॥ मा विद्या या विमुक्तये ॥

स्वामी रामानंद तीर्थ मराठवाडा विद्यापीठ, नांदेड

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

SWAMI RAMANAND TEERTH MARATHWADA UNIVERSITY, NANDED

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

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

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 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 - 431 606 (MS)

(Credit Framework and Structure of Four Year UG Program with Multiple Entry and Exit Option as per NEP-2020)

UNDERGRADUATE PROGRAMME OF SCIENCE & TECHNOLOGY

Major in **Industrial Microbiology** and Minor in **DSM**
(Subject)

Under the Faculty of Science & Technology

(Revised as per the Govt. Of Maharashtra circular dt. 13th March 2024)

Effective from the Academic year 2024 – 2025

(As per NEP-2020)

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

From Desk of Chairman, Board of Studies of the Subject Industrial Microbiology

Preamble:

The emergence of microbiology many centuries ago is considered one of many of the most important scientific achievements. Since then, it has become a leading field in the biological sciences and a popular course of study in higher institutions worldwide. Like every other BSc programme in tertiary education, B.Sc. Industrial Microbiology has its own set of different syllabi, which students must cover before they are allowed to graduate.

The New Education policy presents an opportunity to shift paradigm from a teacher – centric to student centric higher education system in India. It caters for skill-based education. The learning outcomes-based curriculum framework for a degree in B. Sc. (Honors) B.Sc. Industrial Microbiology is intended to provide a comprehensive foundation to the subject and to help students develop the ability to successfully continue with further studies and research in the subject while they are equipped with required skills at various stages. Efforts has been made to integrate use of recent technology in teaching and learning. The syllabus is designed to equip students with valuable cognitive abilities and skills so that they are successful in meeting diverse needs of professional careers in a developing and knowledge-based society. The curriculum considers the need to maintain globally competitive standards of achievement in terms of knowledge and skills in B.Sc. Industrial Microbiology as well as develop scientific orientation, problem solving skills, human and professional values which foster rational and critical thinking in the students. This course serves a good opportunity in different fields in Microbiology.

In addition to these Program Educational Objectives, for each course of undergraduate program, objectives and expected outcomes from learner's point of view are also included in the curriculum to support the philosophy of outcome-based education. I believe strongly that small step taken in right direction will definitely help in providing quality education to the stake holders.

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B. Sc. Industrial Microbiology Program Objectives and Outcomes

PROGRAMME OBJECTIVES:

- To enrich students with knowledge and understanding of the different disciplines of Microbiology such as medical Microbiology, immunology, biochemistry, fermentation technology, environmental Microbiology, genetics, agricultural and food Microbiology, Waste management.
- To make students learn advanced fields of Industrial Microbiology such as Nanobiotechnology and Marine microbiology.
- To introduce the concepts of application and research in Industrial Microbiology and inculcate sense of scientific responsibilities.
- To help student's build-up a progressive and successful career in Industrial Microbiology.
- To take a step ahead for the holistic development of students through activities like lectures from eminent personalities, Visits, and various competitions.

- It makes the students competent enough to use Industrial Microbiology knowledge and skills to analyze problems involving microbes and undertake remedial measures.
- In addition, students are to be trained to use this knowledge in day-today applications and get a glimpse of research.
- The students graduating in B.Sc. Industrial Microbiology degree must have thorough understanding the fundamentals of Microbiology as applicable to wide ranging contexts.
- They should have the appropriate skills of Industrial Microbiology so as to perform their duties as microbiologists.
- They must be able to analyze the problems related to Industrial Microbiology and come up with most suitable solutions.
- As Industrial Microbiology is an interdisciplinary subject the students might have to take inputs from other areas of expertise. So, the students must develop the spirit of team work.

PROGRAM SPECIFIC OBJECTIVES [PSOB]: Programme Specific Objectives for B.Sc. Industrial Microbiology are as follows:

- PSOB-1. The broad goal of the teaching to under graduate students in Industrial Microbiology is to provide knowledge and skills in Industrial Microbiology to develop practical skills through the laboratory work, their presentation and articulation skills, exposure to industry and interaction with industry experts, write short research - based projects.
- PSOB-2. To learn basic concepts of amazing world of Microorganisms, Techniques in Microbiology, basics of Bacteriology, Cultivation, and growth of Micro-organisms.
- PSOB-3. To understand concepts of Medical Microbiology, Epidemiology, Immunology, Bacterial Physiology, Fermentation Technology, Bacterial Genetics, Air, Water and Soil Microbiology.
- PSOB-4. To strengthen the fundamentals of various fields of Industrial Microbiology.
- PSOB-5.To develop scientific aptitude and motivate students to take up higher studies like B. Sc. (Hons. / Hons. with Research) microbiology and Research.
- PSOB-6. To realize and appreciate the applicability of knowledge and Interdisciplinary approach in everyday life.
- PSOB-7. The graduate students of Industrial microbiology should have basic skills such as culturing microbes, maintaining microbes, safety issues related to handling of microbes, Good Microbiological practices etc.

PROGRAMME SPECIFIC OUTCOMES [PSOC]: Programme specific outcomes for B.Sc. Microbiology are as follows:

- PSOC-1. The student will be able to explain various fields of Applied Science including Medicine, Pharmacy, Cell biology, Biotechnology, Industrial Production, Biochemistry, Nanotechnology, Environmental Management, Food, Dairy, Immunology, Agriculture and Bioinformatics

- PSOC-2. The students will be able to design and execute experiments related to Basic Microbiology, Immunology, Molecular Biology, Recombinant DNA Technology, and Microbial Genetics, etc.
- PSOC-3. The students will be able to execute a short research project incorporating techniques of Basic and Advanced Industrial Microbiology under supervision.
- PSOC-4. The students will be able to acquire sound knowledge of classification, taxonomy, structure , types of microorganisms and various fields of Industrial microbiology.
- PSOC-5. The students will be able to do experiment in Industrial microbiology laboratory to identify the microorganisms in various samples including clinical, environmental, water and food samples.
- PSOC-6. The students will be able to acquire knowledge about various diseases thereby can create awareness to the public.
- PSOC-7. The students will be able to provide knowledge on food processing, and fermented food products.
- PSOC-8. The students will be able to utilize various agricultural waste, marine sources as raw material for production of various fermented products to reduce accumulation of waste in the environment.
- PSOC-9. The students will be able to check the quality of water, dairy and food products by various learnt microbiological techniques
- PSOC-10. The students will be able to provide knowledge about history of Industrial Microbiology and contribution of various scientists. branches of Microbiology, basic structure of organism in details, microbial nutrition requirement for organism and microbial growth, microbiological techniques and control, different type of staining techniques used to distinguish between different type of bacteria and its organelles.
- PSOC-11. The students will be able to acquire knowledge about the different types of bacteria and viruses, microbial interaction, prevention of food from spoilage, preservation of food from food borne disease and food standards. also study the testing and preservation of milk and milk product in dairy industries.
- PSOC-12. The students will be able to acquire knowledge about the basic structure like Nucleic acid, carbohydrates metabolism, amino acids, enzymology in details and various vitamins. also study the fermentation at industrial level and upstream and downstream processing of fermentation
- PSOC-13. The students will be able to acquire knowledge about different types of metabolic pathways and its regulation related to carbohydrates amino acid. also study about different type of waste water treatment methods and water testing methods. this also cover air and agriculture microbiology with bioremediation and biomagnification.
- PSOC -14. The students will be able to acquire knowledge about the epidemiology and host parasites, disease transmitted and their various sources, control and prevention & spreading of infection, learn about normal flora present in body, study of pathogenic and non-pathogenic organism, morphology, cultural and biochemicals characteristic, pathogenesis, serology

test and lab diagnosis, gene mutation and regulation of gene.

- PSOC-15. The students will be able to acquire knowledge about Immunity, various defense mechanism, organs of immune system, adaptive immunity, and cell mediated immune response. tools and techniques of genetic engineering. also come to know about health care, agriculture, and industrial biotechnology.
- PSOC-16 The students will be able to explain why microorganisms are ubiquitous in nature; inhabiting a multitude of habitats and occupying a wide range of ecological habitats, their role in these ecological niches, influence of microbiome on our health, environmental cleanup, variety of industrial product development, and their significance in human wellbeing.
- PSOC-17. The students will be competent enough to use microbiology knowledge and skills to analyze problems involving microbes, learning use of microbes as a model organisms to understand facts about living systems, analyze the genetic makeup of different types understand of microbes, articulate these with peers/ team members/ other stake holders through effective communication, and undertake remedial measures/ studies etc.
- PSOC-18. The students will take up a suitable position in academia or industry and to pursue a career in research.
- PSOC-19. The students will be able to develop their skills to start small scale business in various Industrial microbiological laboratories and in the field of research and health.

Dr. Santosh M. More
Chairman,
Board of Studies of the Microbiology
Swami Ramanand Teerth Marathwada
University, Nanded

Details of the Board of Studies Members in the subject Microbiology under the faculty of Science & Technology of S. R. T. M. University, Nanded

Sr No	Name of the Member	Designation	Address	Contact No.
1.	**Dr. Santosh M. More**	**Professor & BOS, Chairman**	**Yeshwant Mahavidyalaya, Nanded**	**9422871533**
2.	**Dr. Rajendraprasad S. Awasthi**	**Principal**	**Shivaji Mahavidyalaya, Renapur**	**8275924462**
3.	**Dr. Prashant Wakte**	**Professor**	**DSM's College of Arts, Commerce and Science, Parbhani**	**8669062962**
4.	**Dr. Anupama P. Pathak**	**Professor**	**School of Life Sciences, SRTM University Nanded**	**9404732162**
5.	**Dr. Shiva C. Aithal**	**Professor**	**DSM's College of Arts, Commerce and Science, Parbhani**	**7483715560**
6.	**Dr. Deepak Vedpathak**	**Professor**	**Rajarshi Shahu Mahavidyalaya, Latur**	**9822757890**
7.	**Dr. Sanjivkumar V. Kshirsagar**	**Assistant Professor**	**Sant Janabai Education Society's ACS College, Gangakhed**	**9421448741**
8.	**Dr. Hemlata J. Bhosle**	**Associate Professor**	**School of Life Sciences, SRTM University Nanded**	**8698809434**
9.	**Dr. Sunita Mukkawar**	**Associate Professor**	**B. Raghunath ACS College, Parbhani**	**9422415911**
10.	**Dr. Ravindra R. Rakh**	**Associate Professor**	**Shri Guru Buddhiswami Mahavidyalaya, Purna**	**9545335680**
11.	**Dr. Prashant P. Dixit**	**Associate Professor**	**Dr. B.A.M. Uni. Aurangabad, Sub-camps, Osmanabad**	**9421335704**
12.	**Dr. M. K. Ranjekar**		**Green Vitlas Biotech, Ranje Village, Pune**	**9422015217**
13.	**Dr. Prita S. Borkar**	**Associate Professor**	**Science College, Nanded**	**9921121194**
14.	**Dr. Abhay B. Solunke**	**Associate Professor**	**Shri Govindrao Munghate Arts & Science College, Kurkheda, Gadchiroli**	**9403579999**
15.	**Dr. M. S. Dharne**	**Principal Scientist**	**National Collection of Industrial Microorganisms, CSIR- NCL, Pune**	**9730257991**

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

Teaching Scheme

	Course Code	Course Name	Credits Assigned			Teaching Scheme (Hrs/ week)	
			Theory	Practical	Total	Theory	Practical
Optional 1	SINMICCT1101	Introduction to Industrial Microbiology	02	--	**04**	02	--
	SINMICCP1101	Practicals based on Paper SIMICCT1101	-	02			04
Optional 2	SDSCMT1101		02	--	**04**	02	--
	SDSCMP1101		-	02			04
Optional 3	SDSCMT1101		02	--	**04**	02	--
	SDSCMP1101		-	02			04
Generic Electives *(from other Faculty)*	SINMICGE1101	Fundamentals of Industrial Hygiene **(Basket 3 of respective Faculty)**	02	--	**02**	02	--
Skill Based Course (related to Major)	SINMICSC1101	Fundamental Microbiology Laboratory Techniques	--	02	**02**	--	04
Ability Enhancement Course	AECENG1101	L1 – Compulsory English	02	--	**02**	02	--
Indian Knowledge System (IKS)	IKSXXX1101	Select from **Basket 5**	02	--	**02**	02	--
Community Engagement Services (CES)	CCCXXX1101	Any one of NCC/ NSS /Sports/ Culture /Health Wellness /Yoga Education / Fitness **(Basket 6)**	-	02	**02**	--	04
Total Credits			**14**	**08**	**22**	**12**	**20**

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

Examination Scheme

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

(For illustration we have considered a paper of 02 credits, 50 marks, need to be modified depending on credits assigned to individual paper)

Subject (1)	Course Code (2)	Course Name (3)	Theory				Practical		Total Col (6+7) / Col (8+9) (10)
			Continuous Assessment (CA)			ESA			
			Test I (4)	Test II (5)	Average of T1 & T2 (6)	Total (7)	CA (8)	ESA (9)	
Optional 1	SINMICCT1101	Introduction to Industrial Microbiology	10	10	10	40	--	--	50
	SINMICCP1101	Practicals based on Paper SIMICCT1101	--	--	--	--	20	30	50
Optional 2	SDSCMT1101		10	10	10	40	--	--	50
	SDSCMP1101		--	--	--	--	20	30	50
Optional 3	SDSCMT1101		10	10	10	40	--	--	50
	SDSCMP1101		--	--	--	--	20	30	50
Generic Elective	SINMICGE1101	Fundamentals of Industrial Hygiene **(Basket 3 of respective Faculty)**	10	10	10	40	--	--	50
Skill Based Course	SINMICSC1101	Fundamental Microbiology Laboratory Techniques	--	--	--	--	20	30	50
Ability Enhancement Course	AECENG1101	**L1 – Compulsory English**	10	10	10	40	--	--	50
Indian Knowledge System	IKSXXX1101	Title **(Basket 5)**	10	10	10	40	--	--	50
Community Engagement Services (CC)	CCCXXX1101	Any one of NCC/ NSS/Sports/ Culture /Health Wellness /Yoga Education / Fitness **(Basket 6)**	--	--	--	--	20	30	50

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

Teaching Scheme

	Course Code	Course Name	Credits Assigned			Teaching Scheme (Hrs/ week)	
			Theory	Practical	Total	Theory	Practical
Optional 1	SINMICCT1151	Basics of Fermentations	02	--	**04**	02	--
	SINMICCP1152	Practicals based on Paper SINMICCT1151	-	02			04
Optional 2	SDSCMT1151		02	--	**04**	02	--
	SDSCMP1152		-	02			04
Optional 3	SDSCMT1151		02	--	**04**	02	--
	SDSCMP1152		-	02			04
Generic Electives *(from other Faculty)*	SINMICGE1151	Microorganisms for Human Welfare **(Basket 3 of respective Faculty)**	02	--	**02**	02	--
Skill Based Course (related to Major)	SINMICSC1151	Physiological and Biochemical Laboratory Techniques	--	02	**02**	--	04
Ability Enhancement Course	AECENG1151	L1 – Compulsory English	02	--	**02**	02	--
Indian Knowledge System (IKS)	IKSXXX1151	Select from **Basket 5**	02	--	**02**	02	--
Community Engagement Services (CES)	CCCXXX1151	Any one of NCC/ NSS /Sports/ Culture /Health Wellness /Yoga Education / Fitness **(Basket 6)**	-	02	**02**	--	04
Total Credits			**14**	**08**	**22**	**12**	**20**

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

Examination Scheme

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

(For illustration we have considered a paper of 02 credits, 50 marks, need to be modified depending on credits assigned to individual paper)

Subject (1)	Course Code (2)	Course Name (3)	Theory				Practical		Total Col (6+7) / Col (8+9) (10)
			Continuous Assessment (CA)			ESA			
			Test I (4)	Test II (5)	Average of T1 & T2 (6)	Total (7)	CA (8)	ESA (9)	
Optional 1	SINMICCT1151	Basics of Fermentations	10	10	10	40	--	--	50
	SINMICCP1152	Practicals based on Paper SINMICCT1151	--	--	--	--	20	30	50
Optional 2	SDSCMT1151		10	10	10	40	--	--	50
	SDSCMP1152		--	--	--	--	20	30	50
Optional 3	SDSCMT1151		10	10	10	40	--	--	50
	SDSCMP1152		--	--	--	--	20	30	50
Generic Elective	SINMICGE1151	Microorganisms for Human Welfare **(Basket 3 of respective Faculty)**	10	10	10	40	--	--	50
Skill Based Course	SINMICSC1151	Physiological and Biochemical Laboratory Techniques	--	--	--	--	20	30	50
Ability Enhancement Course	AECENG1151	**L1 – Compulsory English**	10	10	10	40	--	--	50
Indian Knowledge System	IKSXXX1151	Title **(Basket 5)**	10	10	10	40	--	--	50
Community Engagement Services (CC)	CCCXXX1151	Any one of NCC/ NSS/Sports/ Culture /Health Wellness /Yoga Education / Fitness **(Basket 6)**	--	--	--	--	20	30	50

Course Structure: *Major 1 -Teaching Scheme*

Course Code (2)	Course Name (3)	Teaching Scheme (Hrs.)		Credits Assigned		
		Theory	Practical	Theory	Practical	Total
SINMICCT1101	Introduction to Industrial Microbiology	02	--	02	--	02

Major 1 -Assessment Scheme

Course Code (2)	Course Name (3)	Theory				Practical		Total [Col (6+7) or Col (8+9)] (10)
		CA			ESA (7)			
		Test I (4)	Test II (5)	Avg of T1 & T2 (6)		CA (8)	ESA (9)	
SINMICCT1101	Introduction to Industrial Microbiology	10	10	10	40	--	--	50

SINMICCT1101: *Introduction to Industrial Microbiology*

National Education Policy 2020
Swami Ramanand Teerth Marathwada University Nanded
Faculty of Science and Technology
B. Sc. First Year (Semester – I)
Core Theory Course: Industrial Microbiology
Course Name: Introduction to Industrial Microbiology
Course Code :SINMICCT1101

Credits: 02 (Marks: 50) Periods: 30

Course pre-requisite:

1. The course is offered for a student registered for undergraduate programme in the faculty of Science and technology who had primary training in the field of biology at higher secondary school level evident in terms of certificate by CBSC/ ICSC/HSC for entry level core courses in microbiology optional subject.

Course objectives:

- To make students to understand the contribution made by microbiologist in the field of industrial microbiology.
- To make students understand the importance of industrial products.
- To make students understand the basic concept of fermentation and techniques used for isolation of industrially useful microorganisms.
- Students able to acquire the characteristics and industrial importance of microorganisms.

Course outcomes:

- Students have the acquaintance of contribution made by microbiologist in the field of industrial microbiology.
- Students comprehend the importance of industrial products.
- Students get acquainted with basic concept of fermentation and techniques used for isolation of industrially useful microorganisms.
- Students get acquainted with the characteristics and industrial importance of microorganisms.

Module No.	Unit No.	Topic	Hrs. Required to cover the contents
1. 0	I	**History and Scope of Industrial Microbiology**	**07**
	1.1	Definition and Scope of Industrial Microbiology	
	1.2	The Era of Discovery of Microorganisms - Anton van Leeuwenhoek	
	1.3	The Era of Discovery of Chemotherapeutics, Antitoxins and Antibiotics - Emile Roux and Alexandre Yersin, Alexander Fleming, Salmen Waksman	
	1.4	Historical Development of Vaccine - Edward Jenner	
	1.5	Microbial Fermentation - Louis Pasteur	
	1.6	The Chronological Development of The Fermentation Industry	
2.0	II	**Basic Concepts of Fermentation**	**07**
	2.1	Fermentation – Definition	
	2.2	Primary and secondary metabolites	
	2.3	Types of fermentation - a) Batch and continuous fermentations b) Dual and multiple fermentation c) Solid state and liquid state fermentation	
	2.4	The Design of A Fermentation Process	

3.0	III	**Introduction to Industrially important products**	**08**
	3.1	a. Pharmaceutical products – i) Vitamins – Vit B12 ii) Antibiotics–Penicillin iii) Vaccine – Types with examples	
	3.2	b) Agricultural products – i) Biofertilizers – Azotobacter ii) Biopesticides – Bacillus thuringiensis	
	3.3	c) Food products – i) Fermented milk products – Curd, Yogurt ii) Pickles – Sauerkraut	
	3.4	d) Other Industrial products – i) Enzymes – Amylase ii) Organic acid -Citric acid	
4.0	IV	**Isolation and Study of Industrially important Microorganisms**	**08**
	4.1	Classification of Living Things: Three Domains of Living Things	
	4.2	Taxonomic Grouping of Industrial Microorganisms	
	4.3	Important Characteristics of Industrial Microbes	
	4.4	Screening of industrially important microorganisms 1. Primary Screening of - a. Antibiotic producers b. Organic acid producers c. c)Amylase producers d. Amino acid producers 2. Secondary screening - a. Detail information of microorganism used. b. Detail information of products produced. c. Qualitative & quantitative study of products	
		Total	**30**

Reference Books:

1. Modern Industrial Microbiology and Biotechnology (2007) by Nduka Okafor. Published by Science Publishers, Enfield, NH, USA
2. Practical Fermentation Technology Edited by Brian McNeil and Linda M. Harvey 2008 John Wiley & Sons, Ltd. ISBN: 978-0-470-01434-9
3. Industrial Microbiology: An Introduction (2001); Michael J. Waites, Neil L. Morgan, John S. Rockey& Gary Higton
4. Bioprocess Engineering Principles by Pauline M. Doran (1995), Elsevier Science & Technology Books , ISBN: 0122208552
5. Basic Biotechnology 2nd Ed. (2001); Colin Ratledge and Bjorn Kristiansen. Cambridge University Press.
6. Bioreaction Engineering Principles 3rd Ed. (2011); John Villadsen, Jens Nielsen, Gunnar Lide´n, Springer
7. Industrial Microbiology by Casida. LE, New age International (P) Limited,Publishers.
8. Industrial Microbiology by Prescott & Dunns, AVI Publishing Company Inc.
9. Principles of Fermentation Technology by P.F. Stanbury, A. Whitaker and S.J. Hall,Butterworth Heineman, Aditya Books (P) Ltd.
10. Batch Fermentation Modeling: Monitoring, and Control. Authors: Ali Cinar; Satish J. Parulekar; Cenk Undey

Course Structure: *Major 1 -Teaching Scheme*

Course Code (2)	Course Name (3)	Teaching Scheme (Hrs.)		Credits Assigned		
		Theory	Practical	Theory	Practical	Total
SINMICCP1101	Practicals based on Paper SINMICCT1101	--	04	--	02	02

Major 1 -Assessment Scheme

Course Code (2)	Course Name (3)	Theory				Practical		Total [Col (6+7) or Col (8+9)] (10)
		CA			ESA (7)			
		Test I (4)	Test II (5)	Avg of T1 & T2 (6)		CA (8)	ESA (9)	
SINMICCP1101	Practicals based on Paper SINMICCT1101	--	--	--	--	20	30	50

SINMICCP1101: *Practicals based on Paper SINMICCT1101*

National Education Policy 2020
Swami Ramanand Teerth Marathwada University Nanded
Faculty of Science and Technology
B. Sc. First Year (Semester – I)
Core Practical Course: Industrial Microbiology
Course Name: Practicals based on Course SINMICCT1101
Course Code :SINMICCP1101

Credits: 02 (Marks: 50) Periods: 60

Course pre-requisite:

1. The course is offered for a student registered for undergraduate programme in the faculty of Science and technology who had primary training in the field of biology at higher secondary school level evident in terms of certificate by CBSC/ ICSC/HSC for entry level core courses in microbiology optional subject.

Course objectives:

- To understand and practice various biosafety techniques used in microbiology laboratory.
- To study working, principles, handling and use of microscope as well as various instruments used in microbiology laboratory.
- To prepare liquid, solid media and to study the working principles of sterilization and disinfection of culture media and glassware.
- To understand the basic laboratory technique used to isolate and cultivate bacteria, yeast, molds and actinomycetes.
- To understand the primary screening methods used for isolation of industrially important products.

Course outcomes:

- Students have acquainted the skill and technique used in industrial Microbiology.

Module No.	Unit No.	Topic	Hrs. Required to cover the contents
1. 0	I	**Biosafety in Industrial Microbiology Laboratory**	**12 [3 Practicals]**
	1.1	a) Aseptic techniques : i. Table disinfection ii. Hand wash, iii. Use of aprons b) Proper disposal of used material c) Cleaning and sterilization of glassware	
	1.2	Studying parts of Light compound microscope and its use and care	
	1.3	Study of the principle and applications of instruments used in the microbiology laboratory: a) Biological safety cabinets b) Autoclave c) Incubator d) Hot air oven e) Seitz filter f) Centrifuge g) pH meter h) Spectrophotometer i) Distillation Unit	
2.0	II	**Preparation of Media for the Study of Microorganism in Fermentation**	**12 [3 Practicals]**

	2.1	Preparation of liquid and solid culture media and their sterilization: a) Preparation of - agar plates, butts and slants	
	2.2	Preparation of media suitable for the growth of: a) Bacteria – i. Nutrient broth ii. Nutrient agar iii. Soil extract agar b) Molds – i. Potato Dextrose Agar ii. Czapek Dox agar c) Yeasts – i. Glucose Yeast Extract Agar ii. Sabouraud's agar d) Actinomycetes – i. Glycerol Asparagine Aga	
3.0	III	**Study of Industrially Important Microorganism**	**20 [5 Practicals]**
	3.1	Isolation and study of microorganisms: a. Bacteria – Isolation, colony characters, Gram staining &motility. b. Fungi – Aspergillus and Penicillium mounting &identification. c. Yeasts – Saccharomyces cerevisiae, monochrome staining. d. Actinomycetes –cultivation using coverslip technique and direct e. microscopic observation	
4.0	IV	**Primary Screening**	**16 [4 Practicals]**
	4.1	Amylase Producer	
	4.2	Organic Acid Producer	
	4.3	Antibiotic Producers	
	4.4	Amino Acid Producers	
		Total	**60**

Reference Books:

1. Brock Biology of Microorganisms, Thirteenth Edition by Michael T. Madigan, John M. Martinko, David A. Stahl, David P. Clark, Benjamin Cummings, 1301 Sansome Street, San Francisco, CA 94111.
2. A. B. Solunke, P. S. Wakte, V. D. Hamde, and R. S. Awasthi, Manual of Methods for Pure Culture Study, by Nirmal Publication Delhi (India).
3. Alfred Brown, and Heidi Smith, Benson's Microbiological Applications, Laboratory Manual in General Microbiology. The McGraw−Hill Companies, 2001 8th edition.
4. John P. Harley and Lansing M. Prescott, Laboratory Exercises in Microbiology, © The McGraw−Hill Companies, 2002 5th edition.
5. James Cappuccino and Natalie Sherman, Microbiology: A Laboratory Manual, Pearson Education India; 10th edition (1 January 2014)

Course Structure: *Generic Elective Course - Teaching Scheme*

CourseCode	Course Name (Paper Title)	Teaching Scheme (Hrs.)		Credits Assigned		
		Theory	Practical	Theory	Practical	Total
SINMICGE1101	Fundamentals of Industrial Hygiene	02	--	02	--	02

Generic Elective Course - Assessment Scheme

Course Code (2)	Course Name (3)	Theory				Practical		Total [Col (6+7) / Col (8+9)] (10)
		CA			ESA (7)			
		Test I (4)	Test II (5)	Avg (T1+T2)/2 (6)		CA (8)	ESA (9)	
SINMICGE1101	Fundamentals of Industrial Hygiene	10	10	10	40	--	--	50

SINMICGE1101: *Fundamentals of Industrial Hygiene*

National Education Policy 2020
Swami Ramanand Teerth Marathwada University Nanded
Faculty of Science and Technology
B. Sc. First Year (Semester – I)
Generic Elective Course: Industrial Microbiology
Course Name: Fundamentals of Industrial Hygiene
Course Code :SINMICGE1101

Credits: 02 (Marks: 50) **Periods: 30**

Course pre-requisite:

1. This course is opted by the students which have not opted Core theory and Skill course.

Course objectives:

Students will be able to,

- Study personal, community and public health and Industrial hygiene
- Study the advantages of being hygienic.
- Understand the role of industrial hygiene in the daily production of industrial products.
- Know different personal protective equipment.

Course outcomes:

Students should be able to,

- Practice own personal, community and public hygiene
- Implement Public Hygiene standards with the help of digital media.
- Implement good hygiene practices regularly in society.

Module No.	Unit No.	Topic	Hrs. Required to cover the contents
1. 0	I	**Industrial Hygiene**	**08**
	1.1	Definition and Concept of Industrial Hygiene	
	1.2	History and Basis of Industrial Hygiene: the Historical View	
	1.3	Overview of Industrial Hygiene	
2.0	II	**Hazardous Environmental Agents and Factors in Industrial Microbiology**	**08**
	2.1	Physical Agents	
	2.2	Chemical Agents	
	2.3	Biological Agents	
	2.4	Ergonomic Factor	
3.0	III	**Industrial Toxicology**	**08**
	3.1	Definition of Toxicity	
	3.2	Entry Toxic compound into the body	
	3.3	Dose–Response Relationship	
	3.4	Timing: Exposure and Effect	
	3.5	Effects Of Exposure to Air Contaminants	
	3.6	Systemic Toxins	
	3.7	Biological Testing	
4.0	IV	**Personal Protective Equipment (PPE)**	**06**
	4.1	Definition of PPE	
	4.2	OSHA'S PPE STANDARD	
	4.3	Employer/Employee Requirements	

	4.4	PPE Training Requirement	
	4.5	PPE - Head Protection, Hand Protection, Eye And Face Protection, Foot Protection, Full Body Protection	
	4.6	Description of Protective Clothing - Clothing Selection Factors	
	4.7	Levels of Protection	
		Total	**30**

References:

1. Fundamentals of industrial hygiene / edited by Barbara A. Plog (editor in chief), Patricia J. Quinlan (editor).-- 5th ed. (2002).
2. Basic Concepts of Industrial Hygiene by Ronald Scott, CRC Press Taylor & Francis Group Boca Raton London New York. (1933).
3. Industrial Hygiene Simplified A Guide to Anticipation, Recognition, Evaluation, and Control of Workplace Hazards by Frank R. S Pellman. (2006).
4. Bisesi and Kohn's Industrial Hygiene Evaluation Methods, Second Edition by Michael S. Bisesi, Lewis Publishers (2003)

Course Structure: *Skill Enhancement Course - Teaching Scheme*

CourseCode	Course Name (Paper Title)	Teaching Scheme (Hrs.)		Credits Assigned		
		Theory	Practical	Theory	Practical	Total
SINMICSC1101	Fundamental Microbiology Laboratory Techniques	--	04	--	02	02

Skill Enhancement Course - Assessment Scheme

Course Code (2)	Course Name (3)	Theory				Practical		Total [Col (6+7) / Col (8+9)] (10)
		CA			ESA (7)			
		Test I (4)	Test II (5)	Avg (T1+T2)/2 (6)		CA (8)	ESA (9)	
SINMICSC1101	Fundamental Microbiology Laboratory Techniques	--	--	--	--	20	30	50

SINMICSC1101: *Fundamental Microbiology Laboratory Techniques*

National Education Policy 2020
Swami Ramanand Teerth Marathwada University Nanded
Faculty of Science and Technology
B. Sc. First Year (Semester – I)
Skill Enhancement Course: Industrial Microbiology
Course Name: Fundamental Microbiology Laboratory Techniques
Course Code :SINMICSC1101

Credits: 02 (Marks: 50) **Periods: 60**

Course pre-requisite:

1. This course is opted by students with core subject in Microbiology.

Course objectives:

- To make students understand the Safety rules in microbiology Laboratory.
- develop the skill of handling the instruments which are used in Microbiology Laboratory.
- To develop skill for preparation different types of media for cultivation of bacteria.
- To develop skills for isolation of bacteria by using different techniques.

Course outcomes:

- Students have the skill to handle different instruments used in microbiology laboratory.
- Students comprehend the skill for preparation of different types of culture media used for cultivation of bacteria.
- Students get acquainted with skill for isolation of bacteria by using different techniques.

Module No.	Unit No.	Topic	Hrs. Required to cover the contents
1. 0	I	**Safety Rules and Aseptic Techniques**	**12 [3 Practicals]**
	1.1	Microbiology Lab Safety rules	
	1.2	Aseptic Techniques: a. Hand Washing b. Tabletop Disinfection c. Bunsen Burner Usage d. Disposal of Cultures and Broken Glass e. Cleaning of glassware f. Incineration of Nichrome wireloop	
	1.3	Preparation cotton plug, Smear preparation on Slide	
2.0	II	**Handling, Care and Working with Instruments**	**12 [3 Practicals]**
	2.1	Compound Microscope [Transport, Clutter, Electric Cord, Dust Protection] Lens Care [Cleaning Tissues, Solvents, Oculars, Objectives, and Condenser]	
	2.2	Hot Air Oven	
	2.3	Autoclave	
	2.4	Incubator	
	2.5	Laminar Air Flow	
3.0	III	**Cultural Techniques**	
	3.1	Preparation and method of making of Nutrient Agar slant culture	

	3.2	Preparation and Method of Making Gelatin stab culture	**16 [4 Practicals]**
	3.3	Preparation of Litmus milk	
	3.4	Nitrate Peptone Solution	
	3.5	Preparation of Nutrient Agar plates	
4.0	IV	**Isolation and Cultural Characterization of Bacteria**	**20 [5 Practicals]**
	4.1	Isolation and Cultural Characterization of bacteria from Soil streak plate method	
	4.2	Isolation and Cultural Characterization of bacteria from Food by pour plate method	
	4.3	Isolation and Cultural Characterization of bacteria from Water by spread plate method	
	4.4	Direct Microscopic Count	
		Total	**60**

Text books:

1. C. J. Alexopoulos, C. W. Mims and M. Blackwell, “Introductory Mycology,” 4th Edition, John Wiley & Sons Inc., New York. (2007).
2. H.C. Dube A textbook of fungi and Viruses, Vikas Publishing House Pvt. Ltd. Delhi. (2007)
3. Dubey R.C. and D. K, Maheshwari, A textbook of Microbiology 5th edition, S Chand and Co. New Delhi. (2022)
4. Subhash Chandra Parija. Textbook of Practical Microbiology, 1st edition, Ahuja Publishers, (2006).
5. Alfred Brown and Heidi Smith, Benson’s Microbiological Applications , Laboratory Manual in General Microbiology, 13th Edition, McGraw hill publisher (2015).

Reference Books:

1. Brock Biology of Microorganisms, Thirteenth Edition by Michael T. Madigan, John M. Martinko, David A. Stahl, David P. Clark, Benjamin Cummings, 1301 Sansome Street, San Francisco, CA 94111.
2. A. B. Solunke, P. S. Wakte, V. D. Hamde, and R. S. Awasthi, Manual of Methods for Pure Culture Study, by Nirmal Publication Delhi (India).
3. B. M. Sandikar Fundamental Microbiology, First edition by, Books and Allied (P) LTD. Kolkata.....
4. Laboratory Manual in General Microbiology, Laboratory of Bacteriology, Hygiene and Pathology, Michigan Agricultural College, First Edition, New York.
5. James Cappuccino and Natalie Sherman, Microbiology: A Laboratory Manual, Pearson Education India; 10th edition (1 January 2014).

Course Structure: *Major 1 -Teaching Scheme*

Course Code (2)	Course Name (3)	Teaching Scheme (Hrs.)		Credits Assigned		
		Theory	Practical	Theory	Practical	Total
SINMICCT1151	Basics of Fermentations	02	--	02	--	02

Major 1 -Assessment Scheme

Course Code (2)	Course Name (3)	Theory				Practical		Total [Col (6+7) or Col (8+9)] (10)
		CA			ESA (7)			
		Test I (4)	Test II (5)	Avg of T1 & T2 (6)		CA (8)	ESA (9)	
SINMICCT1151	Basics of Fermentations	10	10	10	40	--	--	50

SINMICCT1151: *Basics of Fermentations*

National Education Policy 2020
Swami Ramanand Teerth Marathwada University Nanded
Faculty of Science and Technology
B. Sc. First Year (Semester – II)
Core Theory Course: Industrial Microbiology
Course Name: Basics of Fermentations
Course Code :SINMICCT1151

Credits: 02 (Marks: 50) Periods: 30

Course pre-requisite:

1. The course is offered for a student registered for undergraduate programme in the faculty of Science and technology who had primary training in the field of biology at higher secondary school level evident in terms of certificate by CBSC/ ICSC/HSC for entry level core courses in microbiology optional subject.

Course objectives:

- To study the formulation of fermentation media.
- To understand the use of agricultural and industrial waste as fermentation media
- To understand the principles of sterilization of equipment, culture media, air in industries and validation of sterilization process.

Course outcomes:

- Students have the acquaintance about the sterilization techniques, agricultural and industrial waste as fermentation media and preservation of cultures used in industrial microbiology.

Module No.	UnitNo.	Topic	Hrs. Required to cover the contents
1. 0	I	**Nutrient Media for Cultivation of Industrial Microorganisms and Generation of Microbial Products**	**08**
	1.1	The Basic Nutrient Requirements of Industrial Media	
	1.2	Criteria for Raw Materials in Industrial Media	
	1.3	Raw Materials Used in Compounding Industrial Media	
	1.4	Medium Formulation : Water, Growth Factors, Carbon source, Protein Source,	
	1.5	Plant waste materials in Industrial Microbiology media : Starch, Cellulose	
2.0	II	**Sterilizations Process in Industrial Microbiology**	**08**
	2.1	Introduction to Media Sterilization	
	2.2	Design of Batch Sterilization Processes	
	2.3	Design of Continuous Sterilization Processes	
	2.4	Sterilization of the Fermenter, the Feeds, liquid waste, Sterilization by filtration	
3.0	III	**Culture Collections and Methods of Preservation of the Industrial Microorganisms**	**07**
	3.1	The Importance of Culture Collections in Industrial Microbiology	
	3.2	Types of Culture Collections	
	3.3	Handling Culture Collection	
	3.4	Methods of Preserving Microorganisms: i. Microbial Preservation Methods Based on the Reduction of the Growth Temperature	

		ii. Microbial Preservation Methods Based on Dehydration iii. Microbial Preservation Methods Based on the Reduction of Nutrients iv. Determination of the Most Appropriate Method of Preserving an Organism	
4.0	IV	**Microbial Growth Kinetics**	**07**
	4.1	Batch Culture	
	4.2	Continuous Culture	
	4.3	Fed-Batch Culture	
		Total	**30**

Reference Books:

1. Modern Industrial Microbiology and Biotechnology (2007) by Nduka Okafor. Published by Science Publishers, Enfield, NH, USA
2. Practical Fermentation Technology Edited by Brian McNeil and Linda M. Harvey 2008 John Wiley & Sons, Ltd. ISBN: 978-0-470-01434-9
3. Industrial Microbiology: An Introduction (2001); Michael J. Waites, Neil L. Morgan, John S. Rockey& Gary Higton
4. Bioprocess Engineering Principles by Pauline M. Doran (1995), Elsevier Science & Technology Books , ISBN: 0122208552
5. Basic Biotechnology 2nd Ed. (2001); Colin Ratledge and Bjorn Kristiansen. Cambridge University Press.
6. Bioreaction Engineering Principles 3rd Ed. (2011); John Villadsen, Jens Nielsen, Gunnar Lide´n, Springer
7. Industrial Microbiology by Casida. LE, New age International (P) Limited, Publishers.
8. Industrial Microbiology by Prescott & Dunns, AVI Publishing Company Inc.
9. Principles of Fermentation Technology by P.F. Stanbury, A. Whitaker and S.J. Hall, Butterworth Heineman, Aditya Books (P) Ltd.
10. Batch Fermentation Modeling: Monitoring, and Control. Authors: Ali Cinar; Satish J. Parulekar; Cenk Undey

Course Structure: *Major 1 -Teaching Scheme*

Course Code (2)	Course Name (3)	Teaching Scheme (Hrs.)		Credits Assigned		
		Theory	Practical	Theory	Practical	Total
SINMICCP1151	Practicals based on Paper SINMICCT1151	--	04	--	02	02

Major 1 -Assessment Scheme

Course Code (2)	Course Name (3)	Theory				Practical		Total [Col (6+7) or Col (8+9)] (10)
		CA			ESA (7)			
		Test I (4)	Test II (5)	Avg of T1 & T2 (6)		CA (8)	ESA (9)	
SINMICCP1151	Practicals based on Paper SINMICCT1151	--	--	--	--	20	30	50

SINMICCP1151: *Practicals based on Paper SINMICCT1151*

National Education Policy 2020
Swami Ramanand Teerth Marathwada University Nanded
Faculty of Science and Technology
B. Sc. First Year (Semester – II)
Core Practical Course: Industrial Microbiology
Course Name: Practicals based on Course SINMICCT1151
Course Code :SINMICCP1151

Credits: 02 (Marks: 50) Periods: 60

Course pre-requisite:

1. The course is offered for a student registered for undergraduate programme in the faculty of Science and technology who had primary training in the field of biology at higher secondary school level evident in terms of certificate by CBSC/ ICSC/HSC for entry level core courses in microbiology optional subject.

Course objectives:

- To develop skill and technique among the students for handling different instruments in Microbiology Laboratory
- To develop skill and technique among the students for preparation of media and isolation of bacteria from different source.
- To develop skill and technique among the students for studying the effect of environmental factors on the growth of bacteria

Course outcomes:

- Students have acquainted the skill and technique for handling different instruments in Microbiology Laboratory.
- Students developed skill and technique for preparation of media and isolation of bacteria by different methods from different sources.
- Students developed the skill and technique for studying the effect of environmental factors on the growth of bacteria.

Module No.	Unit No.	Topic	Hrs. Required to cover the contents
1. 0	I	**Formulation of Nutrient Media for Cultivation of Industrial Microorganisms**	**12 [3 Practicals]**
	1.1	To demonstrate that acids are formed from carbohydrate by bacteria	
	1.2	To show that organic acids may serve as food for some organisms	
	1.3	To demonstrate the variations in food requirement of bacteria	
	1.4	To demonstrate the splitting of carbohydrate into alcohol and CO_2	
	1.5	To demonstrate the necessity of nitrogen in some form for microbial growth	
	1.6	To study Nutritional requirements for cultivation of bacteria	
2.0	II	**Methods of culture preservation and Maintenance**	**16 [4 Practicals]**
	2.1	Storage in Lyophilization	
	2.2	Storage at - 70° C	
	2.3	Storage in paraffin	

	2.4	Storage in gelatin discs	
	2.5	Storage in mineral oil	
	2.6	Storage in soil	
3.0	III	**Study the growth of Industrial Microorganisms**	**16 [4 Practicals]**
	3.1	Measurement of fungal growth by linear determination	
	3.2	Measurement of fungal growth by weight determination	
	3.3	Determination of bacterial growth (bacterial growth curve)	
4.0	IV	**Monitor the efficacy of sterilization equipment,**	**16 [4 Practicals]**
	4.1	Instrumental monitoring the efficacy of sterilization equipment,	
	4.2	Chemical indicators monitoring the efficacy of sterilization	
	4.3	Biological monitoring with spore preparations the efficacy of sterilization	
		Total	**60**

Reference Books:

1. Practical Microbiology: based on the Hungarian practical notes by Erika M. Tóth, Andrea K. Borsodi, Tamás Felföldi, Balázs Vajna, Rita Sipos and Károly Márialigeti.
2. Laboratory Manual in General Microbiology prepared by Laboratory of Bacteriology and Hygiene, Michigan Agricultural College, 1st Edition, New York John Wiley and Sons, Inc. 1916.
3. Microbiology, A Laboratory Manual, 11th edition, by James G. Cappuccino and Chad Welsh, Pearson Publisher, 2018.
4. Practical Microbiology by R. C. Dubey and D. K. Maheshwari, S. Chand and Company Ltd. New Delhi.2007.
5. Experiments in Microbiology, Plant Pathology and Tissue Culture by K. R. Aneja Wishwa Prakashan. 1993

Course Structure: *Generic Elective Course - Teaching Scheme*

CourseCode	Course Name (Paper Title)	Teaching Scheme (Hrs.)		Credits Assigned		
		Theory	Practical	Theory	Practical	Total
SINMICGE1151	Microorganisms for Human Welfare	02	--	02	--	02

Generic Elective Course - Assessment Scheme

Course Code (2)	Course Name (3)	Theory				Practical		Total [Col (6+7) / Col (8+9)] (10)
		CA			ESA (7)			
		Test I (4)	Test II (5)	Avg (T1+T2)/2 (6)		CA (8)	ESA (9)	
SINMICGE1151	Microorganisms for Human Welfare	10	10	10	40	--	--	50

SINMICGE1151: *Microorganisms for Human Welfare*

National Education Policy 2020
Swami Ramanand Teerth Marathwada University Nanded
Faculty of Science and Technology
B. Sc. First Year (Semester – II)
Generic Elective Course: Industrial Microbiology
Course Name: Microorganisms for Human Welfare
Course Code :SINMICGE1151

Credits: 02 (Marks: 50) **Periods: 30**

Course pre-requisite:

1. This course is opted by the students which have not opted DSC Microbiology.

Course objectives:

- To develop the understanding among the students for fermented food prepared from Wheat.
- To develop the understanding among the students for fermented food prepared Milk and Vegetables.
- To develop the understanding among the students for fermented food prepared Legumes and Oil Seeds.
- To develop the understanding among the students for fermented food prepared from Grape.

Course outcomes:

- Students get acquainted with fermented food prepared from Wheat.
- Students get acquainted with fermented food prepared Milk and Vegetables.
- Students get acquainted with fermented food prepared from Legumes and Oil Seeds.
- Students get acquainted with fermented food prepared from Grape.

Module No.	Unit No.	Topic	Hrs. Required to cover the contents
1. 0	I	**Fermented Food from Wheat: Bread**	**06**
	1.1	Introduction	
	1.2	Ingredients for Modern Bread-making	
	1.3	Systems of Bread-making	
	1.4	*Role of Yeasts in Bread-making*	
2.0	II	**Fermented Foods Made from Milk and Vegetables**	**06**
	2.1	Composition of Milk	
	2.2	Cheese	
	2.3	Yogurt (Yoghurt) and Fermented Milk Foods	
	2.4	Sauerkraut	
	2.5	Cucumbers (pickling)	
3.0	III	**Fermented Foods Derived from Legumes and Oil Seeds**	**09**
	3.1	Fermented Foods from Soybeans : Soy sauce	
	3.2	Fermented Foods from Beans: Idli	
	3.3	Fermented Foods from Protein-rich Oil-seeds	
	3.4	Food Condiments Made from Fish	
4.0	IV	**Production of Wines from Grape**	**09**

	4.1	Grape Wines	
	4.2	Processes in Wine Making	
	4.3	Fermentation	
	4.4	Ageing and Storage	
	4.5	Clarification	
	4.6	Packaging and Preservation	
		Total	**30**

Text books:

1. C. J. Alexopoulos, C. W. Mims and M. Blackwell, “Introductory Mycology,” 4th Edition, John Wiley & Sons Inc., New York. (2007).
2. Nduka Okafor and Benedict C. Okeke, Modern Industrial Microbiology and Biotechnology 2nd edition, CRC Press, Taylor & Francis Group, (2018).
3. Prescott, Harley and Klein's (2001) Microbiology 5th edition. The McGraw-Hill Companies.
4. Michael Pelxzar, Jr. Chan E.C.S., Noel Krige, Microbiology – Concepts and applications, International Ed. McGraw Hill. (1993).
5. Powar C. B. and Daginawala H.I., General microbiology Vol I and II by Himalaya publishing house, Bombay.
6. P.C. Trivedi, Sonali Pandey and Seema Bhadauria. Text book of Microbiology, Aavishkar Publishers, Distributors, Jaipur 302 003 (Raj.) India (2010)

Reference Books:

1. Brock Biology of Microorganisms, Thirteenth Edition by Michael T. Madigan, John M. Martinko, David A. Stahl, David P. Clark, Benjamin Cummings, 1301 Sansome Street, San Francisco, CA 94111.
2. A. B. Solunke, P. S. Wakte, V. D. Hamde, and R. S. Awasthi, Manual of Methods for Pure Culture Study, by Nirmal Publication Delhi (India).
3. B. M. Sandikar Fundamental Microbiology, First edition by, Books and Allied (P) LTD. Kolkata.....

Course Structure: *Skill Enhancement Course - Teaching Scheme*

CourseCode	Course Name (Paper Title)	Teaching Scheme (Hrs.)		Credits Assigned		
		Theory	Practical	Theory	Practical	Total
SINMICSC1151	Physiological and Biochemical Laboratory Techniques	--	04	--	02	02

Skill Enhancement Course - Assessment Scheme

Course Code (2)	Course Name (3)	Theory				Practical		Total [Col (6+7) / Col (8+9)] (10)
		CA			ESA (7)			
		Test I (4)	Test II (5)	Avg (T1+T2)/2 (6)		CA (8)	ESA (9)	
SINMICSC1151	Physiological and Biochemical Laboratory Techniques	--	--	--	--	20	30	50

SINMICSC1151: *Physiological and Biochemical Laboratory Techniques*

National Education Policy 2020
Swami Ramanand Teerth Marathwada University Nanded
Faculty of Science and Technology
B. Sc. First Year (Semester – II)
Skill Enhancement Course: Industrial Microbiology
Course Name: Physiological and Biochemical Laboratory Techniques
Course Code :SINMICSC1151

Credits: 02 (Marks: 50) **Periods: 60**

Course pre-requisite:

1. This course is opted by students with DSC in Microbiology.

Course objectives:

- To develop the skill and technique of determining the motility of the bacteria.
- To develop skill for the testing of effect of environmental factor on bacterial pigment formation.
- To develop skills and technique for biochemical analysis of Bacteria.
- To develop skill for the microscopic measurement of Cyanobacteria, Bacteria, and yeast.

Course outcomes:

- Students have the skill of determining the motility of the bacteria.
- Students comprehend the skill for testing the effect of environmental factor on environmental factor on bacterial pigment formation.
- Students get acquainted with skill and technique for biochemical analysis of Bacteria.
- Students get acquainted with skill for the microscopic measurement of Cyanobacteria, Bacteria, and yeast.

Module No.	Unit No.	Topic	Hrs. Required to cover the contents
1. 0	I	**Motility Determination**	**12 [3Practicals]**
	1.1	Wet Mount Slide	
	1.2	Hanging Drop Slide	
	1.3	Tube Method	
	1.4	Soft Agar Plate Method	
2.0	II	**Physiological Study of bacteria**	**20 [5 Practicals]**
	2.1	Effect of light on Microbial pigment and their formation	
	2.2	Effect of Temperature on Microbial pigment and their formation	
	2.3	Effect of Chemical on Microbial pigment and their formation	
	2.4	Effect of air on Microbial pigment and their formation	
	2.5	Determination of the Phenol Coefficient of some common Disinfectant	
3.0	III	**Biochemical Study of bacteria**	**16 [4 Practicals]**
	3.1	Sugar Fermentation Test [Glucose, Lactose, and Mannitol]	
	3.2	Lipid Hydrolysis	
	3.3	Gelatin Hydrolysis	
	3.4	Nitrate Reduction Test	
	3.5	Catalase Test	
4.0	IV	**Microscopic Measurement of Organisms [Micrometry]**	**12 [3 Practicals]**

	4.1	Calibration of ocular micrometer	
	4.2	Cyanobacteria	
	4.3	Bacteria	
	4.4	Yeast	
		Total	**60**

Text books:

1. C. J. Alexopoulos, C. W. Mims and M. Blackwell, “Introductory Mycology,” 4th Edition, John Wiley & Sons Inc., New York. (2007).
2. H.C. Dube A textbook of fungi and Viruses, Vikas Publishing House Pvt. Ltd. Delhi. (2007)
3. Dubey R.C. and D. K, Maheshwari, A textbook of Microbiology 5th edition, S Chand and Co. New Delhi. (2022)
4. Subhash Chandra Parija. Textbook of Practical Microbiology, 1st edition, Ahuja Publishers, (2006).
5. Alfred Brown and Heidi Smith, Benson’s Microbiological Applications , Laboratory Manual in General Microbiology, 13th Edition, McGraw hill publisher (2015).

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