VII**	SBTTC401 (4Cr) SBTTC402 (4Cr) SBTTC403 (4Cr) SBTTC404 (2Cr) **14 Credits**	SBTTE401 (2Cr) SBTTE402 (2Cr) **4 Credits**	*Research Methodology* **SVECR401** (4Cr) **4 Credits**	--	--	--	--	**22**	**44**
	VII I	SBTTC451 (4Cr)	SBTTE451 (2 Cr)	--	--	--	--	SBTTO451 (4Cr) **(OJT)**	**22**	

		SBTTC452 (4Cr) SBTTC453 (4Cr) SBTTC454 (2Cr) **14 Credits**	SBTTE452 (2 Cr) **4 Credits**					**4 Credits**		
Exit option: Bachelor of Science with Major in BTT (Honors) and Minor in DSM										**172**
4 (6.0)	**VII**	SBTTC401 (4Cr) SBTTC402 (4Cr) SBTTC403 (2Cr) **10 Credits**	SBTTE401 (2Cr) SBTTE402 (2Cr) **4 Credits**	*Research Methodology* **SVECR401** (4Cr) **4 Credits**	--	--	--	Research Project **SBTTP401 (4Cr)**	**22**	**44**
	VII I	SBTTC451 (4Cr) SBTTC452 (4Cr) SBTTC453 (2Cr) **10 Credits**	SBTTE451 (2Cr) SBTTE452 (2Cr) **4 Credits**	--	--	--	--	Research Project **SBTTP451 (8Cr)**	**22**	
Exit option: Bachelor of Science with Major in BTT (Honours with Research) and Minor in DSM										**176**
Total Credits		**92 (Honors)/ 84 (Research)**	**18 + 04**	**12**	**V-08 + S-06**	**AEC-8 + VEC-4 + IKS-2**		**22 / 30**	**176**	

B. Sc. Second Year, Semester III (Level 5.0)

Teaching Scheme

Subject	Course Code	Course Name	Credits Assigned			Teaching Scheme	
			Theory	Practical	Total	Theory (Hrs/week)	Practical (Hrs/week/ Batch)
Major	SBTTC-201	Genetics I	02	--	**02**	02	--
	SBTTC-202	Bio-instrumentation	02	--	**02**	02	--
	SBTTC-203	Lab Course in Genetics I	-	02	**02**	--	04
	SBTTC-204	Lab Course in Bio-instrumentation	--	02	**02**	--	04
Minor	SBTTC-201	Introductory Biochemistry and Bio-instrumentation	02	--	**02**	02	--
	SBTTC-202	Environmental Biotechnology	02	--	**02**	02	--
Generic Elective	SBTTG-201	Medical Biotechnology (Group A of Basket 2)	02	--	**02**	02	--
Vocational & Skill Enhancement Course	SBTTV-201	Vermiculture and Vermicompost	--	02	**02**	--	04
Ability Enhancement Course	AECEN-201	L1 –Compulsory English	02	--	**02**	02	--
Field Work (F)/ Project (P)/ Internship/ OJT (O)/ Apprenticeship (A) / Case Study(C)	SBTTX-201	Field Work (F)/ Project (P)/ Internship (I)/ OJT (O)/ Apprenticeship (A) / Case Study(C)	--	02	**02**	--	04
Cocurricular Courses (CC)	CCXXX-201	Any one of NCC/ NSS /Sports (SPT)/ Culture Studies (CLS) /Health Wellness (HWS) / Yoga Education (YGE) / Fitness (FIT) (Basket 4)	--	02	**02**	--	04
Total Credits			**12**	**10**	**22**	**12**	**20**

B. Sc. Second Year, Semester III (Level 5.0)

Examination Scheme

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

Subject	Course Code	Course Name	Theory				Practical		Total
			Continuous Assessment (CA)			ESA			
			Test I	Test II	Avg of (T1+T2)/2	Total	CA	ESA	
Major	SBTTC-201	Genetics I	10	10	10	40	--	--	50
	SBTTC-202	Bio-instrumentation	10	10	10	40	--	--	50
	SBTTC-203	Lab Course in Genetics I	--	--	--	--	20	30	50
	SBTTC-204	Lab Course in Bio-instrumentation	--	--	--	--	20	30	50
Minor	SBTTC-201	Introductory Biochemistry and Bio-instrumentation	10	10	10	40	--	--	50
	SBTTC-202	Environmental Biotechnology	10	10	10	40	--	--	50
Generic Elective	SBTTG-201	Medical Biotechnology (Group A of Basket 2)	10	10	10	40	--	--	50
Vocational & Skill Enhancement Course	SBTTV-201	Vermiculture and Vermicompost	--	--	--	--	20	30	50
Ability Enhancement Course	AECEN-201	L1 –Compulsory English	10	10	10	40	--	--	50
Field Work (F)/ Project (P)/ Internship/ OJT (O)/ Apprenticeship (A) / Case Study(C)	SBTTX-201	Field Work (F)/ Project (P)/ Internship (I)/ OJT (O)/ Apprenticeship (A) / Case Study(C)	--	--	--	--	20	30	50
Community Engagement Services (CC)	CCXXX-201	Any one of NCC/ NSS /Sports (SPT)/ Culture Studies (CLS) /Health Wellness (HWS) / Yoga Education (YGE) / Fitness (FIT) (Basket 4)	--	--	--	--	20	30	50

B. Sc. Second Year Semester IV (Level 5.0)

Teaching Scheme

Subject	Course Code	Course Name	Credits Assigned			Teaching Scheme	
			Theory	Practical	Total	Theory (Hrs/week)	Practical (Hrs/week/ Batch)
Major	SBTTC-251	General Microbiology	02	--	**02**	02	--
	SBTTC-252	Genetics II	02	--	**02**	02	--
	SBTTC-253	Lab Course in General Microbiology	-	02	**02**		04
	SBTTC-254	Lab Course in Genetics II	--	02	**02**	--	04
Minor	SBTTC-251	General Microbiology & Immunology	02	--	**02**	02	--
	SBTTC-252	Microbial Genetics	02	--	**02**	02	--
Generic Elective	SBTTG-251	Human Microbiome (Group A of Basket 2)	02	--	**02**	02	--
Vocational & Skill Enhancement Course	SBTTS-251	Principles of Fermentation Technology	--	02	**02**	--	04
Ability Enhancement Course	AECXX-251	L2–Second Language Marathi (MR), Hindi (HN), Urdu (UR), Kannada (KN), Pali (PL) (Basket 3)	02	--	**02**	02	--
Field Work (F)/ Project (P)/ Internship/ OJT (O)/ Apprenticeship (A) / Case Study(C)	SBTTX-251	Field Work (F)/ Project (P)/ Internship (I)/ OJT (O)/ Apprenticeship (A) / Case Study(C)	--	02	**02**	--	04
Cocurricular Courses (CC)	CCXXX-251	Any one of NCC/ NSS /Sports (SPT)/ Culture Studies (CLS) /Health Wellness (HWS) / Yoga Education (YGE) / Fitness (FIT) (Basket 4)	--	02	**02**	--	04
Total Credits			**12**	**10**	**22**	**12**	**20**

B. Sc. Second Year Semester IV (Level 5.0)

Examination Scheme

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

Subject	Course Code	Course Name	Theory				Practical		Total
			Continuous Assessment (CA)			ESA			
			Test I	Test II	Avg of (T1+T2)/2	Total	CA	ESA	
Major	SBTTC-251	General Microbiology	10	10	10	40	--	--	50
	SBTTC-252	Genetics II	10	10	10	40	--	--	50
	SBTTC-253	Lab course in General Microbiology	--	--	--	--	20	30	50
	SBTTC-254	Lab course in Genetics II	--	--	--	--	20	30	50
Minor	SBTTC-251	General Microbiology & Immunology	10	10	10	40	--	--	50
	SBTTC-252	Microbial Genetics	10	10	10	40	--	--	50
Generic Elective	SBTTG-251	Human Microbiome (Group A of Basket 2)	10	10	10	40	--	--	50
Vocational & Skill Enhancement Course	SBTTS-251	Principles of Fermentation Technology	--	--	--	--	20	30	50
Ability Enhancement Course	AECXX-251	L2–Second Language Marathi (MR), Hindi (HN), Urdu (UR), Kannada (KN), Pali (PL) (Basket 3)	10	10	10	40	--	--	50
Field Work (F)/ Project (P)/ Internship/ OJT (O)/ Apprenticeship (A) / Case Study(C)	SBTTX-251	Field Work (F)/ Project (P)/ Internship (I)/ OJT (O)/ Apprenticeship (A) / Case Study(C)	--	--	--	--	20	30	50
Community Engagement Services (CC)	CCXXX-251	Any one of NCC / NSS /Sports (SPT) / Culture Studies (CLS) / Health Wellness (HWS) / Yoga Education (YGE) / Fitness (FIT) (Basket 4)	--	--	--	--	20	30	50

SEMESTER –III (Core Course)

SBTTC-201: Genetics I

Theory	**Subject Code: SBTTC- 201**
Total Marks for Evaluation: 50	No. of Contact Hours: 2hr/week, Credit: 2

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

Course objectives:

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

Course outcomes:

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

Curriculum Details:

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

	4.1	Phases of linkage, test cross, recombination frequency.	
	4.2	Gene mapping, determination of map distances based on two and three point test crosses, coincidence, interference eg. Drosophila and Maize.	
	4.3	Tetrad analysis – Neurospora.	
	4.4	Cytological proof of crossing over.	
		Total	30

Reference Books:

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

SBTTC- 203 Lab Course in Genetics I

Course Objectives:

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

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

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

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

Recommended Books:

1. Robert J. Brooker. Genetics: Analysis & Principles. 7th Edition. Mc Graw Hill Publication
2. M. Cooper and Robert. E. Hausman. The Cell: A Molecular Approach: Geoffrey. , Sinauer Associates, 5th Ed. 2009.
3. W. H. Freeman Lodish. Molecular Cell Biology: 5th Ed. 2003.
4. Bruce Alberts. Molecular Biology of the cell: Garland Publishing, 5th Ed. 2008.

5. Ganesh M. K. & Shivashankara A. R. Laboratory Manual for Practical Biochemistry: , Jaypee Publications, 2nd Ed. 2012.
6. Bhat, Sujata, V. Biometerials: ., Narosa Publishing House, 2010.

SBTTC- 202: Bio-instrumentation (Core Course)

Theory	Subject Code: SBTTC- 202
Total Marks for Evaluation: 50	No. of Contact Hours: 2hr/week, Credit: 2

Course pre-requisite
The candidate should have basic knowledge of instruments
Course objectives:
- To introduce the students to analytical techniques in the field of Biotechnology
- To make the students understand the basic principles of Bioanalytical instruments

Course outcomes:
On successful completion of the course, students will be able to
- Demonstrate the basics of instrumentation by analysis
- Exemplify the structure of atoms and molecules by using the principles of Spectroscopy
- Evaluate by Separating and Purifying the components
- Understand the need and applications of imaging techniques.

Curriculum Details:

Module No.	Unit No.	Topic	Hrs.
1. 0		**Unit 1**	08
	1.1	Beer Lambert's law - Colorimeter and its applications.	
	1.2	Spectrophotometer-Principle and its applications	
	1.3	Types of Spectrophotometer- UV, visible, Infrared Spectrophotometer.	
	1.4	Principle and working of pH meter.	
2.0		**Unit II**	08
	2.1	Introduction and various approaches for characterization of biomolecules.	
	2.2	Centrifugation: Simple theory of preparative and analytical centrifuges and rotors, sedimentation analysis differential rate zonal and equilibrium density gradient centrifugation.	
	2.3	Density gradient media types and their applications	
	2.4	Isolation of cells, sub cellular organelles, viruses and macromolecules.	
3.0		**Unit III**	08
	3.1	Electrophoresis - Principle and its applications	
	3.2	Types of electrophoresis- Agarose Gel and isoelectric focusing.	
	3.3	Gel Documentation, Working principle of Autoclave, Incubator and Hot air oven.	
	3.4	Blotting techniques, PAGE staining techniques	
4.0		**Unit IV**	
	4.1	Fluorescence in situ hybridization (FISH), Scanning electron	06

		microscope (SEM), Transmission Electron Microscope (TEM), optical rotation.	
	4.2	Birefringence, Circular dichroism, NMR,	
	4.3	ESR spectroscopy, x-ray diffraction, Mass spectrometry.	
	4.4	Principle & different types, MALDI-TOF	
		Total	30

References:

1. Chromatography: Concepts and Contrasts-. James Miller, John Wiley and Sons, Inc
2. H.V. Volkones., General Biophysics, Vol I&II 1988
3. Upadhyay, Biophysical Chemistry-, Himalaya Publication, Edition III 2007
4. S.Mahesh., Biophysics New Age International Private Ltd 2003.
5. Ghatak, K.L., Techniques and Methods In Biology. PHI Learning Private Ltd. New Delhi 2003.
6. Zubay.G.L,,. Biochemistry, 4th Edi. WmC. Brown Publishers 1993.

SBTTC- 204 Lab Course in Bioinstrumentation

Course Objectives:

- To teach the fundamental theory, design and operational principles of bio-instrumentation and measurement systems used to conduct biotechnological practicals.

Course Outcomes:

- On successful completion of the course, the student will understood the analytical techniques in the field of Biotechnology

Sr. No.	**List of Experiments**
1	Beer and Lambert's Law – Components and working of Colorimeter, Spectrophotometer
2	Working and components of various types of Centrifuges
3	Absorption spectra of dsDNA and ssDNA melting
4	To find out isoelectric point of amino acids
5	Functioning and Standardization of pH meter
6	Microscopy – Components and working of Bright field compound microscope
7	Working of Electronic Balance for micro measurements
8	Working of Gel Documentation
9	Working of PCR
10	Working of various Imaging techniques

Recommended Books:

1. Chromatography: Concepts and Contrasts- . James Miller, John Wiley and Sons, Inc
2. H.V. Volkones., General Biophysics, Vol I&II 1988
3. Upadhyay, Biophysical Chemistry-, Himalaya Publication, Edition III 2007
4. S.Mahesh., Biophysics New Age International Private Ltd 2003.

5. Ghatak, K.L., . Techniques and Methods In Biology. PHI Learning Private Ltd. New Delhi 2003
6. Zubay.G.L,, . Biochemistry, 4th Edi. WmC. Brown Publishers 1993.

SBTTC 201 : Introductory Biochemistry and Bio-instrumentation (Minor)

Theory	Subject Code: SBTTC 201
Total Marks for Evaluation: 50	No. of Contact Hours: 2hr/week, Credit: 2

Course pre-requisite:

- The candidate should have basic knowledge of Biochemistry and Bio-instruments

Course objectives :

- To acquaint the students with general introduction to the basic concepts of Biochemistry and the functions of biomolecules.
- To acquaint the students with basic instruments used in biotechnology lab.

Course outcome: 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.
- The student will understood the analytical techniques in the field of Biotechnology

Curriculum Details:

Module No.	Unit No.	Topic	Hrs.
1. 0		**Unit I**	08
	1.1	Laws of thermodynamics and their application in biochemistry	
	1.2	free energy change in biochemical systems	
	1.3	ATP and other high-energy phosphates as energy carrier	
	1.4	Basic principles of biological chemistry; water, acid, base, p H and buffers.	
2.0		**Unit II**	08
	2.1	Structure and classification of carbohydrate.	
	2.2	Structure and classification of proteins, amino acids and lipids.	
	2.3	Structure and forms of DNA and RNA.	
	3.4	DNA as genetic material, DNA replication, genetic code, Transcription.	
3.0		**Unit III**	08
	3.1	Beer Lambert's law - Colorimeter and its applications.	
	3.2	Spectrophotometer-Principle and its applications	
	3.3	Types of Spectrophotometer- UV, visible, Infrared Spectrophotometer.	
	3.4	Paper, Gel (starch, acrylamide and agrarose) Disc vertical , NATIVE-PAGE,SEMINATIVE,SDS-PAGE	
4.0		**Unit IV**	06
	4.1	Electrophoresis - Principle and its applications	
	4.2	Types of electrophoresis- Agarose Gel, SDS-PAGE and isoelectric focusing.	
	4.3	Gel Documentation, Working principle of Autoclave, Incubator and Hot air oven.	

	3.4	Fluorescence in situ hybridization (FISH), Scanning electron microscope (SEM),	
		Total	30

Reference Books:

1. Smith et al. Principles of Biochemistry: , McGraw - Hill International book Company, 8th Edition 1973.
2. Lehninger , Nelson, Cox, Principles of Biochemistry - -W.H. Freeman and Company,New York 2013.
3. Voet et al Fundamentals of Biochemistry: .- John Wiley and Sons, Inc. Biochemistry: Zubay- WCB publishers
4. R.K. Murray, D.K. Granner, P.A. Mayes and V.W Rodwell, Harper's Biochemistry: - Prentice-Hall International 2003.
5. James Miller, Chromatography: Concepts and Contrasts- . John Wiley and Sons, Inc 1988
6. H.V. Volkones., General Biophysics, Vol I&II, 2007
7. Upadhyay., Biophysical Chemistry-, Himalaya Publication, Edition III 2007

SBTTC 202 : Environmental Biotechnology (Minor)

Theory	Subject Code: SBTTC 202
Total Marks for Evaluation: 50	No. of Contact Hours: 2hr/week, Credit: 2

Course pre-requisite :

- The candidate should have basic knowledge of Microbiology, Biochemistry, Genetics

Course objectives:

- To introduce and elaborate the fundamental concepts and applications of biotechnology in all aspects of environment including its protection, restoration and sustainability.

Course outcomes:

- On successful completion of the course, students will be able to learn about concepts of Biodegradation, Biodegradation of hydrocarbon, and Measurement of biodegradation. Bioremediation-Concept, Methods of Bioremediation (lnsitu and Ex-situ Bioremediation) and Xenobiotic biodegradation.

Curriculum Details:

Module No.	Unit No.	Topic	Hrs.
1. 0		**Unit I**	08
	1.1	Environmental Biotechnology and Sustainability.	
	1.2	Basics of ecosystem structure and function, Global Environmental Problems; Ozone depletion, Influence on Biodiversity of aquatic and terrestrial environment.	
	1.3	Acid rain, Arid and semi-arid plant biotechnology.	
	1.4	Environmental pollution and measures; Air, Water, Soil, Radioactive pollutions.	
2.0		**Unit II**	08
	2.1	Microbiology of Environmental Engineering System: Microbial diversity, growth and decay. Stoichiometry of microbial energetics and kinetics.	
	2.2	Degradation of lignin and cellulose using microbes.	
	2.3	Phyto-remediation, Degradation of pesticides and other toxic chemicals by micro-organisms	
	2.4	Degradation of aromatic and chlorinates hydrocarbons and petroleum products.	
3.0		**Unit III**	08
	3.1	Aerobic and Anaerobic Degradation of Aliphatic and Aromatic Compounds. .	
	3.2	Microbial interaction with plastics, antibiotics and others emerging pollutants	
	3.3	Bioleaching, Enrichment of ores by microorganisms (Gold, Copper and Uranium).	
	2.4	Environmental significance of genetically modified microbes,	

		plants and animals.	
4.0		**Unit IV**	06
	4.1	Microbially Enhanced Phosphorus and Nitrogen Removal	
	4.2	Global warming and its impact on Human life.	
	4.3	Case studies : Bioremediation,	
	4.4	Case studies: Carbon Storage	
		Total	**30**

Reference Books:

1. P. K. Mohapatra, Textbook of Environmental Biotechnology, I.K. International Publishing House; 1st Ed. Edition (2013).
2. Sree Krishna V Bioethics and Biosafety in Biotechnology, New age international publishers (2007)
3. Bruce E Rittman and Perry L McCarty, Environmental Biotechnology, Principles and Applications McGrawhill Higher education (2001).
4. Hans-Joachim Jördening and J Winter, Environmental Biotechnology WILEY-VCH Verlag Gmbh & Co (2005).
5. Pedro J J Alvarage and Walter A Illman, Bioremediation and Natural Attenuation Wiley Interscience (2005).
6. L K Wang et al, Environmental Biotechnology, Vol 10 Handbook of Environmental Engineering, Humana Press (2010).

SEMESTER –III (GENERIC ELECTIVE)

SBTTG 201: Medical Biotechnology

Theory	**Subject Code: SBTTG 201**
Total Marks for Evaluation: 50	No. of Contact Hours: 2hr/week, Credit: 2

Course pre-requisite :

- The candidate should have basic knowledge of Microbiology, Biochemistry, Genetics

Course objectives :

- The objective of the course is make aware students about the various medical diagnostic techniques and their use in diagnosing various disorders in humans.

Course outcomes:

- On successful completion of the course, students will be able to compare and contrast different microbial diseases, including properties of different types of pathogens, and mechanisms of pathogenesis; summarize role of host in infectious disease,.

Curriculum Details:

Module No.	Unit No.	Topic	Hrs.
1. 0		**Unit I**	08
	1.1	Concepts of microbial sterilization and disinfection. Bacterial growth and measurements, Principles of microbial pathogenesis.	
	1.2	Correction of host immunodeficiency, Probiotics.	
	1.3	Human genetics- background and history, types of genetic diseases and clinical impact.	
	1.4	Types of genetic diseases and clinical impact.	
2.0		**Unit II**	08
	2.1	Molecular basis of infection and pathogenesis of Bacillus anthracis, Mycobacterium spp.	
	2.2	PCR based diagnostics; ligation chain reaction, diagnostics, array-based diagnostics.	
	2.3	DNA sequencing, genetic profiling	
	2.4	Single nucleotide polymorphism. EST	
3.0		**Unit III**	08
	3.1	Diagnosis of infectious diseases, respiratory diseases (influenza, etc.)	
	3.2	Parasitic diseases and mycobacterium diseases. Phage display, immunoarrays, FACs	
	3.3	Diagnosis of Viral diseases-HIV;	
	3.4	Diagnosis of bacterial diseases, enteric diseases	
4.0		**Unit IV**	06
	4.1	Molecular basis of viral infections	
	4.2	Molecular biology of Hepatitis infection,.	

	4.3	Molecular basis of fungal infections, therapeutics and control.	
	4.4	Vector based vaccine, Vaccine against COVID 19	
		Total	30

Reference Books:

- Buckingham and Maribeth Flaws. Molecular Diagnostics: Fundamentals, , Lela Buckingham Publisher: F A Davis Co (2007)
- Wayne W. Grody, Robert. Molecular Diagnostics: Techniques and Applications for the Clinical Laboratory (2005)

SEMESTER –III (Vocational Course)

SBTTV 201 Vermiculture and Vermicompost

Theory	**Subject Code: SBTTV 201**
Total Marks for Evaluation: 50	No. of Contact Hours: 4hr/week, Credit: 2

Course pre-requisite

- The candidate should have basic knowledge of cultivation of worms (Earthworms)

Course Objectives:

- To introduce the students t to compost in a limited space and describe the decomposing process. The interested students will get the knowledge of composting. They will get the knowledge of biodiversity of local earthworms

Course Outcomes:

- The students will get the knowledge of composting.
- They will get the knowledge of biodiversity of local earthworms

Curriculum Details:

Module No.	Unit No.	Topic	Hrs.
1. 0		**Unit I**	08
	1.1	Introduction to vermiculture. definition, meaning, history, economic important, their value in maintenance of soil structure, role as fourr's of recycling reduce, reuse, recycle, restore.	
	1.2	Bio transformation of the residues generated by human activity and production of organic fertilizers.	
	1.3	The matter and humus cycle (product, qualities). Ground population, transformation process in organic matter.	
	1.4	Choosing the right worm. Useful species of earthworms. Local species of earthworms. Exotic species of earthworms. Complementary activities of auto evaluation.	
2.0		**Unit II**	08
	2.1	Key to identify the species of earthworms.	
	2.2	Biology of Eisenia fetida.Taxonomy Anatomy, physiology and reproduction of Lumbricidae. Vital cycle of Eisenia fetida: alimentation, fecundity, annual reproducer potential and limit factors (gases, diet, humidity, temperature, PH, light, and climatic factors).	
	2.3	Complementary activities of auto evaluation	
	2.4	Small Scale Earthworm farming for home gardens - Earthworm compost for home garden	
3.0		**Unit III**	08
	3.1	Conventional commercial composting - Earthworm composting larger scale	
	3.2	Earthworm Farming (Vermiculture), Extraction (harvest),	

		vermicomposting harvest and processing.	
	3.3	Nutritional Composition of Vermicompost for plants, comparison with other fertilizers	
	3.4	Vermiwash collection, composition & use	
4.0		**Unit IV**	06
	4.1	Enemies of Earthworms, Sickness and worm's enemies. Frequent problems.	
	4.2	Effect of vermicompost application on soil and plant growth,	
	4.3	Vermicompost as a organic manure a good substitute of fertilizers	
	4.4	Influence of pests and microbes on vermiculture, measures to control them.	
		Total	30

Sr. No.	**List of Experiments**
1	Stuey to identify different types of earthworms.
2	Field trip- Collection of native earthworms & their identification
3	Study of Sytematic position, habits, and habitat & External characters of *Eisenia fetida*
4	Study of Life stages & development of *Eisenia fetida*
5	Study of Life stages & development of Eudrilus eugeniae.
6	Comparison of morphology & life stages of *Eisenia fetida* & Eudrilus eugeniae
7	Study of Vermiculture, Vermiwash& Vermicompost equipments, devices
8	Preparation vermibeds, maintenance of vermicompost & climatic conditions
9	Harvesting, packaging, transport and storage of Vermicompost and separation of life stages; Study of verms diseases & enemies

Recommended Books:

1. Bhatt J. V. & S. R. Khambata. "Role of Earthworms in Agriculture" Indian Council of Agricultural Research, New Delhi.(1959)
2. Dash, M.C., B.K.Senapati, P.C. Mishra " Verms and Vermicomposting" Proceedings of the National Seminar on Organic Waste Utilization and Vermicomposting Dec. 5-8, 1984, (Part B), School of Life Sciences, Sambalpur University, Jyoti Vihar, Orissa (1980)
3. Edwards, C.A. and J.R. Lofty"Biology of Earthworms" Chapman and Hall Ltd., London. 1977
4. Lee, K.E. "Earthworms: Their ecology and Relationship with Soils and Land Use" Academic Press, Sydney 1985.
5. Kevin, A and K. E .Lee " Earthworm for Gardeners and Fisherman" (CSIRO, Australia, Division of Soils) 1989.
6. Rahudakar V. B. . Gandulkhatashivay Naisargeek Paryay, Atul Book Agency, Pune. 7. 2004.
7. Satchel, J.E. "Earthworm Ecology" Chapman Hall, London. 8. 1983.
8. Wallwork, J.A. "Earthworm Biology" Edward Arnold (Publishers) Ltd. London. 1983.
9. Christy, M. V. Vermitechnology, 1st edition, MJP Publishers 2008.
10. Dash, M. C. Charles Darwin's Plough Tool for Vermitechnology, I. K. International Publishing House Pvt Ltd. New Delhi, India. 2012

SEMESTER IV

SBTTC- 251: General Microbiology

Theory	Subject Code: SBTTC- 251
Total Marks for Evaluation: 50	No. of Contact Hours: 2hr/week, Credit: 2

Course pre-requisite:

- The candidate should have basic knowledge of microbes

Course objectives:

- Exploring the microbial world and analyzing the specific benefits and challenges.

Course outcome: By the end of the program the students will be able to:

- Get knowledge and understanding of concepts of microbiology and its application in pharma, food, agriculture, beverages, nutraceutical industries.
- Get learning and practicing professional skills in handling microbes and contaminants in laboratories and production sectors.

Curriculum Details:

Module No.	Unit No.	Topic	Hrs.
1. 0		**Overview of history of Microbiology**	08
	1.1	Biogenesis and abiogenesis,	
	1.2	Contributions of Redi, Spallanzani, Needham, Pasteur, Tyndal, Joseph Lister.	
	1.3	Koch [Germ Theory], Edward Jenner and Flemming [Penicillin]	
	1.4	Scope of Microbiology(Industrdy, Medical science and Agriculture).	
2.0		**Classification of Microbes**	08
	2.1	Systems of classification, Numerical taxonomy, Identifying characters for classification.	
	2.2	General properties and principles of classification of microorganisms.	
	2.3	Systematics of bacteria, Nutritional types [Definition and examples].	
	2.4	Classification of bacteria on the basis of oxygen requirement.	
3.0		**Concept of Sterilization**	08
	3.1	Definition of sterilization, dry and moist heat, pasteurization, tyndalization; radiation, ultrasonication, filtration.	
	3.2	Physical and Chemical methods of sterilization;	
	3.3	Disinfection sanitization, antisepsis sterilants and fumigation.	
	3.4	Determination of phenol coefficient of disinfectant.	
4.0		**Stains and staining techniques**	06
	4.1	Definition of auxochrome , chromophores, dyes, Classification of stains.	

	4.2	Theories of staining, Mechanism of gram staining, acid fast staining,	
	4.3	Negative staining, capsule staining, flagella staining, endospore staining.	
	4.4	List of common bacterial, fungal and viral diseases of human beings.	
		Total	30

Reference Books:

1. Linda Bruslind. General Microbiology 1 st Edition , Oregon State University 2020
2. Prescott, Harley, Klein's Microbiology, J.M. Willey, L.M. Sherwood, C.J. Woolverton, 7th International, edition McGraw Hill 2008,.
3. K. P. Talaro. Foundations in Microbiology, , 7th International edition , McGraw Hill. 2009.
4. R. C. Dubey and D. K. Maheshwari. A Textbook of Microbiology, , 1st edition, S. Chand & Company Ltd. Brock Biology of Microorganisms 1999.
5. G. J.Tortora, B. R.Funke, C. L. Case,Microbiology – An Introduction, 10th ed. Pearson Education 2008,.
6. Stanier, Ingraham et al. General Microbiology, , 4th and 5th edition , Macmillan education limited 1987.
7. Pelczar Jr,Chan, Krieg. Microbiology- Concepts and Applications, International ed, McGraw Hill 2000.
8. Alexopoulos, C.J., Mims, C.W., and Blackwell, M. Introductory Mycology. John Wiley and Sons (Asia) Pvt. Ltd. Singapore 2002.
9. Atlas, R.M. . Basic and practical microbiology. Mac Millan Publishers, USA. 987pp 1984.
10. Black, J.G. Microbiology principles and explorations. 7edn. John Wiley and Sons Inc., New Jersey 2008.

SBTTC- 253 Lab Course in Microbiology

Course pre-requisite:

- The candidate should have basic knowledge of microbes

Course Objectives:

- To Explore the microbial world and analyse the their specific benefits and challenges

Course Outcomes: At the end of the course, the students should be able to:

- Learn practicing professional skills in handling microbes
- Get thorough knowledge and application of good laboratory and good manufacturing practices in microbial quality control.

Sr. No.	**List of Experiments**
1	Microbiological laboratory standards and safety protocols.
2	Standard aseptic conditions of Microbiological laboratory
3	Operation and working principles of Light/ Compound microscope
4	A. Working principles and operations of basic equipments of microbiological laboratory (Autoclave, Oven, Incubator, pH meter, Spectrophotometer, Colorimeter, Vortex,

	Magnetic stirrer).
5	Applications of basic microbiological tools (Pipettes, Micropipette, Bunsen burner, Inoculation loop, Spreader)..
6	Demonstration and observations of microorganisms from natural sources under light microscope (Algae, Yeast and Protozoa).
7	Demonstration of bacterial motility by hanging drop method.
8	Simple staining & Negative staining
9	Differential staining - Gram staining
10	Acid fast staining
11	Structural staining - Flagella and Capsule
12	Bacterial endospore staining

Recommended Books:

1. Linda Bruslind. General Microbiology 1 st Edition, Oregon State University 2020
2. Prescott, Harley, Klein's Microbiology, J.M. Willey, L.M. Sherwood, C.J. Woolverton, 7th International, edition McGraw Hill. 3, 2008,
3. K. P. Talaro. Foundations in Microbiology, , 7th International edition , McGraw Hill 2009.
4. R. C. Dubey and D. K. Maheshwari. A Textbook of Microbiology, , 1st edition, S. Chand & Company Ltd.1999.
5. M.T.Madigan, J.M.Martinko, P. V. Dunlap, D. P. Clark. Brock Biology of Microorganisms,- 12th edition, Pearson International edition , Pearson Benjamin Cummings, 2009.
6. G. J.Tortora, B. R.Funke, C. L. Case. Microbiology – An Introduction, 10th ed. Pearson Education, 2008,
7. Stanier, Ingraham et al. General Microbiology, 4th and 5th edition , Macmillan education limited. 1987
8. Pelczar Jr,Chan, Krieg. Microbiology- Concepts and Applications, International ed, McGraw Hill 1997.
9. Alexopoulos, C.J., Mims, C.W., and Blackwell, M. Introductory Mycology. John Wiley and Sons (Asia) Pvt. Ltd. Singapore. 2002.
10. Atlas, R.M. Basic and practical microbiology. Mac Millan Publishers, USA. 1984.
11. Black, J.G. . Microbiology principles and explorations. 7edn. John Wiley 2008

SBTTC- 252: Genetics II

Theory	Subject Code: SBTTC- 252
Total Marks for Evaluation: 50	No. of Contact Hours: 2hr/week, Credit: 2

Course pre-requisite:

- The candidate should have basic knowledge of Medical Genetics

Course objectives:

- The objective is to provide students with a broadly-based and fundamental understanding of genetics, Human chromosome and genetic disorders.

Course outcomes:

- Students will be able to demonstrate and apply their knowledge of cell biology and genetics to solve the problems related to the field of Human genetics.

Curriculum Details:

Module No.	Unit No.	Topic	Hrs.
1. 0		**Human Chromosomes**	08
	1.1	Normal Human Karyotype	
	1.2	Paris Nomenclature, Flow karyotyping (Quantification of DNA of individual chromosomes)	
	1.3	FACS- Fluorescence Activated Cell Sorter	
	1.4	Concept of Epigenetics	
2.0		**Genetic Diseases and Inheritance Pattern**	08
	2.1	Autosomal inheritance- Dominant. X-linked- Dominant.	
	2.2	Autosomal inheritance- Recessive.	
	2.3	X-linked – Recessive	
	2.4	Y-linked inheritance : Holandric gene	
3.0		**Pedigree studies**	08
	3.1	Symbols used in pedigree studies, Pedigree analysis and construction,	
	3.2	Pedigree analysis for the inheritance pattern of genetic diseases.	
	3.3	Genetic Counselling : History and pedigree construction, Examination, Diagnosis, Counselling & follow up.	
	3.4	Ethical concerns in genetic counselling.	
4.0		**Immunogenetics & Oncogenetics**	06
	4.1	Introduction to immunology- antigens, antibodies, B and T Cells Immunity- Innate and acquired.	
	4.2	Immune response - Humoral and Cell mediated, Genetics of immune system – Antibody gene rearrangement and class switching.	
	4.3	A brief account of cancer-definition, types-Benign and Malignant; Sarcoma, Carcinoma, Lymphoma and Leukaemia Properties of malignant cells.	

	4.4	Types of genes - Proto oncogenes, Oncogenes, Difference between Vonc and C – onc oncogenes, Tumor Suppressor genes-p53, pRb.	
		Total	30

Reference Books:

1. EJ. Manage and A.P. Manage. Basic Human Genetics Rastogi Publications, Meerut 1997.
2. Peter Turnpenny, Slan Ellard. Emery's Elements of Medical Genetics- 15th Edition. 2017.
3. S.M. Bhatnagaretal. Essentials of Human Genetics IV edition. Orient Longman 1999.
4. R. A. King et al.Genetic basis of common diseases by , Oxford University Press 2002.
5. M.W. Thompson et al. Genetics in Medicine 5 Edition, W.B. Sounders Company, London 1996.
6. Denise Rooney. Human Cytogenetics. Oxford University Press, 2001.
7. Lewis R. Human Genetics : Concepts and Applications McGrawHi; Boston. 2001.
8. S.D. Gangane. Human Genetics, B.L Churchill Livingstone Pvt. Ltd., New Delhi 2001.
9. Lynn Jorde. Medical Genetics. John Carey Michael Bamshad. 2015.
10. Kusick V.A, Mendelian inheritance in Man by-Mc. 1998,

SBTTC- 254 Lab Course in Genetics II

Course pre-requisite :

- The candidate should have basic knowledge of Medical Genetics

Course Objectives:

- To provides suitable platform to use different genetic tools for the proper detection and diagnosis of both common and complex genetic disorders.

Course Outcomes:

- The course has been designed to provide an introduction to the basic concepts about the different types of diagnostic techniques. These techniques are the most relevant techniques used for the genetic testing purposes and would give a more comprehensive picture to make genetic testing relevant in day to day life.

Sr. No.	**List of Experiments**
1	Study of Karyotypes I: Normal Karyotyping in Human, Male (46,XY), Female (46, XX).
2	Study of Karyotypes II: Abnormal Karyotypes
3	Down's syndrome (autosomal).
4	Turner's syndrome (sex chromosomal)
5	Klinefelter's syndrome (sex chromosomal)
6	Study of Barr body in the Buccal epithelial cells.
7	Study of drum sticks in Neutrophils of Blood smear
8	Blood Cell counting using Haemocytometer (RBC and WBC)
9	Pedigree analysis and construction

Recommended Books:

1. EJ. Manage and A.P. Manage. Basic Human Genetics Rastogi Publications, Meerut 1997.
2. Peter Turnpenny, SlanEllard. Emery's Elements of Medical Genetics- 15th Edition. 2017.
3. S.M. Bhatnagaretal. Essentials of Human Genetics IV edition. Orient Longman 1999.
4. R. A. King et al.Genetic basis of common diseases by , Oxford University Press 2002.
5. M.W. Thompson et al. Genetics in Medicine 5 Edition, W.B. Sounders Company, London 1996.

SEMESTER–IV (Minor)

SBTTC 251: General Microbiology & Immunology

Theory	Subject Code: SBTTC 251
Total Marks for Evaluation: 50	No. of Contact Hours: 2hr/week, Credit: 2

Course pre-requisite :

- The candidate should have basic knowledge of microbes

Course objectives:

- To demonstrate an understanding of the structural similarities and differences among microbes and the unique structure/function relationships of prokaryotic cells
- To comprehend the fundamentals of Immunology

Course outcomes:

- Students will get thorough knowledge and understanding of concepts of microbiology & Immunology

Curriculum Details:

Module No.	Unit No.	Topic	Hrs.
1. 0		**Historical development of microbiology**	08
	1.1	Biogenesis and abiogenesis,	
	1.2	Theory of spontaneous generation, Biogenesis and Abiogenesis. Contributions of Anton Von Leeuwenhoek, Louis Pasteur, Robert Koch, Joseph Lister and Edward Jenner, Alexander Fleming, Martinus Beijirinic, Segei Winogrodsky, Elei Metechnikoff. Contributions of Indian scientists in the field of Microbiology.	
	1.3	Fossil evidences of microorganisms. Origin of life, primitive cells and evolution of microorganisms.	
	1.4	Microscopy- working principle, construction and operation of simple and compound microscopes	
2.0		**Types, structure, organisation and reproduction of prokaryotic microorganism**	08
	2.1	Overview of Prokaryotic Cell Structure: Size, shape, arrangement. Diagram of Prokaryotic cell organisation, cell wall structure of Gram positive and negative bacteria, cell membrane.	
	2.2	Bacterial and Archaeal, Cytoplasmic matrix- Cytoskeleton, ribosome, inclusion granules: Composition and function.	
	2.3	Nuclear Materials – Bacterial chromosomes structure (its differences with the Eukaryotic chromosome); Extra Chromosomal materials.	
	2.4	Components external to cell wall- capsule, slime, s- layer, pilli, fimbriae, flagella; structure, motility, chemotaxis.	
3.0		**Types, structure, organisation and reproduction of eukaryotic microorganisms**	08

	3.1	Over view of eukaryotic cell structure: General structure and types of cells; External cell coverings and cell membrane.	
	3.2	Structure and function of Cytoplasmic matrix- cytoskeleton: Structure and function; single Membrane organelles- Endoplasmic reticulum, Golgi complex, Lysosomes, Vesicles and Ribosomes.	
	3.3	Double Membrane organelles- Nucleus, Mitochondrion and Chloroplast: Structure and Functions; Peroxisomes	
	3.4	Organelles of motility- Structure and movement of flagella and cilia.	
4.0		**Immunology**	06
	4.1	Introduction to Immune system; Innate & Acquired Immunity	
	4.2	Cells & organs of Immune system; Immune Response; Antigens: Immunogenicity vs Antigenicity;Structure of T & B cells	
	4.3	Immunoglobulins: Types, Structure & Function;	
	4.4	Cytokines, their role in human diseases	
		Total	30

Reference Books:

1. Linda Bruslind. General Microbiology 1 st Edition,Oregon State University 2020 .
2. Prescott, Harley, Klein's Microbiology, J.M. Willey, L.M. Sherwood, C.J. Woolverton, 7th International, edition, McGraw Hill. 2008,
3. K. P. Talaro. Foundations in Microbiology, , 7th International edition McGraw Hill. 2009.
4. R. C. Dubey and D. K. Maheshwari. A Textbook of Microbiology, , 1st edition, , S. Chand & Company Ltd. Brock Biology of Microorganisms. 1999.
5. G. J.Tortora, B. R.Funke, C. L. Case. Microbiology – An Introduction, 10th ed. Pearson Education 2008,
6. Kenneth Murphy et al., Immunobiology, 8th GS publications, 2012.
7. Richard A. Goldsby, Barbara A. Immunology by Osborne, Thomas J. Kindt, Janis Kuby, Janis Kuby, Richard A. Goldby, 7th edition, 2013.
8. Roitt's, Essential Immunology, 13th edition, Wiley-Blackwell Co., 2017
9. Atlas, R.M. Basic and practical microbiology. Mac Millan Publishers, USA. 1984.
10. Black, J.G.. Microbiology principles and explorations. 7edn. John Wiley and Sons Inc., New Jersey 2008.

SEMESTER–IV (Minor)

SBTTC-252 Microbial Genetics (Minor)

Theory	Subject Code: SBTTC-252
Total Marks for Evaluation: 50	No. of Contact Hours: 2hr/week, Credit: 2

Course pre-requisite

- The candidate should have basic knowledge of microbes

Course objectives:

- To introduce the concept of Classical Mendelian genetics and deviation from Mendelian principles, Microbial genome organization (Prokaryotic and Eukaryotic), Viral Genetics, Mutagenesis, Bacterial plasmids as research tools, transcription and translation in prokaryotes and eukaryotes and application of microbial genetics.

Course outcome: After completion this course, students will be able to

- Explain principles/concept of Prokaryotic and Eukaryotic genetics, Viral genetics and application in research.
- Explain Mutagenesis, Mutation and mutants and their significance in microbial evolution
- Understand the application of bacterial and eukaryotic plasmids in research.

Curriculum Details:

Module No.	Unit No.	Topic	Hrs.
1. 0		**Modern concept of gene**	08
	1.1	Gene structure, co-linearity and polypeptide, one gene – one enzyme, protein polypeptide or product concepts; types of genes.	
	1.2	Genome diversity : Viruses – linear, circular and dividend genomes of RNA and DNA viruses. Prokaryotes – nucleoid and chromosome organization, genome evolution in microbes, phylogenetic trees. Eukaryotes – chromosome organization / structure, histones, nucleosomes, genome complexity, chromosomal banding. Organelle genomes. Genetic mapping of genomes.	
	1.3	Plasmids : bacterial and yeast plasmids, purification, properties, detection, transfer, replication an curing, significance / importance.	
	1.4	Transposal / mobile genetic elements : Prokaryotes – (IS elements, composite and complex transposons), mechanisms of transposition and importance – Eukaryotes (Yeast, Drosophila and Maize) – retrotransposons, retroelements. Exploitation of transposable elements in genetics.	
2.0		**Mutation and Recombination**	08
	2.1	Mutations: Types, mutagens and molecular mechanisms of mutation, isolation and analysis of mutants, significance of mutants.	
	2.2	Genetic recombination: General of homologous recombination,	

		site specific recombination,	
	2.3	Transposition; illegitimate recombination and artificial recombination.	
	2.4	Transposable elements	
3.0		**DNA replication and synthesis**	08
	3.1	DNA replication : general principles, various modes of replication. Continuous and discontinuous synthesis, relation between cell cycle and DNA synthesis, replication fork and enzymology of DNA replication in prokaryotes and eukaryotes, replication of ssDNA.	
	3.2	Retroviruses and their unique mode of DNA synthesis, inhibitors of DNA replication.	
	3.3	Translation (Protein biosynthesis) : Central dogma theory and flow of genetic information, genetic code and its elucidation, structure and composition of prokaryotic and eukaryotic ribosomes, structural features of rRNA, mRNA and tRNA in relation to function, steps of protein biosynthesis (activation of amino acids, initiation, elongation, termination) in prokaryotes and eukaryotes;	
	3.4	Post-translational modification of proteins and their sorting and targeting; regulation of translation; inhibitors of protein biosynthesis; invitro translation systems.	
4.0		**Regulation of gene expression**	06
	4.1	An overview on levels of regulation, terminology and operon concepts, enzyme induction and repression; positive and negative regulation in E. coli.	
	4.2	Lac and ara operons; regulation by attenuation – his and trp operons.	
	4.3	Antitermination – N protein and nut sites in Lambda phage.	
	4.4	Organization and regulation of nif and nod gene expression in bacteria; gal operon in yeast.	
		Total	30

Reference Books:

1. Alberts, B., Bray, D., Lewis, J., Raff, M., Roberts, K., Watson, J.D., Molecular Biology of The Cell, 2nd ed., Garland Publishing, Inc., New York 1989.
2. Darnell, J., Lodish, H., Baltimore, D., , Molecular Cell Biology, Scientific American Books, New York.1990.
3. Freifelder, D., Malacinski, G.M., Essentials of Molecular Biology, John and Bartlett Publishers, London 1987.
4. Watson, Baker, Bell, Gann, Levine, Losick. . Molecular biology of the gene . 5th ed. Pears.pdfMicrobial Genetics. , by David Freifelder. Narosa Publ. House 2004.
5. Biochemistry and Molecular Biology. , by W.H. Elliott & D.C. Elliott. Oxford University Press 1997.
6. Watson et al, Molecular biology of the Gene. 5th ed. Addison Wesley Longman 1998,
7. W.D. Stansfield et al. Schaums Outlines – Molecular and Cell Biology. 1996. , McGraw-Hill Publ.

SEMESTER–IV (Generic Elective)

SBTTG- 251: Human Microbiome (Generic Elective)

Theory	**Subject Code: SBTTG- 251**
Total Marks for Evaluation: 50	No. of Contact Hours: 2hr/week, Credit: 2

Course pre-requisite

- The candidate should have basic knowledge of microbes

Course objectives:

- To demonstrate to the students the importance of the human microbiome to development and health.

Course outcome

- This course will introduce students to the human microbiome and its influences on health and disease.

Curriculum Details:

Module No.	**Unit No.**	**Topic**	**Hrs.**
1. 0		**Unit I**	08
	1.1	Introduction to the human microbiome, role in human health	
	1.2	Microorganisms of the human microbiome	
	1.3	Colonization of the human body	
	1.4	The gut microbiome	
2.0		**Unit II**	08
	2.1	Antibiotics and the human microbiome	
	2.2	Diet and the human microbiome	
	2.3	Probiotics, prebiotics and the human microbiome	
	2.4	Role of probiotics in food	
3.0		**Unit III**	08
	3.1	Drug metabolism by the microbiome	
	3.2	Behavior and the microbiome	
	3.3	The skin microbiome and Exchange between the human microbiome and the built environment	
	3.4	Infection of Helminths: Pathogenesis and Defenses	
4.0		**Unit IV**	06
	4.1	Comparative microbiomes form animals	
	4.2	Human infectious diseases Chickenpox, HIV/AIDS, COVID 19	
	4.3	Various human parasitic infections agents	
	4.4	Neglected tropicaldiseases	
		Total	30

Reference Books:

1. Ley, R. E., et al. "Worlds within worlds: evolution of the vertebrate gut microbiota." Nat Rev Microbiol 6(10): 776-788. 2008.
2. Mueller NT, et al. The infant microbiome development: mom matters. Trends in molecular medicine. :21(2):109-117 2015.
3. Dominguez-Bello MG and Blaser MJ. Microbes as markers for migrations of individuals and human populations. Annual review of anthropology. :40:451-474. 2011
4. Ruiz-Calderon et al. Walls talk: Microbial Biogeography of Homes Spanning Urbanization. Science Advances. : 2(2):e1501061-e1501061.
5. Lozupone, C. A., et al. (2012). "Diversity, stability and resilience of the human gut microbiota." Nature 489(7415): 220-230. 2016

SEMESTER –IV (Skill Enhancement Course)

SBTTS 251 Principles of Fermentation Technology

PRACTICAL	**Subject Code:** SBTTS-251
Total Marks for Evaluation: 50	No. of Contact Hours: 4hr/Week, Credits: 2

Course pre-requisite:

- The candidate should have basic knowledge of fermentation technology

Course Objectives:

- To make the students well versed with the screening techniques, Microbial assays, Primary & secondary metabolites
- To give the students knowledge of design of fermenters, types of fermenters , equipments & instruments used in fermentation and sterilization processers.
- To acquaint the students with fermentation media, inoculum preparation, Scale up processes &.various downstream processes used in fermentation industries

Course Outcomes:

- On successfully completing the module, students will be well versed with the screening techniques, microbial assays, primary & secondary metabolites.
- Students will gain the knowledge of design of fermenters, types of fermenters , equipments, instruments used, sterilization processers.
- Students will be well versed with fermentation media, inoculum preparation, Scale up Processes and with the various downstream processes of fermentation industries.

Curriculum Details:

Module No.	Unit No.	Topic	Hrs.
1. 0		**Unit I**	08
	1.1	Major types of organisms used in fermentation. Microbial growth kinetics.	
	1.2	Batch culture, Continuous Culture, Fed – Batch – Types#, applications, fermentation kinetics.	
	1.3	Isolation, preservation and improvement of industrially important microorganisms.	
	1.4	Media for industrial fermentations – media formulation,	
2.0		**Unit II**	08
	2.1	Fermenter design and types	
	2.2	**B**asic functions of a Fermenter for microbial and animal cell culture	
	2.3	Alternative vessel design, common measurements and control systems.	
	2.4	Bioreactor design for sterile operation – sterilization in place, Clean in place considerations.	
3.0		**Unit III**	08
	3.1	Control of fermentation	
	3.2	Design of a fermentation control systems,	

	3.3	Requirements for control sensors and controllers,	
	3.4	Control of incubation, aeration and agitation.	
4.0		**Unit IV**	06
	4.1	Computers in fermentation, –	
	4.2	Modelling, software sensors,	
	4.3	Control and supervision of fermentation processes.	
	4.4	Off-line / online measurements – PID.	
		Total	30

Sr. No.	**List of Experiments**
1	Media preparation, Sterilization. .
2	Culture transfer techniques, Isolation of pure cultures
3	Microbial isolation and screening.
4	Bacterial staining
5	Bacterial growth curve studies
6	Isoation of Antibiotic producing organism
7	Extracellular activities of micro organisms- amylase, gelatinase, lipase, caseinase
8	Qualitative study of enzyme activity
9	Effect of pH, Temperature, Substrates, Inhibitor on enzyme activity
10	Enzyme kinetics – Km, Vmax, Specific activity and activity determination
11	Anatomy of Fermentor, cleaning of Fermentor, Assembling and final pre-sterilization of Fermentor, Anatomy and calibration of fermentator electrodes / probes, Post – sterilization procedures, Aseptic techniques in inoculation of fermentors
12	Techniques to determine microbial contaminations

Recommended Books:

1. Prescott, L.M, Harley, J.P, Klein, D.A.; 1st Edition. Microbiology McGraw Hill. (2007).
2. Whitaker; Stanbury, Peter F; Hall, S.; Whitaker, A.Principles of Fermentation Technology, Second Edition CICPress. 2003
3. Arnold L. Demain & Julian E. Davis. Industrial Microbiology & Biotechnology ASM Press. (2004).
4. Coulson, J.M. and J.F. Richardson. Chemical Engineering, Pergamon Press. (1984).
5. Mansi & CFA. Bryce. Fermentation Microbiology & Biotechnology Taylor & Francis Ltd. (2004).
6. Stanbury, P.F., A. Whitaker & S.J. Hall. Principles of fermentation technology Oxford. (1997).
7. S.S. Purohit, H.N. Kakarni and A.K. Saluja. Pharmaceutical Biotechnology", Agrobios (India) (2007).
8. Colin Ratledge and Bjorn Kristiansen. Basic Biotechnology, Cambridge University, Press, New York.(2001),

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